Enhancing the understanding and delivery of preconception care

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A thesis submitted to fulfill requirements for the degree of Doctor of Philosophy

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Statement of originality

This is to certify that to the best of my knowledge; the content of this thesis is my own work. This thesis has not been submitted for any degree or other purposes.

I certify that the intellectual content of this thesis is the product of my own work and that all the assistance received in preparing this thesis and sources have been acknowledged.

Name Dr Edwina Dorney

Date 5th November 2024

Summary

Background

Good preconception health, which involves planning and preparing for pregnancy, reduces the incidence of preventable morbidity and mortality for women, their babies and future generations. Preconception care aims to assess and modify biomedical, behavioural and social risk factors before pregnancy. Barriers to the delivery and uptake of preconception care have been identified across the socio-ecological spectrum at the individual, organisational and societal levels. Addressing these barriers presents opportunities to enhance the understanding and delivery of preconception care.

There are low levels of awareness about the importance of good preconception health amongst people of reproductive age in Australia. There are also and limited health promotion activities to raise awareness about the importance of good preconception health. The use of digital health tools is a potential solution for these two related barriers. This is explored in my PhD thesis through the optimisation and dissemination of an online-self assessment tool for preconception care.

There are additional challenges for health care providers in their delivery of preconception care. These include a lack of preconception care guidelines to support the delivery of high-quality preconception care, as well as availability and time constraints for medical personnel. There is a need to consider engaging the wider healthcare workforce beyond medical practitioners to increase access to preconception care for people in Australia.

A significant proportion of pregnancies in Australia are documented to be unintended and these pregnancies reflect missed opportunities for people to access preconception care. Understanding and measuring pregnancy intention can inform the delivery of both family planning and preconception care services.

Given the range of identified barriers to the delivery of preconception care, there is a need to prioritise interventions for maximum health gain. Careful planning and development of strategies can support the successful implementation of interventions. Monitoring for impact and effectiveness of new interventions to improve preconception health and care is also required to achieve the best outcomes for people in Australia.

Methods

To enhance the understanding and delivery of preconception care in Australia, nine barriers to the delivery of preconception care across the socio-ecological spectrum were explored using the methodologies described below. A range of barriers were chosen across the socio-ecological spectrum to inform effective solutions that can enhance the broad and complex delivery of preconception care.

Firstly, I led an international collaboration to undertake a systematic review of the availability and quality of clinical practice guidelines for preconception care. I then formed a second international collaboration with experts on pregnancy planning where I led a review on measures of pregnancy intention. In this review we explored how these

measures can be used to inform service delivery for family planning and preconception care. This was strengthened by my contribution to three additional studies exploring the implementation of measures of pregnancy intention in the Australian setting.

To address clinician and workforce barriers for preconception care I conducted a cross-sectional survey of primary health care nurses in Australia to explore their knowledge, attitudes and practice relating to preconception care.

I then lead a series of qualitative, quantitative and health economic studies that aimed to explore how the understanding and provision of preconception care information could be improved for consumers. This involved using in-depth interviews to explore understandings of preconception care in people of reproductive age across Australia. The interviews also explored the role and perceptions of an existing online self-assessment tool, the “Healthy Conception Tool” (HCT) to increase awareness and knowledge about good preconception health. After modifying the HCT, I sought further consumer feedback through user-experience testing which included a detailed analysis of the visual presentation, language, content and usability of the tool and made additional refinements to optimise the HCT. I then performed a discrete choice experiment where I sought feedback on health promotion advertisements to increase engagement with the enhanced self-assessment tool.

Finally, building on the national collaborations that have emerged from the work in the PhD, I contributed to a modified Delphi process national priority setting exercise. I also

contributed to running a series of workshops to develop a reporting and monitoring framework for preconception health in Australia.

Results

In the systematic review of clinical care guidelines, I identified 11 guidelines that focused on preconception care, only one of which was classified as high quality.
In my review of measures of pregnancy intention, I identified four measures that have been used internationally and explored, and how these can inform service delivery for family planning and preconception care.

In the cross-sectional survey of 152 PHCNs, I found that 95% of respondents identified at least one barrier to the delivery of preconception care. A lack of time, knowledge and financial constraints were the most common barriers.

The in-depth interviews with 25 women and men showed that people in Australia are keen to learn about preconception care and see this as important. The existing HCT was perceived as a valued resource for preconception health information as it can present a breadth of information in a single convenient location. The HCT was optimised and underwent user-experience testing with an additional eleven participants to inform further modifications including a change to the plain English title of “Healthy You, Healthy Baby”. A discrete choice experiment was completed by 334 women and men of reproductive age. This showed that images in an advertisement and the location in which an advertisement is placed were the most important advertisement features

that impacted engagement. This informed a health promotion campaign to promote the dissemination of the enhance Healthy You, Healthy Baby Tool.

A national research collaboration led a modified Delphi technique with 24 cross-sectoral stakeholders and consumers that defined ten preconception care priorities for Australia. Six key strategies and nine underpinning values were also defined to assist the implementation of the priorities.

Finally, I contributed to the design and running of a series of three workshops with stakeholders and consumers to develop a monitoring framework for preconception care in Australia. This led to the development of seven indicator domains that were mapped to existing data sources. Mapping demonstrated that limited indicators are collected in state and national perinatal data.

Conclusion

This PhD has explored nine barriers to the delivery of preconception care across the socio-ecological spectrum. Specifically, it has explored consumer and clinician barriers at the individual level, workforce and resource barriers at the organisational level and a lack of health promotion measures and monitoring processes at the societal level. This approach allowed a comprehensive understanding of how these barriers are connected and how solutions to one barrier can influence another.

To increase individual understanding about the importance of preconception health, the preexisting HCT has been optimised in response to study findings. These findings have informed changes to improve the tool's acceptability, engagement, and impact. At the societal level an informed health promotion plan accompanied the tool's dissemination, and we expect that the revised tool will have greater reach and prompt more people to prepare well for pregnancy.

My other individual studies in this thesis had implications across the socio-ecological spectrum. The systematic review identified that high-quality guidelines on preconception care are lacking. This can inform guideline development to support clinician knowledge and confidence in delivering preconception care. Measuring pregnancy intention in individuals can inform health service reforms at the organisational level. Findings from the cross-sectional study with PHCNs identified areas for improvement at the individual, organisational and health system level. All of these interventions require monitoring to ensure effectiveness and positive impact on preconception health and health behaviours.

These findings from my PhD thesis collectively contribute to increasing the understanding of and delivery of preconception care in Australia.

Supervisory Statement

The work presented in this thesis was carried out by the research candidate under the primary supervision of Professor Kirsten Black at the Faculty of Medicine and Health, The University of Sydney.

Co-supervision was provided by Professor Adrienne Gordon at the Faculty of Medicine and Health, The University of Sydney and Associate Kevin McGeechan at the School of Public Health, The University of Sydney before his retirement.

The candidate, Dr Edwina Dorney, was solely responsible for conceiving the direction of the thesis and undertaking the individual projects that are contained within. Author attribution statements for these projects are provided in each chapter. This thesis also benefited from several research projects to which Dr Dorney contributed, and her contributions are clearly outlined at the beginning of each chapter, and author attribution statements are in the relevant appendices.

Professor Kirsten Black

Faculty of Medicine and Health, The University of Sydney Date: 17th June 2024

Professor Adriene Gordon

Faculty of Medicine and Health, The University of Sydney Date: 18th June 2024

Ethics Approval

The research presented in this thesis has been approved by the relevant Human Research Ethics Committee (HREC). For the studies led by the PhD candidate Dr Edwina Dorney there relevant HREC approvals are listed below.

Ethics approval for the research presented in Chapter 5 was obtained from the University of Sydney Human Research Ethics Committee (HREC) Project Number 2020/430, June 2020.

Ethics approvals for the research presented in Chapters 6, 7 & 8 were obtained from University of Sydney Human Research Ethics Committee (HREC):

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Peer reviewed publications & outputs during enrolment

PhD publications: Published

Dorney E, Black K. Preconception care. Australian Journal for General Practitioners. 2024;53:805-12.

Dorney, E., Boyle, J., Walker, R., Hammarberg, K., Musgrave, L., Schoenaker, D., Jack, B., Black, K. (2022). A Systematic Review of Clinical Guidelines for Preconception Care. Seminars in Reproductive Medicine, 40(2023-04-03 00:00:00), 157-169.

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Co-authored Publications contributing to PhD Thesis

Subasinghe AK, Black KI, **Dorney E**, Boyle JA. Assessing preconception health in Australia to support better outcomes in the first 2000 days - A critical need for building a core indicator framework. Aust N Z J Obstet Gynaecol. Published online April 20, 2024. doi:10.1111/ajo.13815

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Australia and New Zealand: A document analysis study. Australian and New Zealand Journal of Obstetrics and Gynaecology, 61(6), 969-972

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Media

Jean Hailes Women's health week 2022 Preconception Health Checks and the Healthy Conception Tool. Facebook Live Session, September 5, 2022.

Conference presentations

International presentations

5th European Preconception Care Conference 2022, University College London
Measures of pregnancy intention and midwives' understanding of its application to their delivery of preconception care. Oral Presentation.
Edwina Dorney, Kate Cheney, Marilena Pelosi, Kirsten Black.

Online self-assessment tools to improve the delivery of preconception care in rural and remote populations. E-Poster presentation
Edwina Dorney, Karin Hammarberg, Renee DeSilva, Raymond Rodgers, Kirsten Black.

National presentations

Public Health Association of Australia (PHAA) Prevention Conference 2023, Adelaide, Australia
Enabling preconception care in priority groups: optimisation of an online self-assessment tool. Oral Presentation
Edwina Dorney, Karin Hammarberg, Joanna Anagnostou, Raymond Rodgers, Kirsten Black.

NHMRC Centre of Research Excellence in Sexual and Reproductive Health for Women (SPHERE) Annual Meeting 2023, Victoria, Australia
Enabling preconception care: optimisation of an online self-assessment tool. Oral Presentation
Edwina Dorney, Karin Hammarberg, Jody Church, Marion Haas, Joanna Anagnostou, Raymond Rodgers, Kirsten Black.

Health in Preconception, Pregnancy, and Postpartum Early and Mid-career Researcher Collective (HiPPP-EMR-C) conference 2023, Hybrid conference

Developing a set of core indicators for preconception health in Australia.
Edwina Dorney, Asvini Subasinghe, Kirsten Black, Briony Hill, Haimanot Hailu, Jacqui Boyle.

Sydney Institute for Women, Children, and their Families (SIWCF) Webinar Series 2023
Preconception policy in practice
Edwina Dorney

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Online self-assessment tools to enhance preconception care.
Edwina Dorney

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Clinical practice guidelines for preconception care in Australia and New Zealand, a scoping review.
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Online self-assessment tools to enhance preconception health. Oral presentation
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A systematic review of international clinical guidance for preconception care. Oral presentation
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The London Measure of Unplanned Pregnancy to enhance family planning and preconception care and midwives' understanding of its application. Learnings from Sydney Local Health District.
Edwina Dorney

Sydney Institute for Women, Children, and their Families (SIWCF) Webinar Series 2021
Preconception care
Edwina Dorney

Queensland Women's Health Forum, Brisbane, Australia May 2021
Australian Primary Health Care Nurses' practice and attitudes relating to preconception care. Poster presentation.
Edwina Dorney, Jo Millard, Karin Hammarberg, Ken Griffin, Adrienne Gordon, Kevin McGeechan, Kirsten Black.

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Preconception care in priority groups: Optimisation and dissemination of an online preconception health self-assessment tool.
Edwina Dorney

NHMRC Centre of Research Excellence in Sexual and Reproductive Health for Women (SPHERE) annual meeting 2020, Victoria, Australia
Evaluation, optimisation, and dissemination of an online preconception health self-assessment tool – protocol.
Edwina Dorney, Karin Hammarberg, Jody Church, Marion Haas, Kirsten Black.

Australian primary health care nurses' attitude and practice relating to preconception care.
Edwina Dorney, Jo Millard, Karin Hammarberg, Ken Griffin, Adrienne Gordon, Kevin McGeechan, Kirsten Black

Achievements

2023 Best PhD student Rapid-Fire Presentation Award at the Preconception, Pregnancy, and Postpartum Early and Mid-career Researcher Collective International Conference

2022 University of Sydney, Faculty of Medicine and Health 3-Minute-Thesis Semi-Final Presentation

Australasian Faculty of Public Health Medicine, Gerry Murphy Prize for best Oral Presentation – National Winner 2020

Australasian Faculty of Public Health Medicine, Gerry Murphy Prize for best Oral Presentation – NSW State Winner 2020

University of Sydney: Albert S McKern Research Scholarship 2020

List of Abbreviations

ACOG	American Committee of Obstetricians and Gynecologists
AGREE-II	Appraisal of Guidelines for Research and Evaluation II
AJGP	Australian Journal of General Practice
BMI	Body Mass Index
BRFSS	Behavioural Risk Factor Surveillance System
CDC	Centers for Disease Control and Prevention
CI	Confidence Interval
DCE	Discrete choice experiment
DNA	Deoxyribonucleic acid
DOHaD	Developmental Origins of Health and Disease
eMR	electronic medical record
FIGO	International Federation of Obstetricians and Gynecologists
GP	General Practitioner
HCT	Healthy Conception Tool
HIV	Human immunodeficiency virus
LMUP	London Measure of Unplanned Pregnancy
MBS	Medicare Benefits Schedule
MCaFHN	Maternal Child and Family Health Nurse
MeSH	Medical Subject Heading
NCD	Non-communicable disease
ncRNA	non-coding Ribonucleic acid
NICE	National Institute for Health and Care Excellence

NMHS	National Men's Health Strategy
NNT	Number needed to treat
NRHA	National Rural Health Alliance
NSW	New South Wales
NWHS	National Women's Health Strategy
OKQ®	One key Question®
PHCN	Primary Health Care Nurse
RACGP	Royal Australian College of General Practitioners
RCT	Randomised control trial
RNA	Ribonucleic acid
RR	Risk ratio
RWH-CAG	Rural Women's Health Consumer Advisory Group
STI	Sexually Transmitted Infection
TGA	Therapeutic Goods Administration
UK	United Kingdom
US	United States
WHO	World Health Organization

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Orientation of the thesis

This thesis is presented in ten chapters, including four peer reviewed publications and two publications under review, in accordance with the University of Sydney policy: Thesis and examination of Higher Degrees by Research Policy 2015. The papers are not arranged in order of publication but are presented in a logical approach to the identified research gaps in how to enhance the delivery of preconception care in Australia.

Chapter 1 is presented in two parts. Part 1 is a review of the literature, defining what preconception care is, why it is important and the evidence for good preconception health. This is followed by a review of current preconception health and health behaviours of people in Australia. The barriers and enablers to preconception care are explored and from this, opportunities to enhance the understanding and delivery of preconception care are identified. Nine of these opportunities are further investigated in chapters of the thesis. Chapter 1, Part 2 outlines the clinical components of preconception care. This is presented in the format of a clinical update article that has been prepared for the Australian Journal of General Practice.

Chapters 2-9 address nine of the identified barriers to the delivery of preconception care. Chapter 2 is a systematic review of clinical practice guidelines (CPGs) for preconception care. CPGs can assist clinicians to deliver high-quality clinical care, and there is limited evidence outlining the availability and quality of such resources.

Chapter 3 is a review of measures of pregnancy intention and how they can be used to inform the development of family planning and preconception care services. This review is accompanied by a summary of three publications that explore the implementation of two different measures of pregnancy intention in the Australian setting.

Chapter 4 uses a cross-sectional cohort study to investigate the knowledge, attitudes and practices of primary health care nurses to preconception care in Australia. This was to understand workforce issues that need to be addressed to expand the delivery of preconception care in the primary care setting.

Chapter 5 involves in-depth interviews with people of reproductive age in Australia to explore their understandings of preconception health and care. This research had a focus with people in regional and remote areas to understand the additional barriers they face in accessing care. Exploring these understandings can inform efforts and activities to increase awareness of the importance of good preconception health.

Chapter 6 details the process taken to assess and optimise an existing online self-assessment tool for preconception care, the “Healthy Conception Tool” (HCT). This process also used in-depth interviews to explore how people perceive and experience the HCT. These findings informed the development of an enhanced tool prototype that was subject to user-experience testing and further refinements made to improve the

tool. The enhanced tool can be used to increase awareness of preconception health and care.

Chapter 7 explores the health promotion aspects of disseminating the enhanced HCT. This chapter uses a discrete choice experiment (DCE) study to ascertain the preferred features in an advertisement for reproductive health that will increase engagement with the new tool. It also details the health promotion activities undertaken with the launch of the new tool.

Chapter 8 is a priority setting exercise for preconception health in Australia. This identified key actions for preconception care, strategies to deliver them, and values to uphold them.

Chapter 9 is a monitoring framework for preconception health and care activities so that issues, trends and outcomes from interventions can be assessed.

Chapter 10 provides a summary of the findings of the PhD thesis. It also summarises the strengths, limitations and challenges of this body of work to address barriers to the delivery of preconception care. It includes a research agenda to further enhance the understanding and delivery of preconception care in Australia.

Chapter 11 contains the appendices for this thesis.

Contents

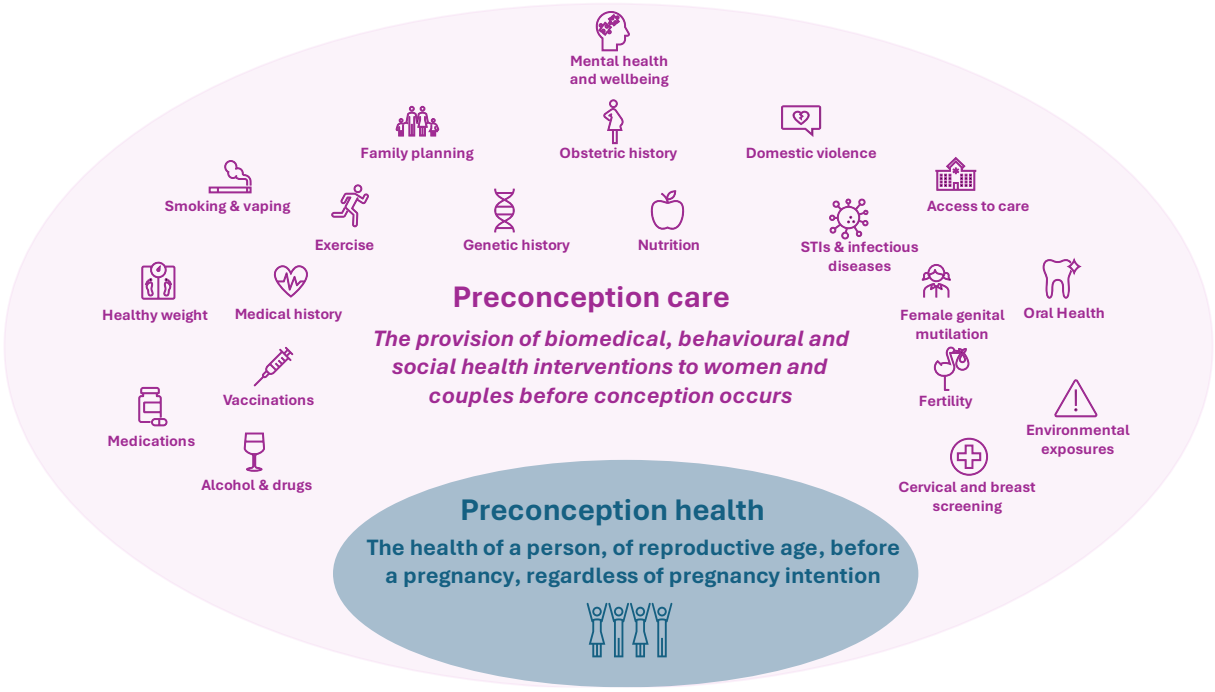
Chapter 1: Part 1 - Literature Review

1.1.a Defining preconception health and care

Preconception health describes the health of a person of reproductive age before a pregnancy. (1) Preconception care, as defined by the World Health Organization (WHO), is "*the provision of biomedical, behavioral and social health interventions to women and couples before conception occurs"*. (2) This involves the assessment, identification, and intervention to improve risk factors for preconception health. Preconception care is more than interactions at the individual clinician-consumer level and includes promotion and education about the importance of good preconception health at the population level. (3-5)

Public Health England defined two over-arching components of preconception health; planning for pregnancy, and preparing for pregnancy. (6) A clinical workgroup for the implementation of preconception care, established by the Centers for Disease Control and Prevention (CDC) defined over 80 clinical components to include in a preconception health and care package. (7) These components, and the relationship between preconception health and care are represented in Figure 1.1.

Figure 1.1: Preconception health and care



Improving health before pregnancy improves conception rates, pregnancy outcomes for women and their babies, offspring health in the short and long term, and the health of future generations. (2, 8) The benefits of preconception care are not limited to a first pregnancy, improving health before all pregnancies is also important, and health events and outcomes in previous pregnancies can inform preventive actions. Interconception care is defined as interventions "*provided to women of childbearing age between pregnancies, to improve health outcomes for women, newborns and children"*. (9)

In this PhD thesis, the term preconception care covers both preconception and interconception care. Each year there are over 300,000 women in Australia who give birth, and an estimated 10% of women in Australia become pregnant. (10) In 2021, 42.3% of Australia's population (over 10 million people) were of reproductive age (11)

which is a substantial proportion of the population in need of the delivery of a comprehensive package of preventive care.

1.1.a.i Defining the preconception period

In its broadest definition, the preconception period can be considered as the time when a person has the reproductive capacity to achieve pregnancy. (1) When considering improving preconception health or delivering preconception care, the preconception period can be further defined by considering certain exposures and outcomes, or the time taken to optimise a preconception risk factor. Stephenson et al proposed three "perspectives" of the preconception period in their 2018 review, to provide a practical structure to implementing preconception care interventions. (8) The group also applied the taxonomy of *"critical periods, sensitive periods and cumulative effects"* to their preconception perspectives. (8) Stephenson et al's three preconception period perspectives were:

1. **Biological** – defined by the period where the sperm and egg develop and mature, fertilisation takes place, and the time of early embryological development. This perspective is defined by weeks before conception. The biological perspective is a *"critical period"* where exposures have the potential to adversely impact fertilisation, implantation, and embryological development.
2. **Individual** – defined as the period where a person or persons intend to become pregnant. While the duration of this period varies, it is typically defined by weeks to months before conception. The individual perspective is a *"sensitive period"*

where exposures and behaviours can influence the health of future parents with the potential for reproductive health impacts.

3. **Public Health** – defined as the period when people have the potential to become pregnant. Discrete periods of time can be considered as *"sensitive periods"* where behaviours and risk factors can have *"cumulative effects"* on a person's health. The public health period can span months to years.

Combining these perspectives, the time to provide preconception care can be as brief as a few weeks, or across years for more chronic interventions such as achieving a healthy weight prior to pregnancy as shown in Figure 1.2.

Figure 1.2: Defining the preconception period from Stephenson et al (8)

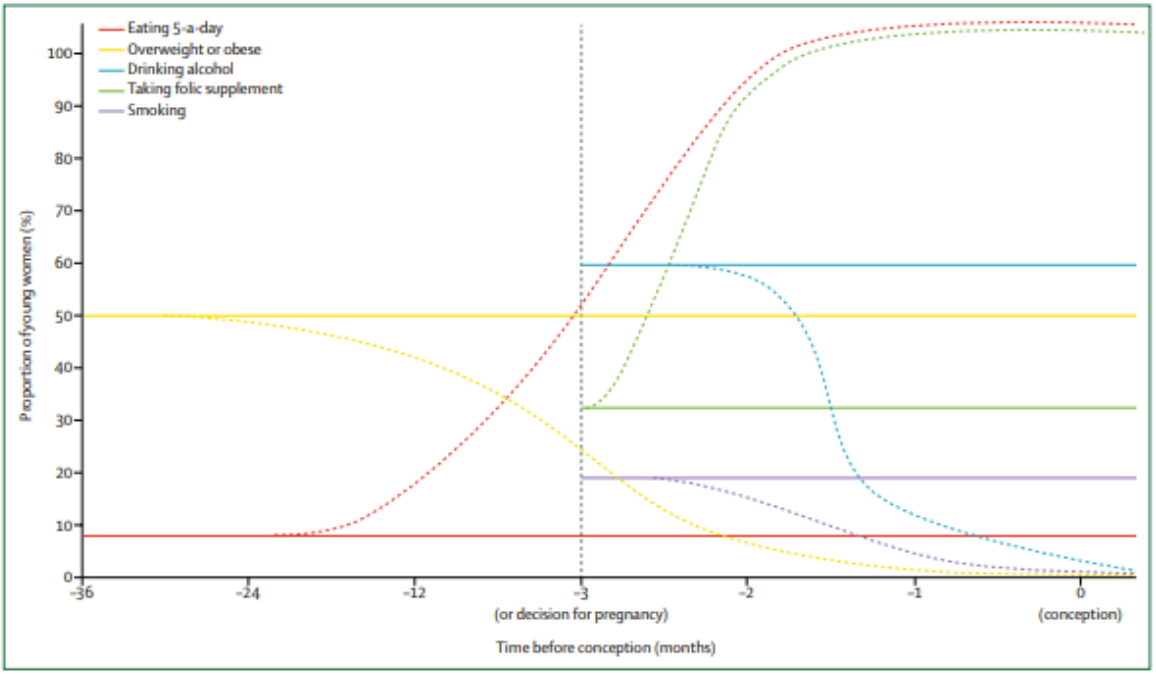


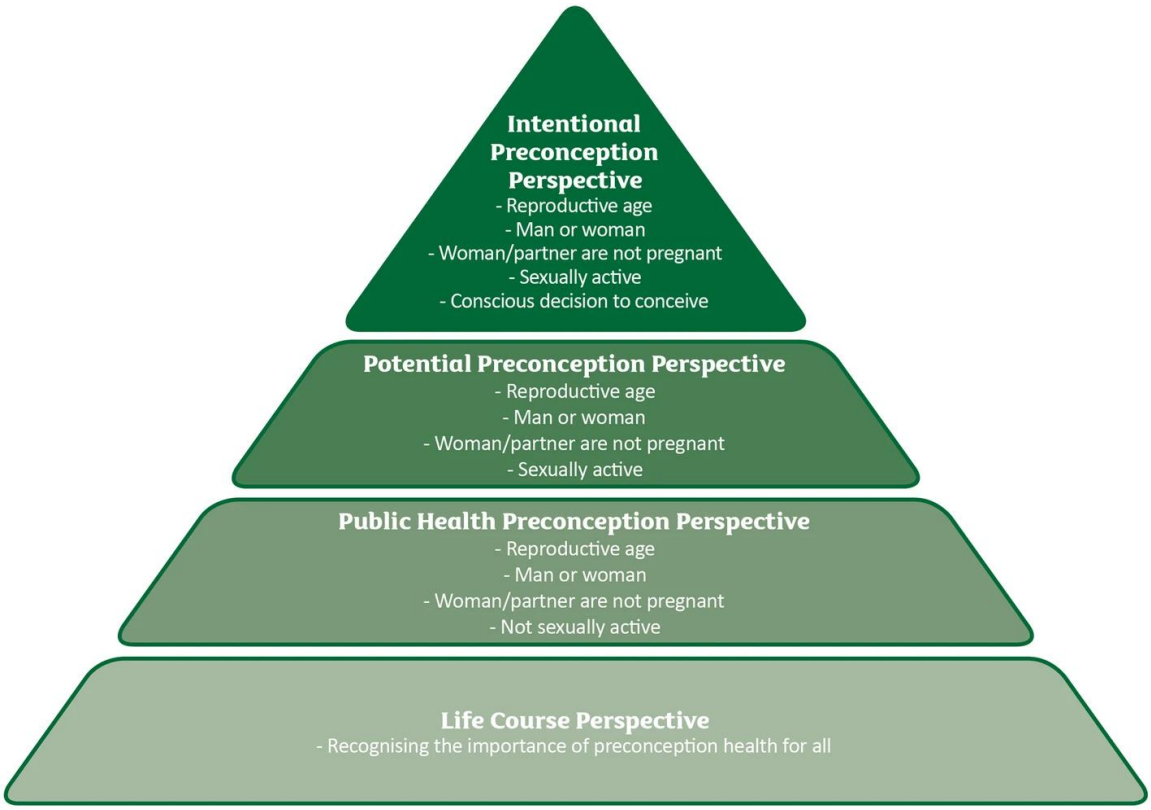
Figure 2: **Challenges of improving preconception health**
Typical levels of each preconception behaviour in young women in high-income countries (solid lines) and optimal behaviours before conception (dashed lines).

1.1.a.ii Defining the preconception population

To plan for and implement preconception care, the target population for a given intervention also needs to be clearly described. Reproductive age, as defined by the WHO is 15-49 years. (12) The preconception population was also defined in a recent review by Hill et al who recommended setting the upper age limit for the focus of preconception care at 41 years, with no lower age limit clearly defined. (13) While all people of reproductive age stand to benefit from good preconception health, Hill et al described four different preconception population perspectives, based on demographic and behavioural attributes which is shown in Figure 1.3. Demographic attributes of sex and age, and behavioural attributes of sexual activity and pregnancy intention were used to classify the preconception population groups. Hill et al's four preconception population perspectives are:

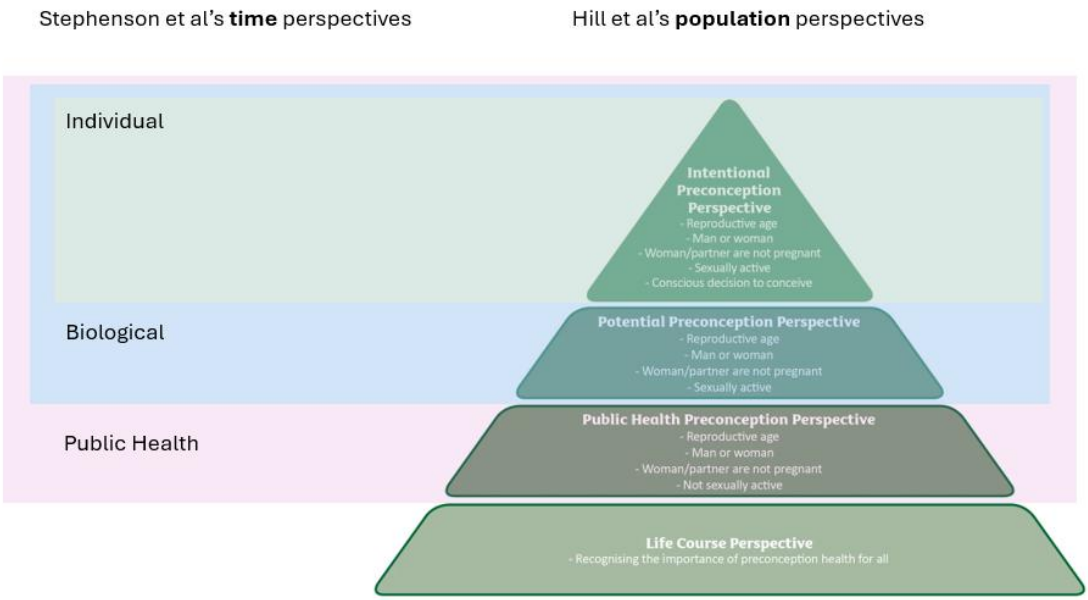
1. **Life course** – all of population
2. **Public health** – reproductive age, not sexually active
3. **Potential** – reproductive age, sexually active
4. **Intentional** – reproductive age, sexually active, planning to become pregnant.

Figure 1.3: The four perspectives upon which to define preconception populations from Hill et al (13)



These populations were defined with the purpose of planning and implementing preconception care interventions, so that a population group could be prospectively selected, and appropriate interventions designed. There is overlap with the perspectives for the time periods defined by Stephenson et al and the populations defined by Hill et al which is depicted in Figure 1.4.

Figure 1.4: Intersections between the preconception periods and the preconception populations.



These overlaps demonstrate potential opportunities to deliver preconception care and improve preconception health across the reproductive life course. Indeed, opportunities exist for the "intentional preconception population" who may be receptive and keen to engage with health promotion activities and efforts need to be directed to making information and care accessible. The overlaps also highlight the vulnerability of the "potential preconception population". This group is also potentially in Stephenson's critical biological period, where exposures can have significant effects on gametogenesis and the developing fetus, yet they may not be intending on conceiving and may not be receptive to preconception care interventions. These perspectives, of both time and population, can be synergistic in informing targeted approaches to implementing preconception care interventions.

1.1.a.iii The history of preconception care

Reference to the recognition of good preconception health can be found in religious and historical documents that date back centuries. Freda, Mood and Curtis quote the Old Testament and Plutarch's account of the Ancient Spartans who *"….ordered the maidens to exercise with wrestling, running, throwing the quoit and casting the dart, to the end that the fruit they conceived might, in strong and healthy bodies, take firmer root and find better growth"* as a record of the awareness of health before conception. (14) Academic literature detailing aspects of preconception health date back to 1935, on the specific topic of radiation exposure in the preconception period. (15) Literature that was focused more generally on preconception health was first published in 1978 and explored trends in reproductive health with the purpose to inform service delivery and education. (16)

Before preconception care was endorsed as a standalone concept, it was supported by various international congresses through women's health and family planning initiatives. The Declaration of Alma-Ata in 1978 at the International Conference on Primary Health Care acknowledged the *"promotive"* and *"preventive"* aspects of primary care and that they included *"maternal and child health care, including family planning"* services. (17) The Department of Health, Education and Welfare in the United States released a statement at the end of the 1970s for primary care that included *"interconceptional care"*. (14) In the 1980's the American Committee of Obstetricians and Gynecologists (ACOG) also recognised the need for preconception care and sponsored the development of a preconception health appraisal guide. (18) This was delivered as a 309-page document, and a review of this guide and its incorporated checklists is shown

in Figure 1.5. The guide is described as a *"valuable resource"* yet shows the practical application of preconception care was limited to populations with perceived increased risk of adverse outcomes. (19)

Figure 1.5 Review of "Preconception Health Promotion" in the Journal of Nurse-Midwifery 1990 (19)

Preconceptional Health Promotion: A Practical Guide. By Robert C. Cefalo and Merry-K. Moos. Rockville, MD: Aspen Publishers, Inc., 1988. 309 pages. $39.00, hardcover.

Reviewed by: Jeanne Chatham Gottlieb, CNM, MSN, Clinical Instructor, Nurse-Midwifery Program, University of Miami, School of Nursing, Miami, Florida.

Preconceptional Health Promotion: A Practical Guide is a valuable resource for both the new and experienced practitioner. The authors indicate that most clients seeking preconceptional health information have had previous pregnancy losses or have advanced maternal age. The goal of the authors is to assist clients in their informed decision making for improved pregnancy outcomes. This guidebook will be highly advantageous for preconceptional counseling and antepartum counseling as well.

Journal of Nurse-Midwifery • Vol. 35, No. 4, July/August 1990

Geoffrey Chamberlain, a London Obstetrician, reported on an established "Prepregnancy clinic" in the United Kingdom in 1980. (20) The purpose of the clinic, as

shown in Figure 1.6, was to advise non-pregnant women on their risk factors and the impact on a future pregnancy and their baby's health. Chamberlain reported that the clinic could be run as an outpatient service, and that both consumers and clinicians found the service helpful.

Figure 1.6: Excerpt from Chamberlain's report "The prepregnancy clinic" in 1980 (20)

Introduction

In January 1978 the Board of Governors at Queen Charlotte's Hospital for Women established a prepregnancy clinic to provide advice to women not yet pregnant but who were worried about problems when they became so. Although their family doctor might send some to a gynaecologist, or if the woman had attended a hospital before she might try to contact her old clinic again, most have no source to which to turn. The prepregnancy clinic was to provide a single referral centre to which family and hospital doctors could send women for authoritative advice about both the likely pattern of management in a future pregnancy and the chances of the risks that pregnancy might have on their or their future baby's health.

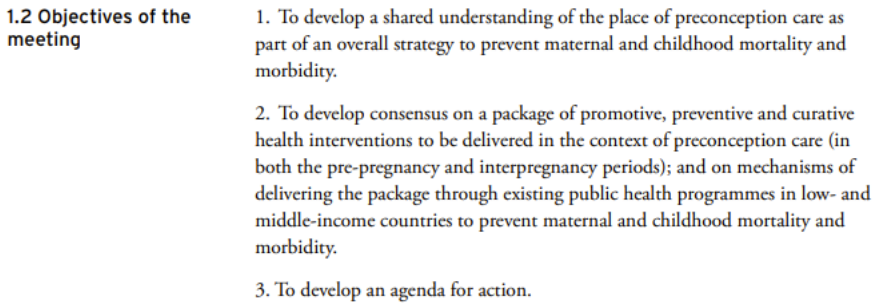
As academic literature grew, the Medical Subject Heading (MeSH) for preconception care was developed in 1992, when the domain was demarcated from "pregnancy" and is defined in scope as:

"*An organized and comprehensive program of health care that identifies and reduces a woman's reproductive risks before conception through risk assessment, health promotion, and interventions. Preconception care programs may be designed to include the male partner in providing counselling and educational information in preparation for fatherhood, such as genetic counselling and testing, financial and family planning, etc. This concept is different from PRENATAL CARE, which occurs during pregnancy."*

In 2004 the CDC gathered a group of experts from the disciplines of medicine (obstetrics and gynaecology, paediatrics, general practice), nursing, midwifery, public health, epidemiology, dentistry, and other disciplines to form the Preconception Care Work Group and the Select Panel on Preconception Care. (4) These groups contributed to the development of ten recommendations to improve preconception health and healthcare in the United States (US). (4) Other countries across Asia, Europe and North America followed and developed preconception care programs. (21, 22)

The WHO met in 2012 with the purpose of developing a global consensus on preconception care. This was attended by academic and clinical subject matter experts in preconception care, and advocacy and philanthropic organisations with an interest in reproductive health. (23) There were three specific objectives as shown in Figure 1.7, to determine the place and scope of preconception care, and to develop an implementation plan.

Figure 1.7: Objectives of the WHO Meeting to Develop a Global Consensus on Preconception Care to Reduce Maternal and Childhood Mortality and Morbidity (23)



1.2 Objectives of the meeting

1. To develop a shared understanding of the place of preconception care as part of an overall strategy to prevent maternal and childhood mortality and morbidity.

2. To develop consensus on a package of promotive, preventive and curative health interventions to be delivered in the context of preconception care (in both the pre-pregnancy and interpregnancy periods); and on mechanisms of delivering the package through existing public health programmes in low- and middle-income countries to prevent maternal and childhood mortality and morbidity.

3. To develop an agenda for action.

Today, preconception health and care are formally recognised concepts, with a place in the reproductive continuum of care to improve maternal and neonatal outcomes.

Internationally preconception health is supported by policy and strategy from national departments and agencies in the United Kingdom (UK) and US, (6, 24) and has support from global collaborations in the WHO and the International Federation of Obstetricians and Gynecologists (FIGO). (2, 25) Within Australia preconception care has been identified by the Royal Australian College of General Practitioners (RACGP) as an area of importance in preventative care strategies, and outlines that every woman (and their partner) of reproductive age should be considered for preconception care. (26) This is also scaffolded by national policy and strategy support. The National Women's and Men's Health Strategies (NWHS and NMHS) are ten-year plans that aim to address the key health issues affecting women and girls, men and boys, across the lifespan in Australia. One of key actions in the NWHS to improve maternal, sexual and reproductive health is to *"Increase health promotion activity to enhance and support preconception and perinatal health"*. (27)

1.1.a.iv Why is preconception care important?

Achieving good pregnancy outcomes for women and babies has always been an international health priority. The continued importance of improving maternal and child health is reflected in the United Nations Sustainable Development Goal 3 *"Good Health and wellbeing",* with Targets 3.1 and 3.2 focused on reducing maternal and childhood mortality, and Target 3.7 acknowledging the importance of family planning and reproductive health services. (28)

Pregnancy outcomes for women and babies are measured by maternal and neonatal morbidity and mortality rates. For many years, attention and interventions to improve these rates were focused on key time periods; antenatally, once a woman was pregnant, the intrapartum period, and neonatal care. Interest grew in preconception care when morbidity and mortality rates were not improving despite advances in maternity and neonatal care. (4, 29-31) Indeed, maternal mortality worsened in some settings in the 1990's such as the US, due to preexisting health issues and a lack of preconception care. (31) Infant morbidity and mortality rates also plateaued at the end of the 20th century in the US for which the three leading causes were congenital anomalies, preterm delivery, and maternal complications of pregnancy. (31, 32) These factors were associated with an increase in pre-existing medical conditions for women entering pregnancy which can be modified through preconception care initiatives. (32, 33) Similarly, an unchanging perinatal mortality rate in the Netherlands, saw the development of their 2007 advisory report on preconception care to respond to this issue. (30)

Antenatal care is key to improving pregnancy outcomes however it does not provide primary prevention for modifiable risk factors, exposures, and health conditions prior to pregnancy. While most women seek care when pregnant, interventions delivered in the pregnancy period alone are thought to be too late to achieve best health outcomes for women and their babies. (8) For example, efforts to reduce the occurrence of congenital anomalies gave impetus to the importance of reducing exposure and risk prior to conception as well as during pregnancy. This included activities such as rigorous glycaemic control in women with pre-existing diabetes, otpimising weight for women above a healthy weight, and folate supplementation. (8)

Preconception care also offers to opportunity to discuss pregnancy planning, where a woman and her partner can consider the number, spacing and the timing of desired pregnancies. (6) This helps to reduce the incidence of unintended pregnancies and improve health before pregnancy for both parents. Employing a reproductive life plan has been found to be an effective adjunct to clinical care in women with chronic conditions to improve knowledge about pregnancy preparation. (34)

The importance of timing of pregnancy awareness

Despite evidence that both positive health behaviours in pregnancy, and early, regular antenatal care improve pregnancy outcomes, delayed recognition of pregnancy and hence delayed behavioural action is common. (35, 36) Studies in the US have investigated the timing of “pregnancy awareness” or “pregnancy recognition”. (37, 38)

One large population-based study reported a mean gestational age of pregnancy awareness of 5.5 weeks, with almost one in four women not being aware they are pregnant till after seven weeks of gestational age. (37) Similar findings have been seen in other studies however data on pregnancy awareness in Australia is lacking. (39-41)

The embryonic period, during which the major body systems of the fetus are forming, lasts from weeks 3-8 after fertilisation, or weeks 5-10 of gestational age. (42) (Figure 1.8) During this time the developing body systems are susceptible to insults from exposures including environmental and infectious agents, teratogenic medications, disease states such as hyperglycaemia from poorly controlled diabetes, or behavioural factors such as smoking and alcohol and other drugs. (8, 42) These can lead to adverse outcomes, including congenital anomalies, and disorders of placentation. (8, 43)

Figure 1.8: Temporal relationship between embryonic age and pregnancy awareness.

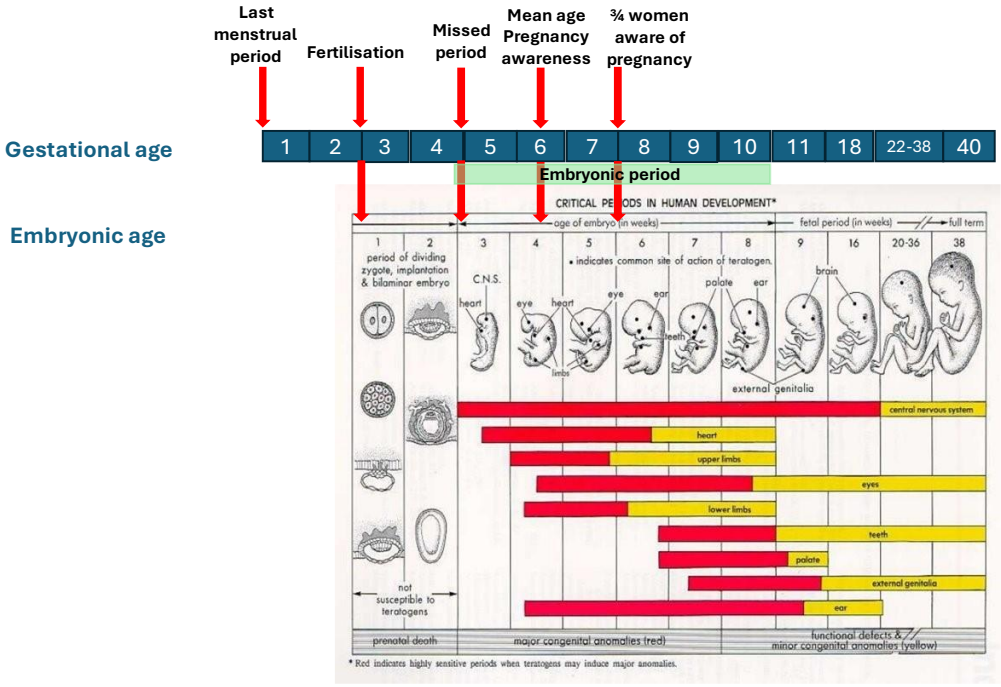


Image credit – Moore KL PT, The developing human. Clinically orientated embryology. The developing human. Clinically orientated embryology. Philadelphia: WB Saunders.

As such, many women are not aware of their pregnancy at the time that organ systems are developing, and therefore do not proactively reduce the risk of exposures. For example, many women are not aware they are pregnant at the time the neural tube is closing, which is at the end of week 4 embryonic age, or week 6 gestational age. This is important as folate supplementation reduces the incidence of neural tube defects but is only effective prior to the closure of the neural tube. (44)

A further delay in care can occur between the time that a woman is aware she is pregnant and when she seeks antenatal care. An American study found a mean delay

between pregnancy awareness and attendance for antenatal care of two to three weeks. (45) In Australia, the National Pregnancy Care Guidelines state that women should attend for antenatal care by ten weeks of gestation (46) but in 2021, only 60% of women in Australia met this recommendation. (36) Additionally, a significant proportion of women do not meet the recommended number of antenatal visits in their pregnancy. In 2021, only 58% percent of first-time mothers in Australia attended the recommended amount of ten antenatal visits in their pregnancy, placing further importance on preparation in the preconception period. (47)

Fetal programming and the developmental origins of health and disease

Some impacts for offspring health, in both the short and long-term, and the health of future generations are attributable to the theory of fetal programming. (8) Fetal programming is the concept whereby gametogenesis and the intrauterine environment can have significant impact on lifetime health. (48) This is also known as the developmental origins of health and disease (DOHaD). (49, 50) This concept was first described by Barker and supported by other epidemiological studies including the Dutch famine that show the impact of adverse intrauterine environments on childhood outcomes. (50, 51) Theses studies showed that parental starvation and undernutrition were associated with metabolic disorders and morbidity in offspring. (50, 52, 53)

There are several molecular mechanisms that are proposed to contribute to fetal programming, one of which is epigenetic modifications. (54, 55) Epigenetics describes the process where certain exposures can lead to alternations in gene expression. (56)

This occurs through disruptions in the mechanisms of Deoxyribonucleic acid (DNA) methylation and histone modifications, on non-coding Ribonucleic acid (ncRNA) which regulate gene expression. (57, 58) There is a vast array of exposures that can cause epigenetic changes. These include, and are not limited to, environmental exposures from the work or home, iatrogenic and infectious exposures, and behavioural exposures including weight, diet, alcohol, and other drugs. (59-63) Some epigenetic changes are permanent, and others have the capacity to be reversed. Epigenetic changes that affect the offspring can take place during gametogenesis (preconception) for both women and men, and throughout pregnancy. (64-67) These changes have the potential to affect offspring health, and the health of future generations. (68) Graphical representation of the process of epigenetic changes in the preconception and pregnancy periods are shown in Figures 1.9 and 1.10.

Figure 1.9: Epigenetic alterations induced by lifestyle and environmental factors (68)

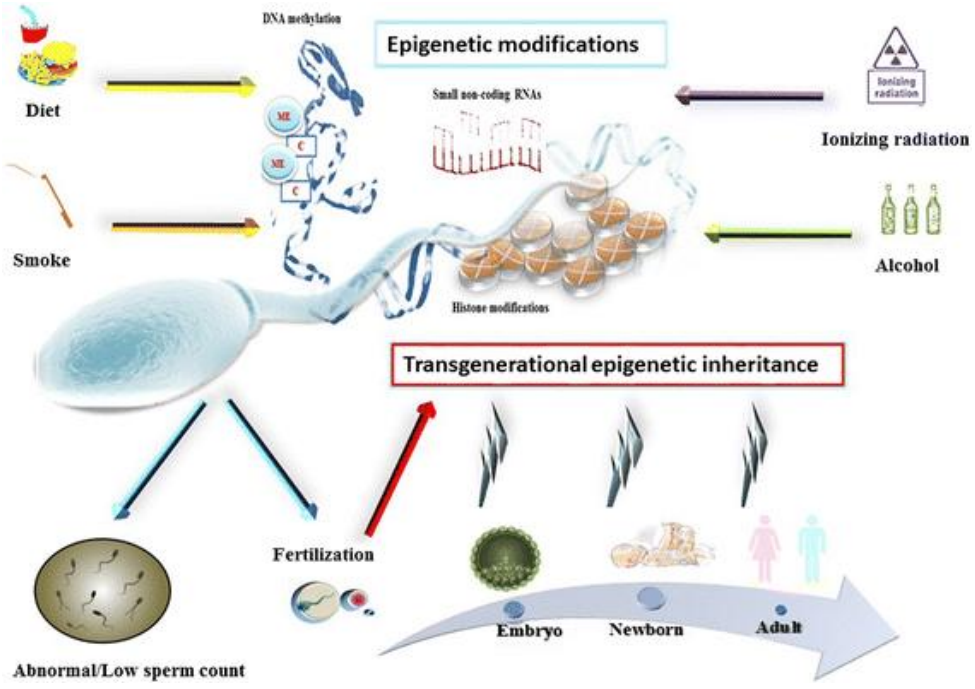
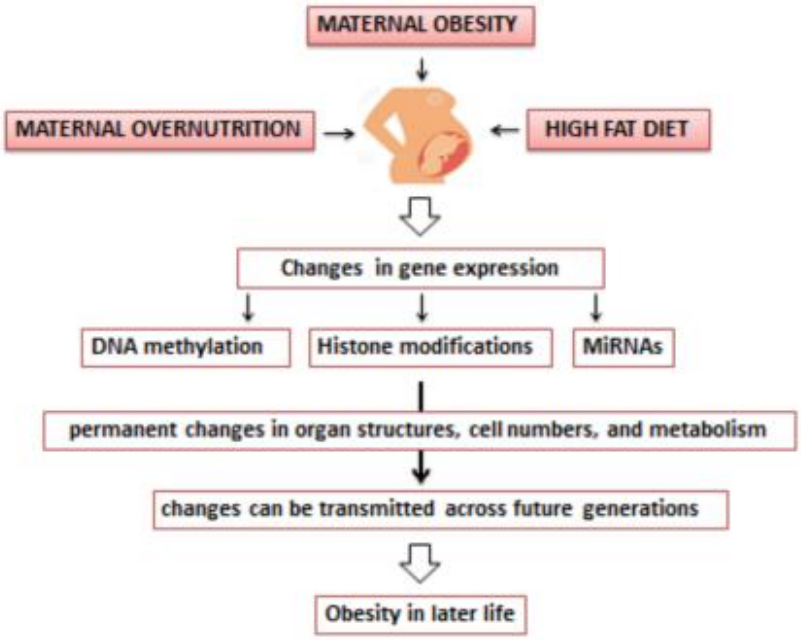


Figure 1.9 demonstrates the potential impact of some environmental and behavioural exposures on sperm in the preconception period. These exposures can result in DNA methylation and histone modification that adversely impacts the offspring in both childhood and adult life. (67) Figure 1.10 demonstrates the impact of behavioural exposures in pregnancy and the epigenetic impact on offspring across the life course. (68)These behavioural exposures can be addressed in the preconception period to optimise parental and offspring outcomes.

Figure 1.10: Basic schematic outlining the consequences of a maternal obesogenic environment on the health and well-being of offspring (67)



1.1.b Evidence to support preconception health and care

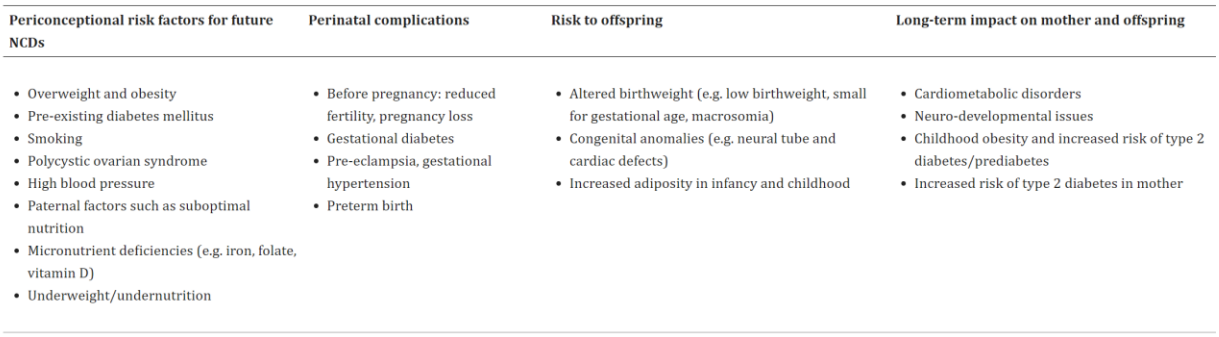
A comprehensive review by Jack et al in 2008 identified numerous domains of a person's health that if enhanced before pregnancy can improve outcomes. These include the domains of non-communicable diseases and associated lifestyle behaviours, optimisation of pre-existing medical conditions and teratogenic exposures.(7)

1.1.b.i Non-communicable diseases

Non-communicable diseases (NCDs) are conditions that are caused through behavioural, environmental or genetic factors or a combination of these, not by transmission between two hosts, or by spread from an infectious agent. (69) Examples of NCDs include obesity, cardiovascular and respiratory disease, and diabetes. (70) Together NCDs appear in the WHO top-ten causes of death across all countries regardless of economic incomes. (70) Risk factors for the development of NCDs include lack of physical activity, poor diet, alcohol use and smoking. (69, 70)

The risk of developing a NCD is influenced by exposures in the preconception period and the fetal environment through epigenetic processes. (25, 71, 72) Indeed, in a 2020 position paper FIGO identified risk factors in the preconception period that impact the offsprings potential to develop NCDs (Figure 1.11). (25)

Figure 1.11: Intermediary risk factors in the time around conception and effects on future noncommunicable diseases (NCDs) in mother and offspring. (25)



Periconceptional risk factors for future NCDs	Perinatal complications	Risk to offspring	Long-term impact on mother and offspring
• Overweight and obesity • Pre-existing diabetes mellitus • Smoking • Polycystic ovarian syndrome • High blood pressure • Paternal factors such as suboptimal nutrition • Micronutrient deficiencies (e.g. iron, folate, vitamin D) • Underweight/undernutrition	• Before pregnancy: reduced fertility, pregnancy loss • Gestational diabetes • Pre-eclampsia, gestational hypertension • Preterm birth	• Altered birthweight (e.g. low birthweight, small for gestational age, macrosomia) • Congenital anomalies (e.g. neural tube and cardiac defects) • Increased adiposity in infancy and childhood	• Cardiometabolic disorders • Neuro-developmental issues • Childhood obesity and increased risk of type 2 diabetes/prediabetes • Increased risk of type 2 diabetes in mother

Weight, physical activity, and diet

Parental weight and pregnancy outcomes.

Healthy weight in the preconception period is defined by the WHO Body Mass Index (BMI) categories. (73) BMI is calculated from a person's height and weight, adult BMI categories are shown in Table 1.1.

Table 1.1 World Health Organization Body Mass Index Categories (73)

Body Mass Index Range (kg/m^2)	Weight category
< 18.5	Underweight
18.5 - 24.9	Normal Weight or Healthy Weight
25.0 - 29.9	Pre-obesity or overweight
30.0 - 34.9	Obesity Class I
35.0 - 39.9	Obesity Class II
$\geq$ 40.0	Obesity Class III

Being above a healthy weight (BMI $\geq$ 25.0 kg/m^2) is associated with increased adverse outcomes across conception rates, pregnancy outcomes, and offspring health in the short and long-term. (74, 75)

When a woman is above a healthy weight her chances of conception are adversely impacted by disorders of ovulation, reduced oocyte quality, prolonged time to conceive and increased rates of early pregnancy loss. (76-79) These impacts are seen across both spontaneous conceptions and those with assisted reproductive technologies, including those with donor oocytes from donors with increased BMI. (80-82) Men who are above a healthy weight prior to pregnancy are more likely to have complications with healthy sperm parameters. (83) Oliveira et al's study of over 1,800 men who were undergoing fertility assessment found that increasing BMI was associated with worsening semen quality based on sperm concentration, motility and morphology and sperm vitality. (84)

Being above a healthy weight before and during pregnancy is also a risk factor for women developing pregnancy complications. These include congenital malformations, hypertensive disorders of pregnancy and pre-eclampsia, gestational diabetes, assisted delivery and intrapartum complications. (85-88) Disorders of placentation, including intrauterine growth restriction and small for gestational age babies, are also increased. (75, 85, 88, 89) A recent systematic review by Nagpal et al exploring the impact of prepregnancy weight on pregnancy outcomes affirmed these findings. (90) A large Australian retrospective cohort study showed that if women were in the next lower BMI

category, that 19% of preeclampsia, and 14% of gestational diabetes diagnoses could be averted. (88) A change to a lower BMI category translates to a weight loss in the order of 13kg before or between pregnancies. A Canadian population-based study that analysed over 200,000 singleton pregnancies over an eight-year period showed a 10% reduction in preconception BMI was associated with a 10% decreased risk of pregnancy complications. (91) This reduction was seen for preeclampsia and gestational diabetes, and also large for gestational age babies and stillbirth. (91) A 10% change in BMI translates to a weight loss in the order of 7kg between pregnancies. Tueling et al's systematic review on interpregnancy weight change showed women who gained weight in between pregnancies had higher risks of gestational diabetes, preeclampsia and large for gestational age babies. For women who lost weight in between pregnancies the risk of delivering a large for gestational age infant was reduced. (92)

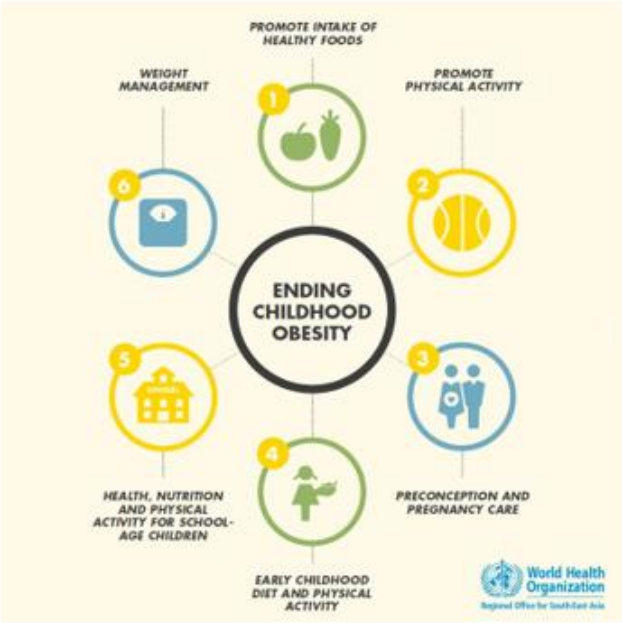
Increased maternal preconception weight is associated with negative health impacts in childhood. (75) A prospective cohort study of almost 500 children from Canada measured the BMI growth rate of children from 0-10 years, where maternal preconception BMI was formally measured and recorded. The findings showed that children who were born to mothers with an increased preconception BMI had 1.41 times the odds of being above a healthy weight in childhood, after accounting for maternal age, ethnicity, education, and smoking status. (93) Early and rapid childhood growth is associated with increased rates of being above healthy weight as an adult (94) therefore maternal preconception weight can have far reaching consequences.

The 2013 cohort analysis by Reynolds et al explored the long-term impacts of maternal preconception weight. This study in over 37,000 people shows that babies born to mothers who had a BMI $\geq$ 30kg/m^2 at their first antenatal visit had a 35% increased risk of premature death as an adult. (95)

The importance of preconception care to break the obesity cycle has been recognised by several leading international health organisations (Figure 1.12). The WHO identified pregnancy and the preconception period as one of the six key pillars to addressing childhood obesity. (96) Locally, in 2017, the Presidents of Medical Colleges of Australia listed preconception planning as one of their six points in their action plan on obesity. (97) These action plans are further reinforced by FIGO's 2023 Best Practice Advice on managing obesity across the life course which calls for health professionals to support people to optimise weight before pregnancy. (98)

Figure 1.12: International strategies involving preconception care to tackle obesity.

World Health Organization



International Federation of Gynecology & Obstetrics

Best practice advice

- Primary care providers, fertility clinics, contraception clinics, obstetric and gynecology services, and community health-care providers should support those with fertility potential with health and weight optimization prior to pregnancy
- Lactation support should be available for all parents
- In addressing obesity-related health with patients, care providers should ask permission to discuss weight and health, perform a physical assessment and an assessment of the root causes of obesity, discuss available care options, and plan for follow-up
- Obesity assessment and health optimization strategies should be incorporated into training programs for all health professionals

Pragmatic practice advice

- Where resources are limited, body mass index can be assessed and consideration given to exercise and nutrition to optimize health and weight prior to pregnancy

The council of Presidents of Medical Colleges Australia – six-point action plan for obesity

- **A chronic disease, not a lifestyle choice:** recognise that obesity is a chronic disease with multiple causes, and remove stigma, focus on prevention (especially in children) and maximise access to optimal disease management.
- **Education and upskilling:** build health professional capability in the prevention and management of obesity by upskilling through education and training, provide disease management toolboxes, and fund clinical research to identify new evidence-based prevention and treatment strategies.
- **Health professionals leading by example:** encourage health professionals to lead by example with initiatives across universities, hospitals and health services, including reducing access to sugar-sweetened beverages and processed foods on site, and promoting a greater variety of fresh foods and water as healthier choices for staff, students and visitors.
- **Pre-conception planning:** focus on prevention before and early after birth; provide obesity prevention and care for all women as part of routine perinatal care (and women and men before conception), and provide support services after birth via a nationally funded strategy.
- **National obesity prevention strategy:** develop and adopt a new comprehensive evidence-based strategy including a focus on diet, exercise and healthy cities (bringing health expertise to the table to maximise the benefits of new urban planning).
- **Stronger voluntary regulation and new legislation:** incentivise voluntary food reformulation and support food ratings; reduce unhealthy food marketing to children; reduce the consumption of unhealthy high sugar beverages and foods by implementing a sugar-sweetened beverage tax, and use the funding to support the entire plan.

Preconception interventions for weight and lifestyle behaviours

Interventions to optimise parental weight before pregnancy include diet and exercise modifications. These are often assessed individually or in combination.

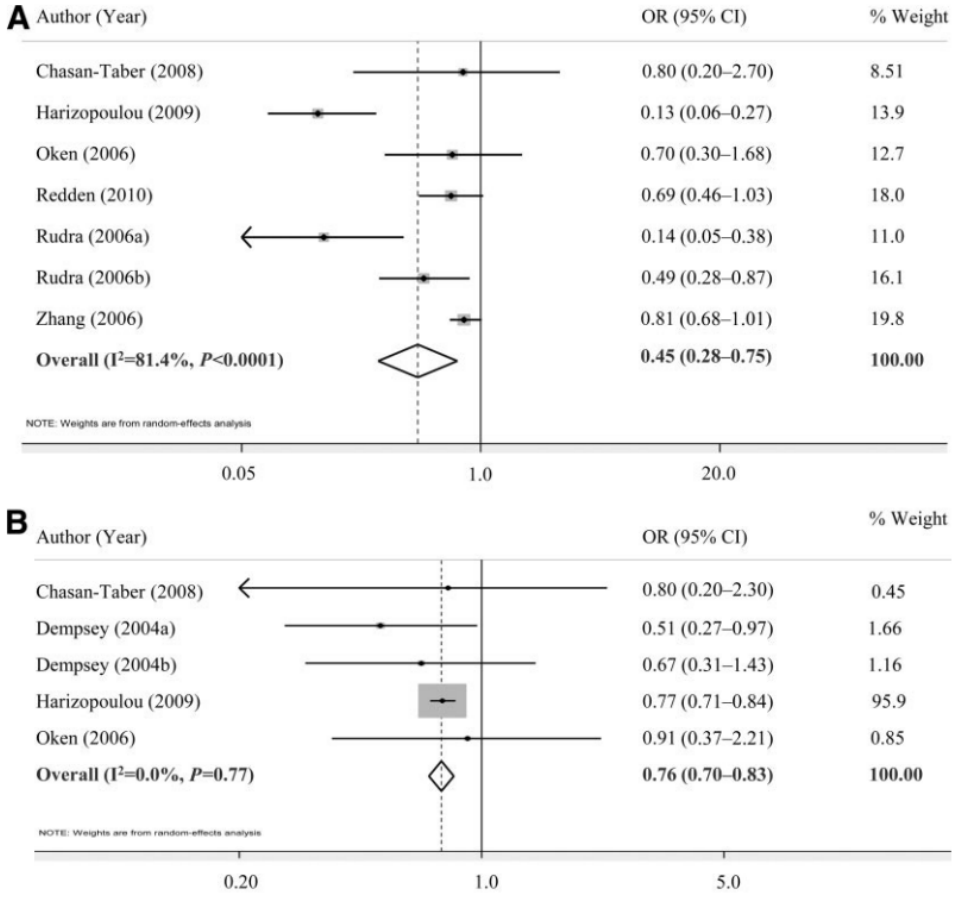
Hunter et al's systematic review on the impacts of weight loss in people with diagnosed infertility who were above a healthy weight (BMI $\geq$ 25kg/m^2) included 15 randomised controlled trials, two of which were from Australia. (99) This systematic review demonstrated that those who received lifestyle interventions of diet and exercise achieved greater weight loss compared to those who did not (mean difference 5.42kg), improvement in ovulation (risk ratio [RR] 4.24) and natural conception rates (RR 2.25). (99)

Another systematic review by Best et al explored preconception lifestyle interventions for women and men who were above a healthy weight having fertility treatment, and the impact on achieving weight change, pregnancy rates and live birth rates. (100) Of the 40 studies included, two focused on men and one involved couples. Best et al's meta-analysis demonstrated significant increased weight loss and pregnancy rates for women who received low calorie diets and who exercised (RR 1.59, 95%CI 1.01-2.50), yet no significant effect on live birth rates. (100) Interventions to promote weight loss in the post-partum period are also shown to be effective for interconception weight loss, with greater results seen for combined diet and exercise interventions. (101)

The benefits of preconception physical activity on reducing the risk of developing gestational diabetes have been demonstrated in both a large longitudinal cohort study and a meta-analysis. (102, 103) Zhang et al's 2006 analysis of the Nurses' Health Study II data showed that increasing amounts of vigorous activity performed in the

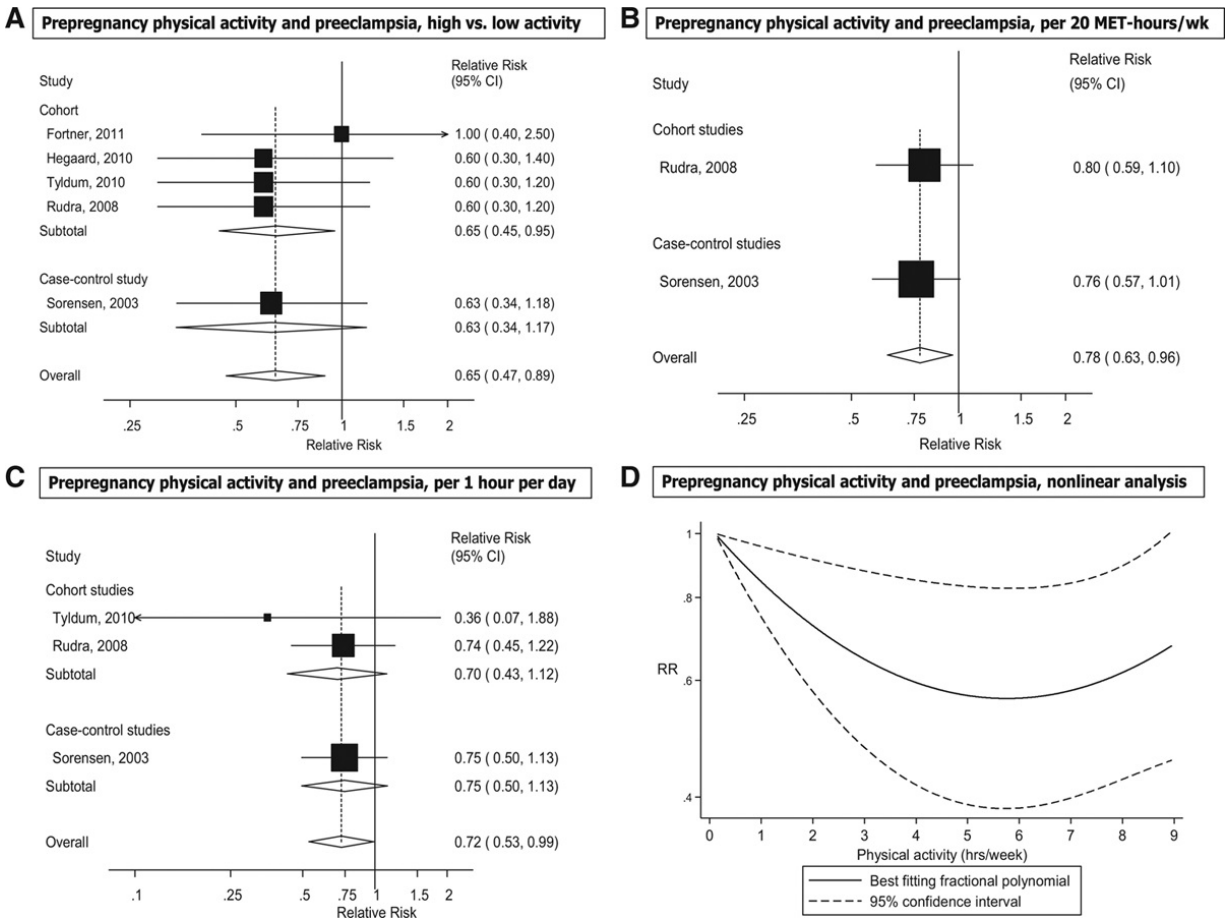
preconception period decreased the risk of gestational diabetes (highest vs lowest quintile RR 0.77, 95% CI 0.69-0.94). (102) They also analysed the impacts of walking in women who did not perform vigorous physical activity and found the risk of gestational diabetes was reduced by 34% for brisk walking compared to easy walking. (102) Tobias et al's meta-analysis included seven studies with almost 35,000 women. (103) They also demonstrated that women with the highest levels of pre-pregnancy physical activity had 55% lower risk of developing gestational diabetes compared to those with the lowest levels of physical activity, although there was significant heterogeneity in the results. (103) While sensitivity analyses were performed, a limitation of this meta-analysis was not being able to provide tangible results on the duration or intensity of exercise that was associated with decreased levels of risk. Interestingly, Tobias et al did show the magnitude of the effect for physical activity was higher in the preconception period compared to the early pregnancy period, showing the importance of positive preconception behaviours (Figure 1.13). (103)

Figure 1.13: Physical activity before and during pregnancy and risk of gestational diabetes mellitus. Results of meta-analyses. A: pre-pregnancy physical activity. B: Early pregnancy physical activity from Tobias et al (103)



Aune et al performed a systematic review and meta-analysis to explore the impact of physical activity in the preconception period on the risk of pre-eclampsia in pregnancy. (104) The five included studies showed a positive impact of regular physical activity, that reduced the risk of pre-eclampsia in pregnancy by 20-40% (Figure 1.14). The highest reduction in risk was seen for women who exercised for 5-6 hours per week. (104)

Figure 1.14: Prepregnancy leisure-time physical activity and preeclampsia. A, High versus low activity; B, dose–response analysis per 20 MET-hours/week; C, dose–response analysis per 1 hour per day; D, nonlinear dose–response analysis from Aune et al. (104)



Research is continuing in this area and there are two large randomised controlled trials (RCTs) currently in Australia exploring the impact of preconception weight loss interventions and composite maternal and neonatal outcomes. The Begin Better trial in South Australia involves a behavioural change intervention of diet and lifestyle advice using health coaching and app support, (105) and the Pre-Babe study in New South

Wales which involves partial meal replacement. (106) These studies will further inform the impact of lifestyle interventions in the preconception period.

Nutrition

Healthy eating, defined by meeting recommended guidelines of food group intakes and limited amounts of discretionary foods, contributes to overall good health for future parents. Additional micronutrient requirements are relevant to the preconception and early pregnancy periods, including folate and iodine. (107, 108) Other supplements may be relevant depending on individual requirements.

Folate and iodine have been shown to have specific benefits to the developing fetus. (109) Folate, a B group vitamin, has been shown to play a key role in healthy development of the central nervous system, in particular the formation of the neural tube, that closes by the 28th day after fertilisation. (110) Failure of the neural tube to properly close leads to neural tube defects, including spina bifida, anencephaly and encephalocele. Pregnancies affected with these conditions often result in termination, stillbirth or neonatal death, and babies can have lifelong physical sequelae. (111) Adequate maternal red blood cell folate concentrations can reduce the incidence of neural tube defects. (44) The WHO has recommended that at the population level, women of reproductive age should have a red blood cell folate concentration of 400ng/mL (906nmol/L). (109) International and Australian evidence suggests that diet alone is not sufficient to achieve these red blood cell folate concentrations at a population level, and that additional folate is required from fortified foods or

supplements. (112-115) Approximately 80 countries now fortify their flour with folic acid, and this has reduced the incidence of neural tube defects internationally. (116-119) Mandatory flour fortification was introduced in Australia in 2009 and following this the prevalence of neural tube defects decreased by 14.4%. (118)

The addition of a 400–500 µg folic acid supplement in the preconception period has been shown to effectively prevent neural tube defects such as spina bifida and anencephaly. A Cochrane review reported that periconceptional folic acid supplementation results in a 72% reduction in risk of developing neural tube defects and a 68% reduction in risk of recurrence, compared with either no intervention, placebo or micronutrient intake without folic acid. (44)

Iodine is required for thyroid hormone production in mothers and babies which impacts the development of the fetal brain. (120) Australian guidelines recommend an intake of 220mcg per day for women before and during pregnancy, a requirement that is also unlikely to be achieved by dietary intake alone. (121, 122) As such, a 150mcg iodine supplement is recommended for all women planning a pregnancy, and women who have a known thyroid condition should seek additional health advice on optimal supplementation. (107)

Smoking

Smoking remains one of the most important modifiable risk factors for reproductive and pregnancy health, with known maternal, fetal and subsequent childhood health

complications. (123) Cigarettes contain multiple harmful chemicals including nicotine, carbon monoxide and cyanide that can harm future parents, cause epigenetic changes in sperm and eggs, affect the process of placentation, and cross the placenta causing harm to the developing fetus. (124) Given these pathological processes, smoking is associated with many adverse outcomes including increased rates of difficulty conceiving, disorders of placentation, preterm birth, low birth weight and pregnancy loss. (125)

Alcohol

Alcohol can cross the placenta and is a recognised teratogen that can cause a spectrum of fetal complications. (126) Given the known delay from conception to pregnancy recognition it is recommended there is no safe level of alcohol consumption for women planning a pregnancy to avoid this teratogenic exposure. (127) Evidence from animal studies shows negative fetal impacts of pre-pregnancy alcohol exposure including metabolic disease and disorders of growth. (128, 129)

A secondary analysis of the Nurses' Health Study II data explored the impact of six healthy preconception lifestyle factors or behaviours on adverse pregnancy outcomes. (130) The analysis involved over 15,000 women and looked at the positive factors of being a healthy weight, meeting physical activity and healthy eating guidelines, not smoking, not drinking alcohol and taking micronutrient supplementation. Results showed that having all six positive factors was significantly associated with a decreased risk of adverse pregnancy outcomes (RR 0.63, 95%CI 0.55-0.72) in comparison to

having none or one healthy factor. The cumulative impact of these factors demonstrates the importance of multiple healthy behaviours before pregnancy. (130)

Optimising pre-existing medical conditions.

Improving chronic medical conditions also improves the health of potential parents and can also have implications for pregnancy and child health outcomes.

For women with pre-existing diabetes, improved glycaemic control in the preconception period has been shown to reduce the risks of congenital malformations, early pregnancy loss, disorders of fetal growth, preterm birth and perinatal mortality. (131-133) A systematic review by Inkster and colleagues explored HbA1c measurements in pregnancy for women with pre-existing Type 1 and Type 2 Diabetes. Twelve out of the thirteen studies in this review recorded HbA1c within the first trimester which is a satisfactory measure of preconception glycaemic control. This showed that poor glycaemic control gave an increased risk for congenital malformations with a pooled odds ratio of 3.44 (95% CI 2.30 – 5.15), miscarriage with a pooled odds ratio of 3.23 (95%CI 1.64 -6.36) and perinatal mortality with a pooled odds ratio of 3.03 (95%CI 1.87-4.92). (131) In 2007 Guerin et al performed a review of cohort studies to determine the level of glycosylated haemoglobin and associated risk for congenital malformations. (133) The purpose of this study was to provide health care providers with a tool to help educate and counsel women with diabetes about the importance of strict glycaemic control. They found as the level of glycosylated haemoglobin increased (indicating

poorer diabetic control) they risk of congenital malformations exponentially increased (Figure 1.15). (133)

Figure 1.15: Risk of a major or minor congenital anomaly according to the number of Standard Deviations of Glycosylated Haemoglobin above normal measured periconceptually. (133)

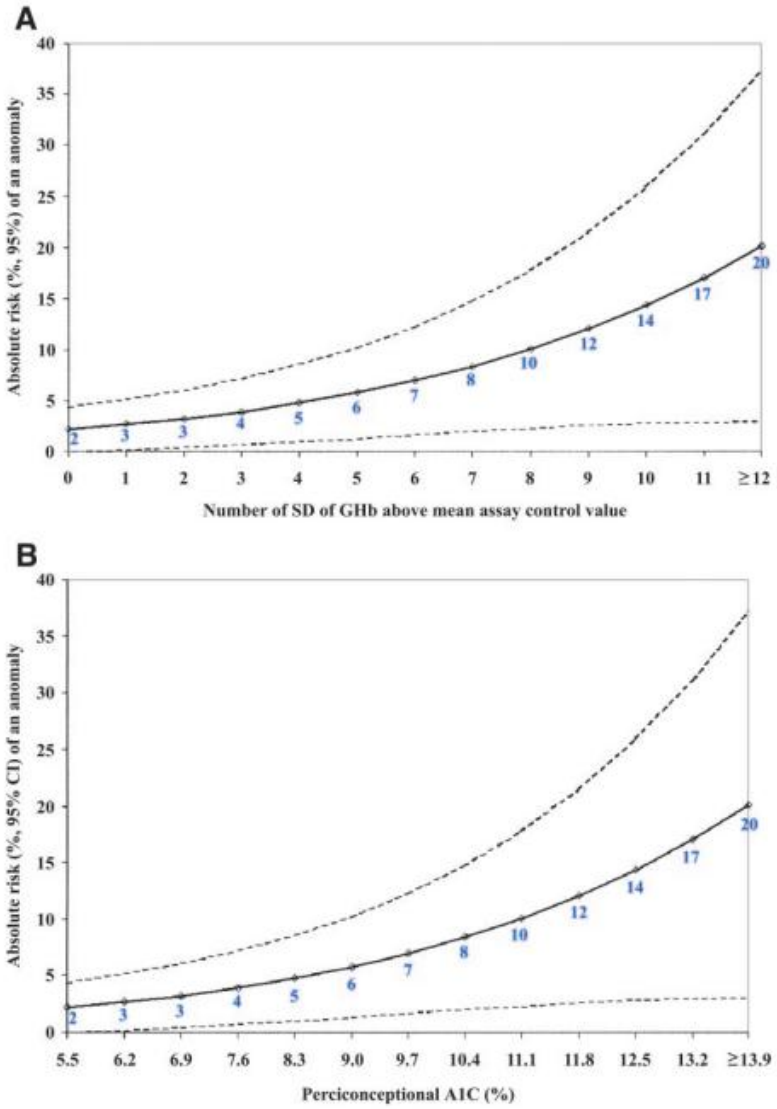


Figure 1—A: *Risk of a major or minor congenital anomaly according to the number of SDs of GHb above normal, measured periconceptionally. Data are presented as an absolute risk (solid line and blue values) ± lower and upper 95% CIs (dashed lines).* B: *Risk of a major or minor anomaly according to periconceptional A1C. *Data are presented as an absolute risk (solid line and blue values) ± 95% CIs (dashed lines).*

Wahabi et al's 2010 systematic review sought to explore the effectiveness of preconception care for women with pre-existing diabetes. (134) There were five interventions that were included in the definition of preconception care for this review:

1. Targeted blood sugar control
2. Counseling/education about the importance of targeted blood sugar control and complications in pregnancy
3. Screening for diabetes complications
4. Contraception until optimal blood sugar control
5. Micronutrient supplementation

Findings included that preconception care was effective at lowering HbA1c levels by 2.43% (95%CI 2.27-2.58) and associated with women booking 1.32 weeks earlier for antenatal care (95%CI 1.23-1.40). This review also showed that preconception care for women with pre-existing diabetes reduced the rate of congenital malformations, preterm delivery and perinatal mortality with numbers needed to treat (NNT) with preconception care ranging from eight to 32 women to achieve such outcomes (Table 1.2) (134)

Table 1.2: Impact of preconception care in women with preexisting diabetes to reduce adverse outcomes (134)

Adverse outcome	RR*	95%CI	NNT**
Congenital malformations	0.25	0.15-0.42	17
Preterm delivery	0.7	0.55-0.90	8
Perinatal Mortality	0.35	0.15-0.82	32

*RR: Risk ratio

**NNT: Number needed to treat

A community-based preconception care intervention in the primary care setting in the UK targeting women with pre-existing diabetes and their health care providers was also found to be effective in achieving improved glycaemic control and micronutrient supplementation. Women who received this intervention were also found to book earlier for antenatal care. (135)

1.1.b.ii Teratogens

A teratogen is a substance or exposure that has the potential to alter, and potentially harm, the developing fetus. (136) There are several categories of teratogens including medications, environmental exposures and infectious agents. The Therapeutic Goods Administration (TGA) in Australia has a categorisation system to classify medications and their potential risk to the developing fetus. (137) An example of a teratogenic medication is sodium valproate (Epilim) an anticonvulsant medication commonly prescribed in the management of epilepsy, and more recently for management of

bipolar disorder. Sodium valproate significantly increases the risk of congenital malformations across several organ systems including the nervous (neural tube) and cardiac systems. (138, 139) Avoidance of teratogens is advised for all women who are planning a pregnancy due to the delay in pregnancy recognition and potential harmful exposure to the developing fetus.

Endocrine disrupters are substances that disturb the usual function of the endocrine system. (140) These substances can therefore adversely interfere with the reproductive functions governed by the endocrine system. Examples of endocrine disrupters include pesticides, plastics and heavy metals. (141) Education about preventive actions to avoid or reduce exposure to endocrine disruptors is an important component or preconception care.

1.1.c Current preconception health and health behaviours in Australia

More than 10 million people in Australia are of reproductive age, (11) and would be classified as the "*Public Health Preconception Perspective"* according to Hill et al's definition. (13) Currently in Australia, there is no national framework of indicators to record and monitor the preconception health and health behaviours of this population group. As a result, it is challenging to capture accurate and complete population level data about preconception health and associated behaviours.

Internationally nine metrics have been suggested for collection at the first antenatal care appointment to serve as markers of "preconception wellness" for women (Table 1.3).

These were developed from criteria that metrics were evidence based, conditions were prevalent, and data could be easily collected from a valid and reliable data source. (142)

Table 1.3: Preconception Wellness Measures at Completion of First Prenatal Assessment from Frayne et al (142)

	Preconception Wellness Measures
1	Pregnancy Intention
2	Access to care
3	Preconception folic acid use
4	Tobacco avoidance
5	Absence of uncontrolled depression
6	Healthy weight
7	Absence of STI
8	Optimal glycaemic control
9	Teratogen avoidance in chronic conditions

There are other significant modifiable risk factors for consideration in optimising preconception health. These include alcohol use, domestic violence, vaccinations, and genetic screening.

1.1.c.i Sources of preconception health data

Information about preconception health and behaviours is collected from several sources. Most data are retrospectively collected in antenatal consultations once a

woman is pregnant, or in cross sectional research surveys. Other data comes from prospective longitudinal studies or population health surveys.

Antenatal care records

Frayne et al propose that the first antenatal visit is currently the most robust timepoint to capture population level data on preconception care. (142) The standardisation of this appointment and the potential to capture pregnancies that may not result in registered births are strengths of this data collection point. Frayne et al also acknowledged the limitations of this timepoint, in that it is retrospective, and does not capture all preconception behaviours in detail. (142) There is also the disadvantage of missing pregnancies that result in termination or miscarriage, and not capturing the preconception health or health behaviours of the partner.

Primary care records

Primary care records are another potential source of preconception health data. A recent review of the electronic medical records (eMRs) of 1000 women of reproductive age across ten general practices in Victoria, Australia showed that only some preconception health risk factors were commonly documented. (143) These included smoking status, alcohol consumption, BMI and presence of high blood pressure. This audit was limited to behaviours with preset, defined data fields and was not able to capture the broader determinants of health that are known to influence a person's preconception health.

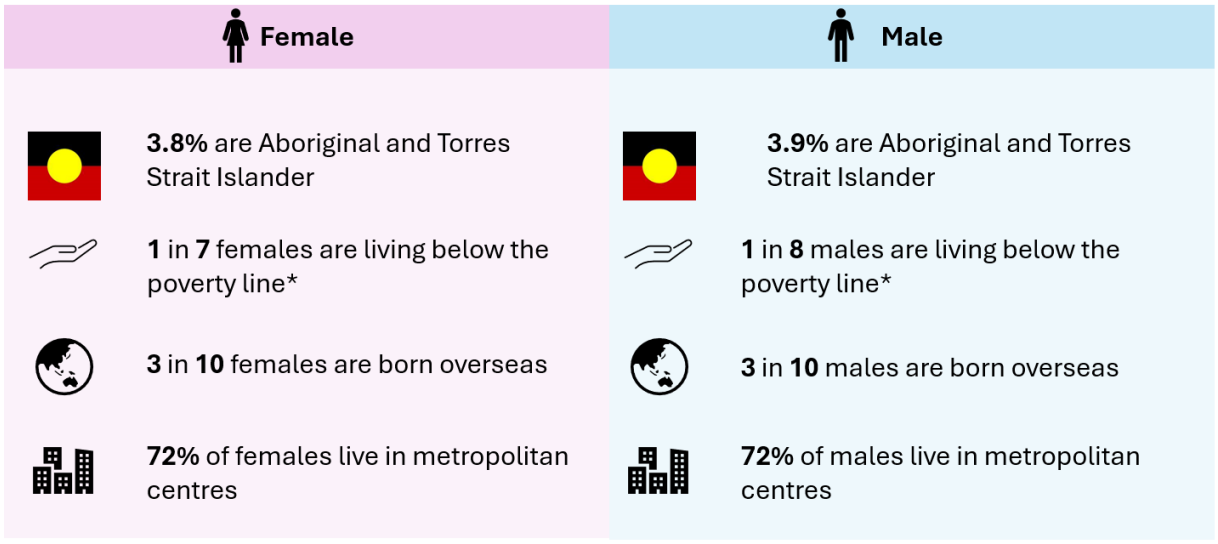
Health surveys

Health surveys conducted at the population level and targeted cross-sectional surveys can also provide valuable preconception health information. Attempts to capture the broader determinants of health have been performed using population level data from the Behavioural Risk Factor Surveillance System (BRFSS) in the US. (144) Outcomes from such surveys can be analysed according to sociodemographic factors including age, ethnicity, annual household income and place of residence.

1.1.c.ii Preconception health behaviours of people in Australia

Figure 1.16 demonstrates some socio-demographic attributes of the Public Health Preconception Perspective population in Australia.

Figure 1.16: Demographics of the preconception "*Public health preconception perspective*" population in Australia



* After-tax household income <50% of the median household income

Data sources: Australian Institute of Health and Welfare; Australia's Mother and Babies, (47) The health of Australia's Females, (145) The health of Australia's Males. (146)

In Australia in 2021, there were 315,705 births from 311,360 mothers. Two in every three mothers were born in Australia, and 5.0% of mothers were Aboriginal or Torres Strait Islander. The average age was 31.1 years, and approximately 70% of mothers resided in major cities. (47)

While the entire Australian population stands to benefit from good preconception health, certain priority groups are at higher risk and therefore require targeted attention. Women from areas of high social and economic disadvantage and those residing in rural and remote communities have poorer preconception health behaviours and experience higher rates of adverse pregnancy outcomes. (147) (148)
This is consistent with recent data from the US that showed women residing in different geographic regions had different rates of preconception risk factors. (149) This was seen across several preconception health fields including smoking, depression, chronic medical conditions (diabetes and hypertension) and rates of unplanned pregnancy.

International data shows that over 90% of women have at least one modifiable preconception health risk factor (150) with one study in primary care in Canada showing that women have on average 15 modifiable risk factors that can affect pregnancy outcomes. (151) The current data presented below suggests that people in Australia have sub-optimal rates of preconception health behaviours. Data is often reported on

specific behaviours rather than comprehensive assessment of a person's preconception health. While there is growing evidence about men's attitudes and knowledge about preconception care, more data exists for the health and behaviours of reproductive aged women in Australia than for men. The data is presented by health and health behaviour, specifying if the data is for women and men only or for both. Typically, where data is obtained from population health sources, it is for women and men. When collected from antenatal records it is for women only.

Preconception Wellness Measure 1: Pregnancy Intention

Pregnancy intention relates to a woman's or couples desire to become pregnant at the time of conception. (152) It is a complex construct that involves social, emotional, financial, cultural, and contextual factors. (153).

Pregnancy intention data is not collected or reported at a state or national level in Australia. Information on pregnancy intention is often collected in antenatal care, usually with a single question of pregnancy planning and a binary outcome. More robust measures of pregnancy intention have been developed to capture this information. The London Measure of Unplanned Pregnancy (LMUP) is a psychometrically validated instrument to measure pregnancy intention and has also been validated for use in the Australian population. (154, 155) Data from cross sectional studies suggests that approximately 30-40% of pregnancies in Australia are unintended, (156, 157) which is consistent with international data. (158)

Pregnancy intention is associated with increased preconception behaviours although the rates remain suboptimal. (159) Both international and local data shows that amongst women with intended pregnancies approximately 60% adopt a preconception behaviour. (160, 161) Amongst women who plan their pregnancies, receiving advice from a health professional in the preconception period is shown to increase the likelihood of adopting a preconception behaviour. (160) Despite this, the numbers of people who consult a health professional for preconception advice remains low. Poels et al found that even amongst women with planned pregnancies, only 60% sought preconception information and 25% saw a health professional. (162) A survey of men with a pregnant partner in the UK showed that less than half had looked for preconception health information online prior to their partner becoming pregnant. (163) The same study showed that over half of all men had not adopted a positive preconception behaviour change prior to their partner becoming pregnant. (163)
Lang et al's study on pregnancy planning behaviours in women in Victoria, Australia found that women who were married/defacto had almost 6 times the odds of planning for pregnancy compared to women who were not, and those with private health insurance had 2.5 times the odds of planning a pregnancy compared to those who were uninsured. (164)

Preconception Wellness Measure 2: Access to care

Frayne et al defined this measure as attending for antenatal care within the first trimester of pregnancy. (142) This is aligned with the WHO recommendations on antenatal care for a positive pregnancy experience that also advise for antenatal care

before the end of the first trimester. (165) This is slightly different to Australia where National guidelines recommend attendance for antenatal care by ten weeks of gestation. (46) Using Frayne's metric, in 2021 79.6% of all women who gave birth in Australia attended for antenatal care within the first trimester. The lowest proportion to receive antenatal care in the first trimester was in women aged less than 20, women living in remote and very remote areas and women who were Aboriginal or Torres Strait Islander. (166)

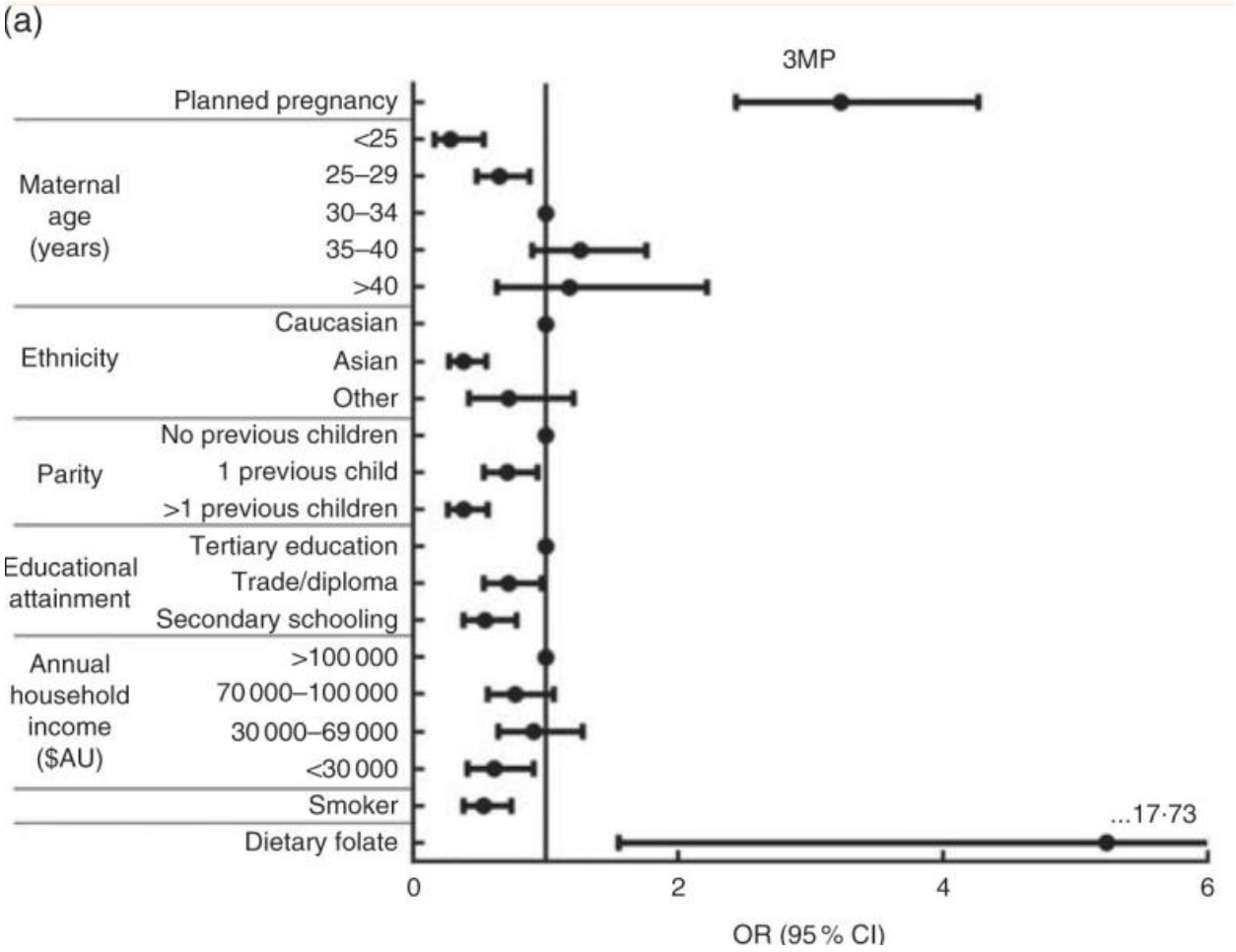
Preconception Wellness Measure 3: Preconception folic acid & other micronutrient use

Preconception nutritional deficiencies including folate, iron, calcium and iodine have been reported across countries of all incomes. (8, 167, 168) In Australia approximately 60% of women take folate in the preconception period, and 20% take iodine supplements. (164, 169-172) Lower rates of supplementation have been reported across different population groups, including women with lower household incomes, younger age, and increasing parity. (173) There is limited evidence available for Aboriginal and Torres Strait Islander women's preconception dietary supplements. A cohort study of 152 Aboriginal women or women who were pregnant with an Aboriginal baby in regional and remote New South Wales (NSW), Australia found 53% took a micronutrient supplement prior to pregnancy. (174)

Livock et al's prospective cohort study performed in metropolitan centres in the Australian state of Victoria explored socio-demographic factors associated with micronutrient supplementation prior to pregnancy. (175) They found that women were

less likely to take supplements if they had a unplanned pregnancy, were younger (< 25 years old), of Asian ethnicity, of higher parity, lower level of attained education and household income, and smokers (Figure 1.17). (175)

Figure 1.17: Multivariate model of variables associated with overall supplement use in (a) early pregnancy (3MP, three months prior to conception) From Livock et al (175)

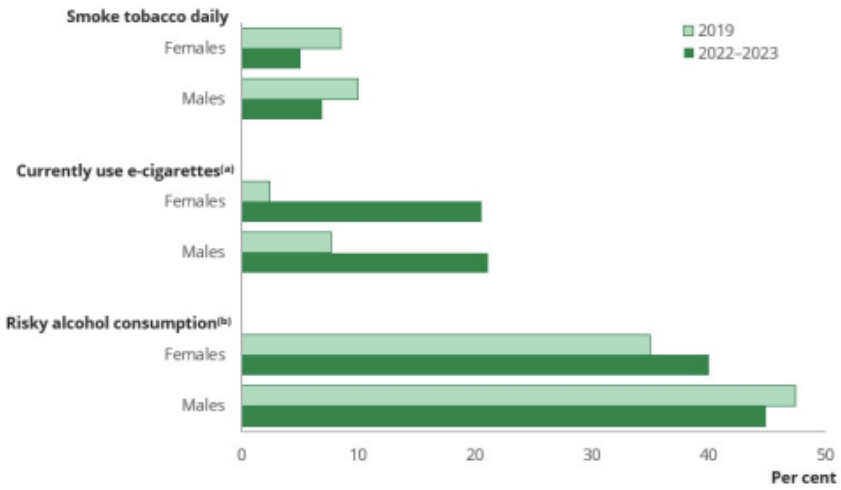


Preconception Wellness Measure 4: Tobacco avoidance

Smoking remains one of the most important preventable causes of adverse pregnancy outcomes. Data from the National Drug Strategy Household Survey in Australia shows approximately 14% of people in within the public health preconception perspective in Australia smoke, a rate that has been declining over the past 5 years. (176) Smoking rates are higher in people from rural and remote areas, from greater socioeconomic disadvantage and in Aboriginal and Torres Strait Islander people.

In contrast the rates of e-cigarette use are increasing in people of reproductive age, with the highest rates of use in those aged 18 – 24 years old. These rates increased 4-fold in people aged 14-17 to 9% and 5-fold in people aged 18-24 to 21% in a three-year period. (176) E-cigarette use is more prevalent in people from areas of socio-economic advantage. (176) A breakdown by gender for people aged 18-24years of age for smoking, e-cigarettes and risky alcohol consumption is shown in Figure 1.18.

Figure 1.18: Use of tobacco and e-cigarettes, and risky alcohol consumption, by gender, people aged 18–24, 2019 and 2022–2023 (176)



(a) Includes people who use e-cigarettes 'daily', 'at least weekly (but not daily)', 'monthly (but not weekly)', or 'less than monthly'.

(b) Consumed more than 10 standard drinks per week on average, and/or more than 4 standard drinks in a single day at least once a month.

Source: NDSHS 2022-2023, Tables 2.4, 3.9 and 4.28.

Alcohol

While not one of Frayne's nine preconception wellness measures, alcohol is an important modifiable risk factor before pregnancy. In Australia it is estimated that up to 80% of reproductive aged women consumed alcohol and almost two thirds of women consumed alcohol in early pregnancy, before they became aware they are pregnant. (176) In Australia and the US, population level data shows over half or reproductive age men report binge drinking behaviours. (176, 177)

Preconception Wellness Measure 5: Absence of uncontrolled depression

Data from US population-based surveys indicates a wide variation in the incidence of self-reported depression in women of reproductive age. This ranges from 4.3 to 40.8%, (178, 179) with one in ten women estimated to experience at least one major depressive episode each year. (180) Amongst women with depression approximately

34% are taking an antidepressant medication. (178) In 2020-2022, 23-45% of reproductive aged females and 17-32% of reproductive aged males in Australia were reported to have a mental health disorder. (181)

Preconception Wellness Measure 6: Healthy weight

The proportion of people of reproductive age who are above a healthy weight is increasing and now over half of all women in Australia enter pregnancy above a healthy weight, which is consistent with international data. (10, 182, 183) Australian and US data indicates that over 50% of men of reproductive age area also above a healthy weight. (177, 183) Shawe et al's survey of over 500 men attending antenatal care appointments with their partner in the UK also showed that half of men fathering a pregnancy were above a healthy weight. (163)

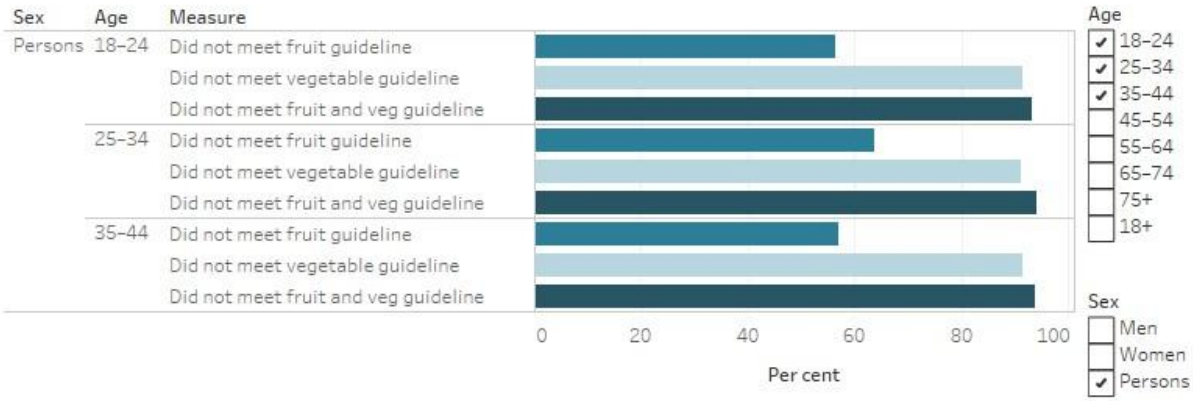
There is limited data about the proportion of couples who are above a healthy weight. Data from the National Free Preconception Health Examination Project in China shows that in 45% of couples, at least one parent was above a healthy weight before pregnancy. (184)

Healthy eating and nutrition

Again, while not one of Frayne's nine preconception wellness measures, a heathy diet, including fruit and vegetable intake is an important modifiable risk factor before pregnancy. In 2020-21 the Australian National Health Survey found that 93.7% of

people of reproductive age were not meting the recommendations for daily fruit and vegetable consumption (Figure 1.19). (185)

Figure 1.19: Proportion of people of reproductive age who do not meet the recommendations for daily fruit and vegetable consumption, 2020-21 (185)



Proportion has a high margin of error and should be used with caution
Source: ABS 2022d. See table S3 for data and footnotes.
http://www.aihw.gov.au/

Preconception Wellness Measure 7: Absence of sexually transmitted infections

In Australia the Kirby Institute produces an annual surveillance report on the incidence of sexually transmissible infections (STIs). (186) The latest data from 2022 showed an increase in new diagnoses of chlamydia, gonorrhoea and syphilis. (186) Chlamydia is

the most frequently notified STI in Australia, with approximately equal rates in women and men. In 2022, there were over 46,000 new chlamydia infections, over 9,000 gonorrhoea, and over 1000 syphilis infections in women in Australia. Congenital syphilis rates have also increased fourfold in Australia over the past ten years. (187) STIs are seen in higher levels in in people in rural and remote areas and Indigenous Australians with rates of infectious syphilis and gonorrhoea five times higher in Aboriginal and Torres Strait Islanders and chlamydia is two times higher in Aboriginal and Torres Strait Islanders. (186, 187) While there are proportionately higher rates of STIs in gay and bisexual males, the rates in heterosexual males and women who live in metropolitan centres are also increasing at accelerated rates. (186)

Preconception Wellness Measure 8: Optimal glycaemic control

Approximately 1% of women of reproductive age in Australia have pre-existing diabetes (145) yet a cross-sectional study of women with pre-existing diabetes in the state of NSW, Australia found that less than half received preconception advice prior to pregnancy. (188) The American Diabetes Association Professional Practice Committee, The National Institute for Health and Care Excellence (NICE) in the UK and the Australasian Diabetes in Pregnancy Society recommend a pre-pregnancy HbA1c of < 6.5% (<48mmol/mol) as optimal glucose control before pregnancy. (189-191)
While measures of glycaemic control are collected at the individual level for women in Australia with pre-existing diabetes in early pregnancy, there is limited information about this at a population level. (192) In 2000, an audit of women who attended a single health care facility in Sydney, Australia was performed over a 12-month period, and showed

that women with pre-existing diabetes had low rate of planned pregnancies and poor glycaemic control (Figure 1.20). (193)

Figure 1.20: Maternal characteristics and glycaemic control from Gunton et al's retrospective analysis of pregnancies in women with pre-exiting diabetes May 1998 - May 1999, Syndey, Australia (193)

Table 1 Maternal characteristics

Diabetes mellitus	Type 1	Type 2
Women (n)	49	12
Pregnancies (n)	74	19
Caucasian	44 (89.8%)	4 (33.3%)***
FHx diabetes	21 (42.9%)	7 (58.3%)
Age (years)	28.0 ± 8.9	35.1 ± 8.6****
Duration	12.8 ± 13.1	6.8 ± 15.6****
Planned	14 (18.9%)	10 (52.6%)**
Smoker	21 (28.4%)	0**
Alcohol	15 (20.3%)	2 (10.5%)
Insulin	64 ± 80	109 ± 327
Weight	69.5 ± 22.8	81.3 ± 66.7
Systolic BP	126 ± 30	122 ± 29
Diastolic BP	77 ± 22	79 ± 8

* p = 0.05 ** p = 0.01 *** p = 0.001 **** p = 0.0001
± = 2 standard deviations, FHx = family history of diabetes, Duration = duration of diabetes, Weight and BP measurements are maximum values.

Table 2 Glycaemic control and diabetic and pregnancy complications

Diabetes mellitus	Type 1	Type 2
HbA_{1c} – Pre	8.0 ± 5.6	6.9 ± 1.6
HbA_{1c} – 1st	6.7 ± 4.0	7.3 ± 3.1
HbA_{1c} – 2nd	5.9 ± 2.3	5.2 ± 1.5
HbA_{1c} – 3rd	5.7 ± 3.3	5.3 ± 2.5
Retinopathy #	11 (22.4%)	0
Nephropathy #	4 (8.2%)	0
Neuropathy #	2 (4.0%)	0
PIH*	20 (38.5%)	4 (36.4%)
Polyhydramnios*	8 (15.4%)	0
Premature labour	5 (9.6%)	3 (27.3%)
PROM*	3 (5.8%)	3 (27.3%)
Oliguria*	3 (5.8%)	0

HbA_{1c} normal range 3.5 – 5.7%, pre = prepregnancy, 1st, 2nd, and 3rd refer to trimester of pregnancy, # = assessed for individual mothers, *= in pregnancies continuing past 22 weeks, PIH = pregnancy induced hypertension, PROM = premature rupture of membranes.

Abell et al's 2017 historical cohort study of women attending a specialist maternity network in the Australian state of Victoria, found women with Type 2 Diabetes had a median HbA1c of 6.8%. (194) Internationally, population level data also shows suboptimal preconception glycaemic control. Evidence from the UK shows average rates of 16% for women with Type 1 Diabetes, and 38% for women with Type 2 diabetes achieving optimal control in early pregnancy. (195) Similarly, a ten-year analysis of glycaemic control in Type 1 diabetics from Finland showed little change in the first trimester readings with mean HbA1c of 7.38 – 7.70% over the study period. (193)

Preconception Wellness Measure 9: Teratogen avoidance in chronic conditions

The proportion of women with chronic medical conditions is increasing and this is seen to increase with increasing parity. (196) This trend is seen across conditions including hypertension and pre-existing diabetes. (36) A study of linked population data sets in the state of NSW, Australia looked at the dispensing of teratogenic medications (defined by Category D or X classification) to perinatal datasets to determine a woman's preconception and early pregnancy time period and exposure to teratogenic medication. (197) This study found an exposure rate of 3.8 – 6.0% of all women pre-pregnancy and a 2.0% exposure rate to teratogenic medications in pregnancy. (163) Lang et al's cross sectional study of women in Victoria, Australia showed that 15% of pregnant women with a chronic medical condition were taking teratogenic medications in the six months before a pregnancy. (164)

Regarding paternal health and exposure to teratogenic medication, Shawe et al found one in twelve men fathering a pregnancy had a chronic medical condition and of those taking a medication one third had a potential adverse reproductive outcome. (163)

1.1.d Who should deliver preconception care?

Given the breadth of evidence-based preconception interventions, and the broad time frame to which they are relevant, there are health professionals from many disciplines, across many settings, who are appropriate to deliver preconception care. A 2006 review on preconception care service delivery across six countries in Europe found preconception care was delivered opportunistically to healthy women, by a range of health care providers, and mostly in the primary are setting. (198) For women with preexisting medical conditions preconception care was provided by relevant specialists. Information on service delivery for preconception care is not currently available for the Australian context.

Shannon et al's 2014 systematic review of preconception care programs and strategies identified four approaches to the delivery of preconception care; (199)

1. Primary care (opportunistic)
2. Hospital based care (opportunistic)
3. Specialised preconception care clinics
4. High-risk and outreach preconception care for women with risk factors.

This review found that a specialist preconception care clinic, that provided holistic preconception care to women and men was effective across several preconception domains however only one example of a national level preconception care clinic was reported. Shannon et al also found the primary care setting was the most common setting for preconception care delivery, with the care being delivered opportunistically. (199)

Several studies regarding attitudes towards the delivery of preconception care have been performed across different clinical workforces in Australia. Kizirian et al performed a cross-sectional study of General Practitioners (GPs) and found that most (84%) GP's felt it was their responsibility to be the main provider of preconception care. (200) Additional studies have also shown that midwives and maternal child and family health care nurses see preconception care as within their scope of practice. (201, 202) FIGO recently issued a "call to action" that all health professionals who see women of reproductive age should deliver preconception care. (25)

Public Health England also endorses this approach, stating that all reproductive health services should deliver preconception care, and that the principles of preconception care should be embedded into existing health services (Figure 1.21). (6)

Figure 1.21: We all have a role to play in making the case for preconception care

From Public Health England (6)

Primary care describes health care that is delivered outside of the hospital setting. It is delivered by a range of health care providers across medical, nursing & midwifery, pharmacy and allied health disciplines and is often a person's first source for health care. (203) Preconception interventions delivered in the primary care setting have been shown to be effective in improving preconception health knowledge, reducing preconception risk factors and improving pregnancy outcomes. (204) Such interventions include single and multiple education sessions, medication, and dietary modifications. Educational interventions delivered in community settings have also shown to be effective in improving preconception health for women with pre-existing diabetes (205)

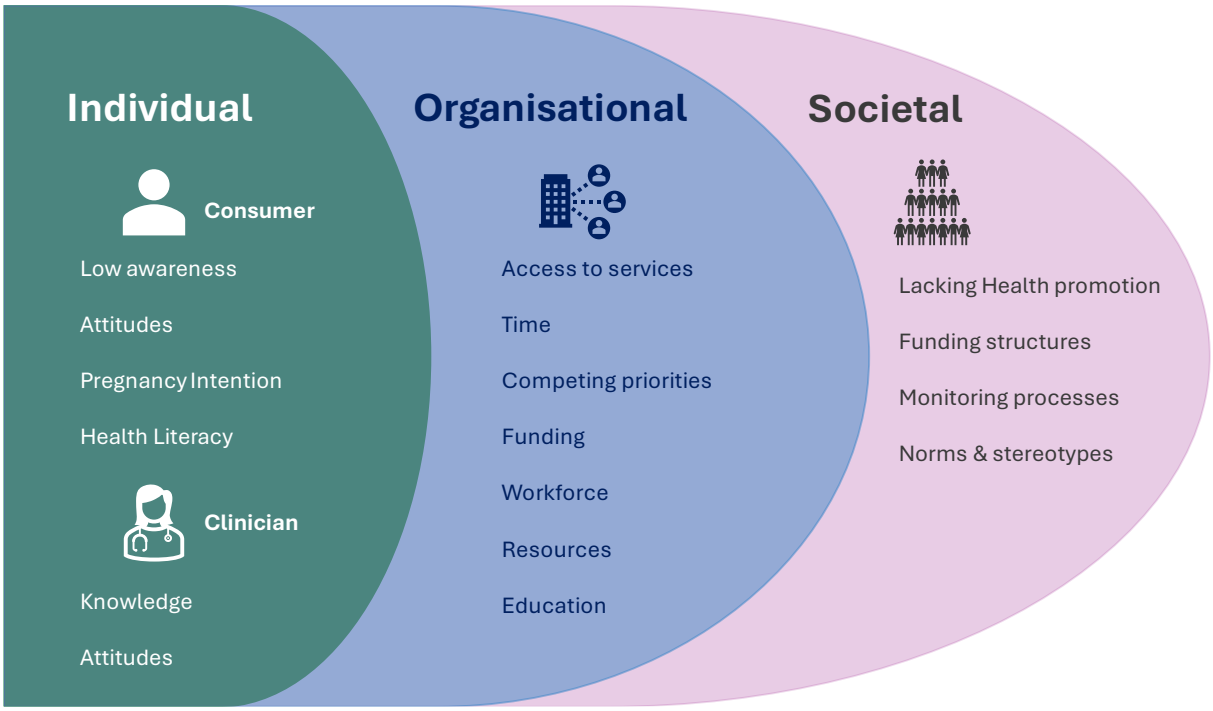
Primary care is frequently accessed by people of reproductive age in Australia, with 85% of women of reproductive age visiting a primary care practitioner within the last 12 months. (206)However, only one in ten people aged 25-24 years discussed the topic of family planning in their primary health care appointment. (206)

Primary care presents an important opportunity to deliver preconception care with good population reach. A structured and systematic approach to supporting health care professionals to be able to deliver preconception care that understands the barriers and enablers to delivering preconception care is required.

1.1.e Overview of barriers and enablers to the delivery of preconception care

There is growing exploration of the barriers to the delivery of preconception care. A systematic review by Goosens et al in 2018 framed these factors across the socio-ecological model, looking at the individual (clinician and consumer), organisational and societal barriers. (207) These barriers have typically been explored from the perspective of women accessing preconception care, but the evidence for men is increasing. A summary of the barriers to the delivery of preconception care across the socio-ecological model is presented in Figure 1.22.

Figure 1.22: Barriers to the delivery of preconception care



1.1.e.i Barriers: Individual level

Consumer

Consumer awareness and attitudes to preconception health can affect the uptake of preconception care. Low levels of consumer awareness about the importance of good preconception health are a frequently reported barrier to the uptake of preconception care (148) and this is seen across countries of all economic incomes. (208-210) Low levels of community awareness can lead to a subsequent lack of presentation for preconception health appointments with health care providers. (211) Several factors have been found to contribute to reduced awareness about preconception care.

Understanding of preconception care

Evidence shows that even though women believe it is important to be in good health for pregnancy, they are unfamiliar with the concept and content of preconception care (212-214). Additional evidence shows that women are also not aware of the health benefits of some preventive activities. (213) Indeed, a survey to assess nutrition knowledge of pregnant women in Australia found that only 45% of pregnant women were aware the benefits of iodine, and 75% were aware of the benefits of folate for fetal development. (171) A limited understanding of preconception care was also evident in women with chronic conditions, who did not understand that preparing for pregnancy was part of their routine care. (213, 215, 216) This limited understanding is often attributed to a lack of public health information on the aims of preconception care and its associated activities. (215)

Attitudes

Studies exploring women's attitudes to preconception care have demonstrated that women do not recognise themselves as a target population due to perceived good health, or an absence of risk factors. (148) These include not having any negative reproductive health outcomes such as difficulty conceiving or miscarriage. (209, 217) In 2008 Hosli et al conducted interviews with women who had declined an invitation from their primary care practitioner to attend a dedicated preconception appointment and had fallen pregnant within a 12-month period of the invitation, to understand why they did not attend. (218) Perceived good health and healthy behaviours, and a resultant assumed lack of risk was a consistent finding across women who declined a preconception appointment. The perceived good health was often reached by a comparison to other women and their behaviours, rather than reflection on own behaviours that could be further modified. (218)

Reproductive health and pregnancy intention are known to be sensitive topics which can be a barrier to attending care or initiating a pregnancy planning discussion. (148) Studies have also identified privacy concerns as a barrier for accessing preconception care. A qualitative study from van der Zee et al found women were concerned about being seen by community members if attending a dedicated reproductive health clinic for preconception care. (217) Tuomainen et al's qualitative research with women from ethnically diverse backgrounds showed that women found it challenging to have open conversations about pregnancy planning. (219) Other studies have demonstrated women's preference for continuity of care and rapport with a health care professional as an enabler to having such conversations. (216, 220)

Unintended pregnancies present missed opportunities to improve preconception health and deliver preconception care. In Australia, approximately 30% of pregnancies are unintended and this rate is increased in women of younger age, women who are not married and with increasing parity (161, 164) Unintended pregnancies are associated with low rates of positive preconception behaviour change and increased rates of adverse pregnancy outcomes. (221) Intended pregnancies, and those where people actively plan to become pregnant, are associated with a relative uptake of positive preconception behaviours, including folate supplementation, and ceasing teratogenic medications. (164) This increases the need to communicate the importance of good preconception health to all who can become pregnant.

Poor consumer health literacy is another recognised barrier to accessing preconception health information, this is both in general and specific to the topic of preconception care. An example is the barriers to the uptake of folate supplements including confusion around the correct timing and dosing for supplementation. (214) Women from low socioeconomic backgrounds are more likely to have lower levels of functional health literacy. (222) This is associated with lower rates of consulting a health professional for preconception care and lower rates of preconception health behaviours. (222, 223)

Health care provider

Several barriers to the delivery of preconception care have been identified from the healthcare provider perspective across qualitative and quantitative studies.

Knowledge about components of preconception care has been reported as a known barrier. (207) This is seen consistently across studies that explore knowledge about comprehensive preconception care programs and isolated components of preconception care such as micronutrient supplementation, healthy weight, and teratogenic advice. (5, 224-226) A survey of Australian healthcare providers (maternity specialists, GPs, midwives) showed that only 56% recommended iodine supplementation in the preconception period as 25% were unaware of this recommendation, 38% did not know the recommended dose and 44% did not know the recommended timing. (227) Other competing preventive priorities have been identified as a barrier to the delivery of preconception care. (210, 211, 228) Examples include vaccinations, screening for STIs and cervical screening. (211)

Kizirian et al performed a cross-sectional study of GPs in Australia, to explore their attitudes, knowledge and practices of preconception care. (200) They found that most GPs felt it was important to provide preconception care, and that they perceived it the GPs responsibility to be the main provider of preconception care. Despite this perceived responsibility, only half of the respondents were aware of any preconception care guidelines, and only 22% stated that it was “very common” for women to seek preconception care advice. (200)

1.1.e.ii Barriers: Organisational level

Access to services has also been raised as a barrier to obtaining preconception care. This relates to service availability, geography and logistical considerations. (148, 212,

215, 219) Women also identify lack of time and living in rural and remote communities as prohibitive factors to seeking preconception care. (148)

A lack of consensus on who is responsible for the delivery of preconception care, the primary care physician or the specialist, has been identified as an organisational level challenge in the implementation of preconception care. (207, 210, 229, 230) The concept of having a dedicated clinician responsible for a care package is easily defined in other clinical conditions compared to the broad package of preconception care. Shared responsibilities relating to the content of preconception care, and clinician specialty area or expertise has been reported. (207) A lack of structured referral pathways for women with complex preconception care needs has also been identified. (210) Clear communication on responsibilities and structured referral pathways between professionals can help overcome these challenges. (210, 229)

Time constraints within appointment times are a recognised barrier to the routine delivery of comprehensive preconception care. (210, 211, 228, 229, 231) This is a consistent finding across health disciplines of medicine, nursing, and midwifery and across primary care and tertiary care settings. Two qualitative studies in the Netherlands, one across health professionals who work in maternal and child health (229) and another across professionals who identify as regularly providing preconception care (210) both reported preconception care as time consuming. In the group who provided regular preconception care, this was attributed to the large number of potential risk factors to address. (210)

Indeed, in Australia, there are limited public hospital preconception clinics across the country. Health care providers also report a lack of funding, for both staff and time, to support the delivery of comprehensive preconception care. (211) A lack of staffing to deliver preconception care in the primary care setting has led to exploring preconception service delivery across different clinician workforces.

A lack of resources to support the efficient and systematic delivery of preconception care has also been identified as a challenge. (211, 232) Such resources include patient information materials, both print and digital, to support conversations and information sharing. (211, 232) A lack of availability and knowledge of clinical practice guidelines to assist the delivery quality clinical care has also been reported to negatively impact the routine provision of preconception care. (207, 233, 234)

A further challenge to implementation of preconception care identified is the lack of formal preconception education programs for health professionals. Embedding preconception care into undergraduate curricula and postgraduate training could enhance health care professionals understanding of the importance of pregnancy preparedness. (229)

1.1.e.iii Barriers: Societal level

Many factors that impact the delivery of preconception care at the societal level echo those experienced at the organisational level. These include a lack of health promotion

activities to promote the importance of preconception health to consumers, a lack of clinician resources, clinical practice guidelines and integrated education programs. (211, 233) A lack of funding support structures and ownership of responsibility for delivering preconception care are also noted at societal level which could help to normalise the concept of a dedicated preconception care appointment. (207, 210, 211) Additionally, stereotypes held by healthcare providers, based on relationship status or age, that can influence starting a conversation about preconception health have also been identified as a barrier to delivering preconception care. (216)

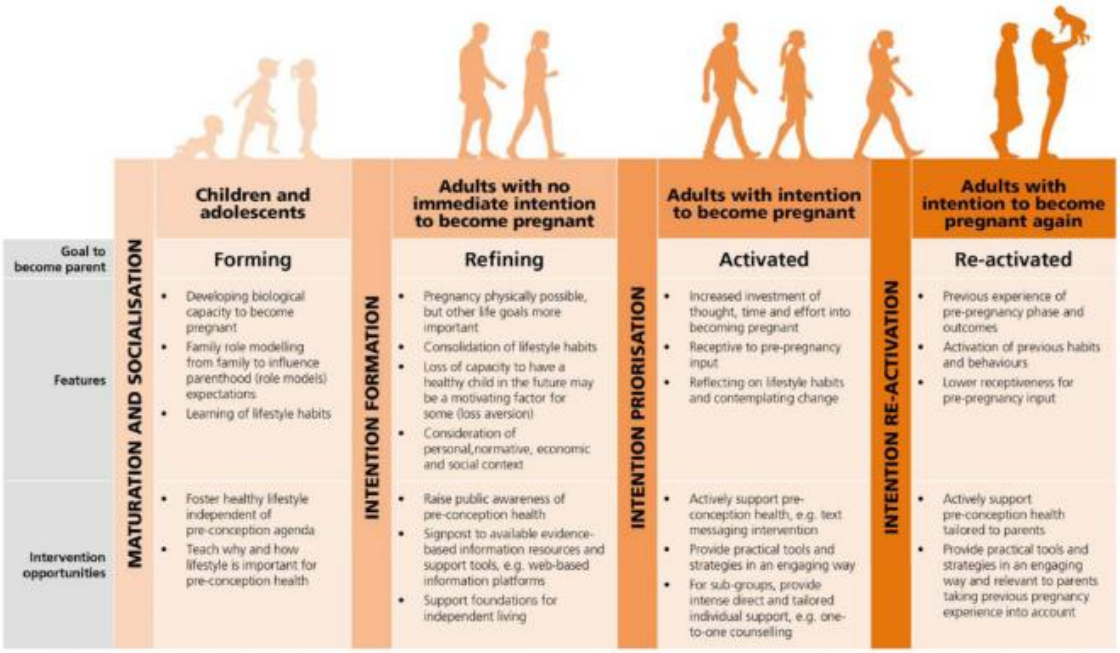
All interventions to enable the delivery of preconception care require reporting and monitoring to determine their impact, effectiveness, and areas for improvement. Reporting and monitoring preconception health data is performed internationally and is yet to have a structured process in Australia. (235, 236) Currently across Australia, both personal and health information is collected at the individual level in maternity data. However, this data is collected in different ways and as such it is not reported consistently at the state or national level.

1.1.e.iv Enablers

While there is more evidence about barriers compared to enablers for the delivery of preconception care, evidence to support effective strategies to improve the delivery of preconception care is evolving. Many enablers are derived through understandings of barriers. Poels et al in 2016, broadly identified addressing “availability” of services and

“consumers belief in the benefits of preconception care” as two enablers to the delivery of preconception care as. (148) A quasi-systematic review in 2018 by Barker et al identified intervention opportunities across four preconception “action phases” over the life course determined by a person’s goal to become a parent (Figure 1.23). (237) While slightly different, these actions phases can be aligned with the preconception populations defined by Hill et al. (13) The intervention opportunities identified by Barker et al also target the provision of evidence-based information to raise awareness of the benefits of good preconception health and enable behaviour change. (237)

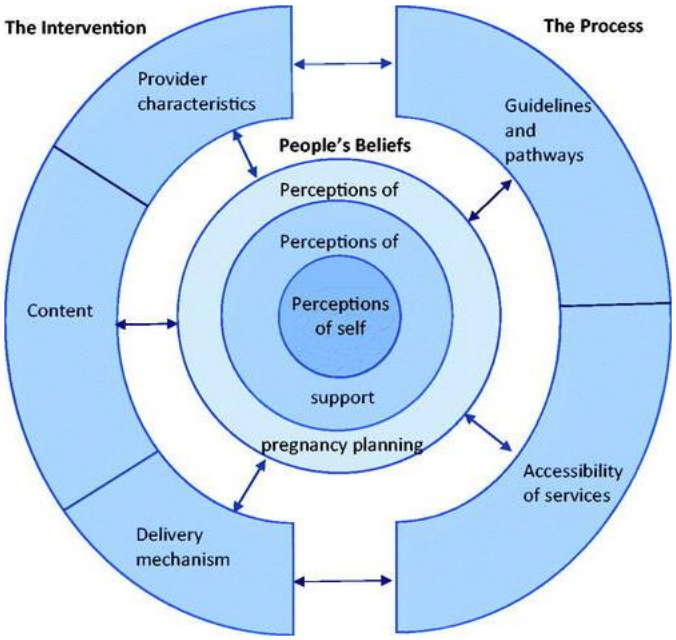
Figure 1.23: Model of preconception action phases from Barker et al (237)



In 2022 Hopper et al performed a realist review of “approaches that work” to enable the delivery of preconception care in people with chronic conditions. (238) This involved an

assessment of what enabled people to seek and receive preconception care and engage with preconception care behaviours. They identified three broad areas of the preconception “intervention” (content, the provider responsible, mode of delivery), people’s beliefs and the process of delivery (organisational factors including accessibility) shown in Figure 1.24. (238)

Figure 1.24: Areas that contribute to the delivery of preconception care From Hopper et al. (238)



Information on preconception care

Providing information to consumers about the content, relevance and benefits of preconception care is a mechanism to increase awareness and improve the uptake of preconception care. (238) The National Preconception Health and Healthcare Initiative,

a multidisciplinary, cross-sectorial collaboration in the US, has identified communicating the importance of preconception care as a “domain for action” to enhance the delivery of preconception care. (24) Information needs to be delivered to individuals, their families, communities, and the broader population and involves a health promotion approach. Heath promotion activities are an effective mechanism for information communication at a population level and can also have indirect benefits such as increasing social supports for behaviour change. (239)

The positive impact of providing targeted preconception information, and the subsequent change in knowledge and behaviour was demonstrated for folate supplements from studies in Australia in the early 1990’s. (240, 241) A multifaceted health promotion campaigned targeted health care professionals (GPs and pharmacists) and women of reproductive age to inform them of the benefits of preconception folic acid supplementation. (240) The campaign resulted in increased health care practitioner knowledge of the correct dosing of folic acid, and recommendation of folic acid to women of reproductive age. Consumers also demonstrated increased knowledge about folic acid and the sales of folic acid increased. (240)

Receiving preconception health information has been shown to improve preconception health behaviours in men. (163) This has been seen to have positive effects across reducing smoking, alcohol consumption and improving healthy eating patterns. (163)

Positive effects were seen when preconception care information was provided by a health care provider or other health promotion sources.

Recent evidence suggests that Australian women are keen to learn more about preconception care and adopt positive health behaviour changes. (242) Most women report a preference for online information sources. (242, 243) In 2020, 99% of Australians aged 18-34 had a smartphone as their primary phone handset, with almost all using this to connect to the internet. (244)

Digital health tools, such as online self-assessment tools, are a possible enabler to the delivery of preconception care. Such tools can be utilised to increase knowledge and promote positive preconception behaviour changes. (245, 246) This includes an increased understanding of the risks of poor preconception health and the benefits of improving health before conception. They have also been shown to be the catalyst for clients to initiate discussions with health care providers. (245) An online preconception health self-assessment tool, delivered at an appropriate health literacy level, is a promising medium to improve knowledge about the importance of preconception health optimisation. (247, 248) An international study of an online preconception health self-assessment tool demonstrated reduced rates of preconception alcohol consumption and improves uptake of folic acid supplementation. (249)

Accessible Services

It has been recognised that the provision of information alone is often not enough to facilitate sustained behaviour change for preconception care. (237, 238) Appropriate and accessible health care services, and health care provider actions are also required. Given more people come into contact with primary care services this has been suggested as the most appropriate setting for structured delivery of preconception care, while noting all services should be aware and able to provide preconception advice. (229) A coordinated approach across all levels of care was noted as an enabler in Hopper et al's realist review. (238)

Services that provide continuity of care for consumers, with available resources to support healthcare provided information are recommended. Given the recognised shortages of GPs in Australia, and limitations on their time, alternative health care providers need to be explored. Indeed, interprofessional collaborations in primary care are recognised as an enabler for quality service delivery including in preconception care. (229, 250) Maternal Child and Family Health Nurses (MCaFHNs), Primary Health Care Nurses (PHCN's) and Midwives are three such disciplines who could deliver preconception care and offer a continuity of care model in primary care.

MCaFHNs are registered nurses with additional, post-registration qualifications in maternal or child and family health. (251) This workforce is predominantly in the community setting and see children and their families from birth through to school age. (252) A cross-sectional study of MCaFHNs in Australia was performed by Hammarberg and Taylor in 2018 to explore MCaFHNs attitudes to delivering preconception care.

(201) While over half felt that preconception care was within their scope of practice, less than half routinely delivered preconception care.

PHCN's are the largest group of clinicians working in primary care in Australia (253) and studies have recommended their involvement in preconception care. (211, 254) Internationally, the CDC stated that PHCNs have an 'equally critical' role in the delivery of PCC alongside specialists and GPs. (4) Midwives, Australia's largest maternity care providers, can also provide preconception education in antenatal and postpartum periods. The Australian National Action Plan for the Health of Children and Young People 2020-2030 calls for consideration to expand midwifery continuity of care to include the preconception period. (255)

For healthcare providers, the availability of high-quality, evidence-based guidelines and tools can enhance the delivery preconception care. (211) Furthermore, funding structures can increase the availability of preconception care services. (238)

All interventions to enable the delivery of preconception care require reporting and monitoring to determine their impact, effectiveness, and areas for improvement. Internationally the US and the UK have frameworks and processes for capturing population preconception health data, this is yet to be developed in Australia. (235, 236, 256)

1.1.f Conclusions and Rationale for this PhD Thesis

This literature review has identified key gaps in preconception health and care knowledge, education and delivery in Australia. Specifically, I recognised that there are low levels of awareness about the importance of preconception health amongst people of reproductive age in Australia and that a health promotion approach may help to overcome this. Furthermore, I recognised that there are challenges for health care providers, these include a lack of preconception care guidelines and a need to support workforces other than medical staff to increase access to preconception care services.

An additional note is that this PhD was commenced in March of 2020, and the initial plan and timeline was significantly affected by the restrictions of COVID-19 pandemic on proposed research activities. Through a modified research plan, I sought to investigate opportunities to enhance preconception health and care in a number of domains. Specifically, I set out to;

1. Identify ways in which health professionals can be supported to provide preconception care through an assessment of the availability and quality of clinical practice guidelines for preconception care. (Chapter 2)
2. Identify ways of measuring women's preparedness for pregnancy and understand how these can be used to inform the delivery of preconception care. (Chapter 3)
3. Identify workforce opportunities to expand delivery of preconception care in primary care. (Chapter 4)

4. Identify ways to enhance preconception knowledge and awareness to equip and empower people of reproductive age to make informed decisions and adopt preconception health behaviours. (Chapter 5)
5. Identify consumer preferences for preconception health promotion. (Chapters 6&7)
6. Identify priorities for preconception health in Australia and ways to monitor the progress of preconception health promotion and delivery. (Chapters 8&9)

This body of work will seek to enhance the understanding and delivery of preconception care in Australia.

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Chapter 1: Part 2 - The clinical components of preconception care.

1.2.a Aim

There is a comprehensive package of preconception care interventions that can be delivered in the interaction between the consumer and the health care provider. This section aims to provide an overview of the care areas to be considered in a preconception health consultation in the primary care setting in Australia. Each consultation must be considered and modified to meet the person's needs.

This paper was written to raise awareness amongst general practitioners about the need for preconception care and the domains to consider when seeing a person of reproductive age. This is a summary and update for clinicians, it also compliments the literature review of this thesis, by briefly outlining a preconception care appointment.

1.2.b Publication Details

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1.2.c Author contribution

ED was responsible for the structure and content of this review. Professor Black read and reviewed the final manuscript.

1.2.d Manuscript

Preconception care

Edwina Dorney, Kirsten Black

Background
Preconception care (PCC) entails a comprehensive suite of interventions to improve the health of potential parents, their babies and future generations. PCC is not limited to a first pregnancy, and addressing health and wellbeing is equally important in the interconception period.

Objective
The aims of this paper are to discuss the evidence for and components of PCC, as well as the role of the general practitioner in the delivery of PCC.

Discussion
It is estimated that 90% of women and over 50% of men have preconception health issues to address. Although all people stand to benefit from PCC, certain population groups experience increased risk of adverse outcomes and require more targeted attention. Although most do not present for a dedicated PCC consultation, asking about pregnancy intention can start the conversation. Evidence shows that interventions delivered in primary care can improve preconception health knowledge and reduce preconception risk factors.

PRECONCEPTION HEALTH, the health of a person before pregnancy, impacts pregnancy outcomes, childhood health and the health of future generations.[1,2] Preconception care (PCC) is the assessment, identification and intervention targeting risk factors to improve a person's health across behavioural, biomedical and social domains.[1,3]

PCC is not limited to a first pregnancy, and addressing health and wellbeing is equally important in the interconception period.[4] Evidence shows increased rates of unintended pregnancies, lower rates of preconception health behaviours and increased prevalence of risk factors with increasing parity.[5,6] In this update, the term 'PCC' relates to care before both a first and subsequent pregnancies.

Each year approximately one in 10 Australian women become pregnant.[7,8] Ninety per cent of women[9] and over half of all men have at least one preconception health issue to address to improve reproductive outcomes.[10]

Recommendations and supporting evidence for PCC

Over 80 clinical content areas have been identified as part of comprehensive PCC.[11] A checklist for PCC is provided in Table 1.

Patient-centred care and reproductive life plan

PCC is underpinned by the principles of patient-centred care and shared decision making, and discussion should focus on the individual's or couple's reproductive life plan. Tools to discuss pregnancy intention are outlined in Table 2. A detailed mental health history and review for family and intimate partner violence should also be performed.[12]

Folate supplementation

A daily folate supplement of at least 400 mcg has been demonstrated to lower neural tube defects (NTDs) by 72% compared with no supplementation.[13] Women with additional risk factors (refer to Table 1) require increased supplementation.[14] Data show that women in Australia have suboptimal rates of preconception folate supplementation, particularly younger women and women having their third or more baby.[6]

There is ongoing research to explore the most effective dose and formulation of folate for women with recurrent miscarriage and gene polymorphisms. Best practice is to ensure those without risk factors do not exceed the maximum daily intake of 1000 mcg, because this can result in elevated levels of unmetabolised folic acid.[15]

Table 1. Preconception care checklist

Reproductive health
- Family planning and reproductive life plan
  - Discussion on desired number of children (if any) and timing of pregnancies
  - Discussion about contraception options, including safety, efficacy and timing for intended pregnancies
  - Discussion about options for unintended pregnancies

Healthy eating and active living

Physical activity
- 150 min exercise per week or 30 min/day
- Pelvic floor training

Weight assessment
- Respectful and supportive assessment of weight including BMI measurement
- Advise of healthy weight range and assist with goals to achieve this
- Refer to Institute of Medicine recommendations for weight gain in pregnancy (www.health.gov.au/resources/pregnancy-care-guidelines/part-d-clinical-assessments/weight-and-body-mass-index)

Nutrient intake
- Supplementation
  - Folate 400 mcg daily or 5 mg if increased risk[A]
  - Iodine 150 mcg daily
- Adequate intake of iron, calcium, vitamin D
- Restricted intake[B]
  - Vitamin A (retinol) 800 mcg/day
  - Restricted caffeine intake (200 mg/day from all sources)
  - Mercury-containing fish[C]

Immunisation
- Review vaccination history and update for human papillomavirus, hepatitis B, varicella zoster, measles mumps rubella, pertussis, influenza and COVID-19

Infectious diseases and conditions
- Recommended screening investigations for all potential parents
  - Blood-borne viruses: HIV, hepatitis B, hepatitis C
  - STIs: syphilis
  - Infectious diseases: rubella, varicella zoster
- Recommended screening investigations determined by individual situation
  - STIs[D]: chlamydia, gonorrhoea
  - Infectious diseases[E]: cytomegalovirus
- Education
- Infectious diseases: cytomegalovirus, toxoplasmosis, parvovirus, herpes simplex virus
  - Food borne: listeriosis
  - Travel: malaria, Zika virus

Medical conditions
- Review and optimisation of pre-existing conditions; referral to specialist as required
- Diabetes: optimise glycaemic control

Psychosocial assessment
- Mental health
- Domestic and intimate partner violence
- Assessment of financial support and access to care

Parental exposure
- Alcohol
  - Ask about alcohol use with AUDIT-C tool and advise there is no safe level in pregnancy
  - Provide support for reducing alcohol intake
- Smoking and e-cigarettes
  - Ask about smoking and e-cigarette use and advise on benefits of quitting
  - Consider cessation support, including referral to Quitline or nicotine replacement therapy
- Illicit substances
  - Ask about recreational drug use and advise on benefits of quitting
  - Consider cessation support, including assistance from drug and alcohol services

Family and genetic history
- Detailed genetic history and referral to genetics counsellor for positive family history, known genetic conditions or previous affected pregnancy
- Carrier screening to be discussed

Environmental exposure
- Assess for endocrine disrupting chemicals and reproductive toxin exposures
  - Workplace: chemical, metal, gas, radiation and animal exposures
  - Household: personal care products and plastics

Medication
- Review prescription and over-the-counter medications for safety in pregnancy
  - Cease and prescribe alternative medications as required

Preventive health
- Cervical screening and breast self-examination
- Dental review

Obstetric history
- Review previous pregnancy outcomes: miscarriages, stillbirth, disorders of placentation

[A]Family history or previous pregnancy affected, body mass index (BMI) ≥30 kg/m², diabetes, on anticonvulsant medication, malabsorptive condition.

[B]For patient information resources, refer to Food Standards Australia and New Zealand for patient fact sheets (www.foodstandards.gov.au/consumer).

[C]Fish containing high levels of mercury: shark (flake), orange roughy (deep sea perch), marlin, swordfish, catfish, broadbill.

[D]For those who request a sexually transmissible infection (STI) screen, have a new sexual partner, previous STI or exposure in the past 12 months, partner from a high-risk population, those who live or travel to areas with high STI prevalence.

[E]Those with increased risk of exposure, childcare workers, those with a child in nappies attending childcare.

AUDIT-C, alcohol use disorders identification test consumption; HIV, human immunodeficiency virus.

Table 2. Tools to discuss pregnancy intention

Preconception (future pregnancies)	
One Key Question*: assesses pregnancy preferences in next 12 months	
Single question: Would you like to become pregnant in the next year?	Four possible answers:
	Yes
	I don't mind
	I'm not sure
	No
Desire to avoid pregnancy scale: assesses preference to avoid pregnancy in the next 3 months (higher score = higher desire to avoid pregnancy)	
14 questions	Answer options
I wouldn't mind it if I became pregnant in the next 3 months	Five possible answers to each question (scored 0–4): strongly agree; agree; neither agree/disagree; disagree; strongly disagree For negatively worded questions, 4 = strongly agree For positively worded questions, 4 = strongly agree
It would be a good thing for me if I became pregnant in the next 3 months	
Thinking about becoming pregnant in the next 3 months makes me feel unhappy	
Thinking about becoming pregnant in the next 3 months makes me feel excited	
Becoming pregnant in the next 3 months would bring me closer to my main partner	
I want to have a baby within the next year	
If I had a baby in the next year, it would be bad for my life	
It would be a positive addition to my life to have a baby in the next year	
It would be the end of the world for me to have a baby in the next year	
Thinking about having a baby within the next year makes me smile	
Thinking about having a baby within the next year makes me feel stressed out	
I would feel a loss of freedom if I had a baby in the next year	
If I had a baby in the next year, it would be hard for me to manage raising the child	
I would worry that having a baby in the next year would make it harder for me to achieve other things in my life	

Table continued on the next page

Non-communicable disease

The evidence supporting PCC interventions for non-communicable disease stems from the concept of fetal programming, where periconceptual health impacts health over the life course, also known as the Developmental Origins of Health and Disease (DOHaD).[16] In 2021, almost 50% of women in Australia were above a healthy weight as they entered pregnancy.[8] Increased weight leads to a greater risk of gestational diabetes, hypertensive disorders and pre-eclampsia.[17] For women who gain weight between pregnancies, these risks further increase in a dose-dependent manner, with women whose body mass index increased by ≥3 kg/m^2 having the higher risk.[18]

Empowering women with type 1 and type 2 diabetes, by providing support and tailored education about the benefits of glycaemic control (target HbA1c <6.5%), can reduce the risk of congenital malformations.[19,20] Contraception should be considered until blood sugar levels are stabilised.[21] Review for micro- and macrovascular comorbidities should be performed. For women with gestational diabetes in a previous pregnancy, testing to ensure normalisation of blood sugars at 6–12 weeks postpartum is required. Women with elevated blood sugar levels require ongoing surveillance and assessment for type 2 diabetes, with management depending on future pregnancy plans.

Smoking, alcohol and other drugs

Smoking remains an important preventable risk factor for preterm birth, low birthweight and perinatal death. Up to 22% of women smoke in the preconception and early pregnancy period, with higher rates among First Nations people, younger people and people living in rural and remote areas.[22] The use of e-cigarettes is increasing, with the largest increase in those aged 18–24 years.

Table 2. Tools to discuss pregnancy intention (cont'd)

Pregnancy and postpartum (current or recent pregnancy)	
Single question of pregnancy intention: Is/was this pregnancy planned?	Two possible answers: Yes No
London measure of unplanned pregnancy	
Six questions:	Answer options (scored 0–2)
In the month that I became pregnant 0 – Always used contraception 1 – Sometimes used contraception 2 – Did not use contraception	Three possible answers to each question Scores 0–9 unintended Scores 10–12 intended
In terms of becoming a mother 0 – Wrong time 1 – Okay, but not quite the right 2 – Right time	
Just before I became pregnant 0 – Did not intend to get pregnant 1 – My intentions kept changing 2 – I intended to get pregnant	
Just before I became pregnant 0 – Did not want a baby 1 – Mixed feelings about a baby 2 – Wanted a baby	
Before pregnancy, had you and your partner 0 – Never discussed pregnancy 1 – Discussed, but no firm agreement 2 – Agreed to get pregnant	
Preparation for pregnancy 0 – No actions 1 – One action 2 – Two or more actions	

The effects of vaping in pregnancy remain unknown, but many e-cigarettes contain harmful substances and their use during pregnancy and preconception is not recommended.[23,24]

Approximately 77% of adults in Australia drink alcohol.[25] There is no safe level of alcohol consumption in the preconception period or during pregnancy, and it is recommended that any person planning a pregnancy abstains from alcohol.[26] Research shows that almost all women expect their healthcare provider to talk about alcohol when planning a pregnancy.[27] The alcohol use disorders identification test consumption (AUDIT-C) tool is a validated tool to assess alcohol intake in the preconception and pregnancy period, and resources are available from the Foundation for Alcohol Research and Education (FARE) to assist clinicians and consumers with this topic.[28] Recreational and other illicit drug use also needs to be assessed, because many of these drugs can cross the placenta and impact fetal brain development.[29] Education should be provided on the benefits of quitting and strategies to achieve this.

Genetic carrier screening

Inherited conditions affect up to one in 400 people in Australia. A detailed family history must be taken to assess the likelihood of an inherited genetic condition and appropriate testing arranged. If there is a family history, or if a person is from Eastern European (Ashkenazi) Jewish background, referral to a genetic counsellor is recommended. Carrier screening is relevant to all people considering pregnancy and is outlined in Table 3.[30] Medicare rebates for cystic fibrosis, spinal muscular atrophy and fragile X screening are available since November 2023. The Royal Australian College of General Practitioners (RACGP) education module *Beware the rare* provides general practitioners (GPs) with additional education in this area.[31]

Medical history and medications

A thorough medical history should be taken, and any medical conditions optimised prior to pregnancy. Contraception should be offered

where appropriate while stabilising chronic conditions. All medications, both prescription and complementary, should be reviewed, considering the drug indication, dosing, route of administration and alternatives to ensure there is no or least risk to a developing fetus. Teratology information resources are available to assist in decision making, with examples including Reprotox (https://reprotox.org) and the Teratogen Information Service (https://uktis.org). Mothersafe (www.royalwomen.org.au/mothersafe) is an example of a local teratogen information service for consumers and health professionals in New South Wales.

Previous pregnancy outcomes

Previous pregnancy outcomes can inform risk factor modification and interventions in the interconception period. Disorders of placental insufficiency, such as intra-uterine growth restriction, pre-eclampsia or gestational diabetes, might require targeted interpregnancy diet and exercise goals, and education for early antenatal intervention in subsequent pregnancies.

Preventive health and screening, including sexually transmissible infections and infectious diseases

All potential parents should be educated about infectious diseases and have a review of their vaccination history for measles, mumps, rubella, varicella zoster, diphtheria, tetanus and pertussis and hepatitis B undertaken. Serological testing is recommended to confirm immunity to varicella, rubella and hepatitis B. Required vaccinations should be provided, including information to wait 28 days after rubella and varicella vaccinations before conceiving.[32,33] Syphilis, human immunodeficiency virus (HIV) and hepatitis C testing should be routinely performed, with other sexually transmissible infection testing determined on individual risk (Table 1).

Although routine screening for cytomegalovirus (CMV) is not currently listed in preconception care guidelines, CMV education and prevention are priority areas of pregnancy planning.[34] CMV can cross the placenta and is the most common congenital infection, affecting up to 2000 babies annually.[35] Fewer than one in five women of reproductive age know about CMV, and this

Table 3. Genetic carrier screening

Preconception and pregnancy		
All people planning a pregnancy, and pregnant, should be provided with information on genetic carrier screening		
Three-gene panel		
Genetic conditions screened: spinal muscular atrophy, cystic fibrosis, fragile X	Considerations • 5% of individuals will carry a gene • 1 in 240 couples affected • Medicare rebate available	
Expanded panel		
Genetic conditions screened: >400, >500, >1000 gene options	Considerations • 75% of individuals will carry a gene • 1 in 20 couples affected • Medicare rebate only for spinal muscular atrophy, cystic fibrosis and fragile X testing	
Offering the test		
Sequential: one person offered screening; screen partner as indicated	Couple screening: both people screened	
Potential pathways for individual or couple with confirmed genes		
Preconception • Spontaneous conception • IVF, own sperm and egg, with pre-implantation genetic diagnosis • IVF, donor sperm or egg from non-carriers • Decision to not have a pregnancy	Pregnant (antenatal testing) • No antenatal testing • CVS from 11 weeks • Amniocentesis from 15 weeks	Postpartum • Postnatal testing on baby (newborn screening)

CVS, chorionic villus sampling; IVF, in vitro fertilisation.

improves with provision of CMV education resources.[36] Individual risk assessment and screening should be performed for women with a risk of exposure, such as childcare workers and those with young children in childcare. All women should be educated about hygiene measures to reduce their risk of infection.

Preventive health measures such as breast self-examination, the importance of good oral health and cervical screening should be discussed. Recent changes to the National Cervical Screening Program now enable all people to access self-collection as a means for cervical screening.

Role of the GP in PCC

The prepregnancy period can range from a minimum of three months to years to improve behaviours and health.[37,38] Given this, the International Federation of Obstetricians and Gynaecologists (FIGO) has called for all healthcare professionals who see people of reproductive age to deliver PCC.[39] Australian studies show that both clinicians and consumers believe that GPs are well placed to deliver PCC.[40,41]

Barriers to delivering PCC include low levels of community awareness, a lack of presentations for a dedicated PCC appointment and high rates of unintended pregnancies.[42,43] For clinicians, barriers include a lack of time, other competing preventive health priorities and a lack of available resources to help facilitate the delivery of PCC.[40,44]

Asking about pregnancy intention can start the conversation about PCC, including contraception options for those who do not intend to become pregnant. A pilot study in Australian GPs found that using the One Key Question® to ask about pregnancy intention was acceptable to women attending for non-preconception consultations.[41] GPs found the tool easy to use, with a median consultation extension time of two minutes.[41] Other enablers to the delivery of PCC include checklists and high-quality clinical practice guidelines. A recent systematic review of clinical practice guidelines for PCC identified only 11 guidelines internationally, with two from Australia, from the RACGP and The Royal Australian and New Zealand College of Obstetricians and Gynaecologists.[45] Evidence exploring the effectiveness of PCC interventions delivered in primary care showed impact for brief interventions in improving a person's preconception health knowledge and reducing their preconception risk factors.[46]

PCC is a shared responsibility from the population level down to the individual. The Preconception Health Network Australia is a multidisciplinary collaboration established to promote best practice in preconception healthcare and research and to drive policy change. Priorities and enablers identified by the Network are outlined in Table 4. The Network works with GPs to enhance the delivery of PCC for all Australians.

Key points

- PCC benefits parents, their children and future generations.
- Challenges to delivering PCC include low levels of community awareness of the importance of preconception health and low numbers of presentations for PCC.
- GPs are ideally placed to deliver PCC, and this can begin with a discussion on pregnancy intention.
- PCC is not only for first pregnancies, and previous pregnancy outcomes need to be reviewed.

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Table 4. Priorities and enablers for preconception care in primary care

For consumers
• Health promotion activities to increase awareness among consumers
• Improved equity of access to care for preconception and contraception consultations
For clinicians
• Health promotion activities to increase awareness among clinicians
• Available clinical guidelines to support delivery of high-quality, evidence-based care
• Available resources of appropriate health literacy to support delivery of preconception care
• Financial support and health service reform including Medicare rebates for primary care, and practice nurses to enable the timely delivery of preconception care
For policy makers
• Data collection on preconception health and care indicators to allow deidentification and monitoring of policy for preconception health and care
• Socioecological enablers for positive healthy eating and active living behaviour change, such as sugar taxes and increased access to green spaces

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Table 1. Preconception care checklist
Reproductive health
Family planning and reproductive life plan
Discussion on desired number of children (if any) and timing of pregnancies
Discussion about contraception options, including safety, efficacy and timing for intended pregnancies
Discussion about options for unintended pregnancies
Healthy eating and active living
Physical activity
150 min exercise per week or 30 min/day
Pelvic floor training
Weight assessment
Respectful and supportive assessment of weight including BMI measurement
Advise of healthy weight range and assist with goals to achieve this including behaviour change support services
Refer to Institute of Medicine recommendations for weight gain in pregnancy
Nutrient intake
Supplementation
Folate 400 mcg daily or 5 mg if increased risk[A]
Iodine 150 mg daily
Adequate intake of iron, calcium, vitamin D
Restricted intake[B]
Vitamin A (retinol) 800 mcg/day
Restricted caffeine intake (200 mg/day from all sources)
Mercury-containing fish[C]
Immunisation
Review vaccination history and update for human papilloma virus, hepatitis B, varicella zoster, measles mumps rubella, pertussis, influenza and COVID-19
Infectious diseases and conditions
Recommended screening investigations for all potential parents
Blood-borne viruses: HIV, hepatitis B, hepatitis C
STIs: syphilis
Infectious diseases: rubella, varicella zoster
Recommended screening investigations determined by individual situation
STIs[D]: chlamydia, gonorrhoea
Infectious diseases[E]: cytomegalovirus
Education
Infectious diseases: cytomegalovirus, toxoplasmosis, parvovirus, herpes simplex virus
Food borne: listeriosis
Travel: malaria, Zika virus
Medical conditions
Review and optimisation of pre-existing conditions; referral to specialist as required
Diabetes: optimise glycaemic control
Psychosocial assessment
Mental health
Domestic and intimate partner violence
Assessment of financial support and access to care
Parental exposure
Alcohol
Ask about alcohol use with AUDIT-C tool and advise there is no safe level in pregnancy
Provide support for reducing alcohol intake
Smoking and e-cigarettes
Ask about smoking and e-cigarette use and advise on benefits of quitting
Consider cessation support, including referral to cessation support services or nicotine replacement therapy
Illicit substances
Ask about recreational drug use and advise on benefits of quitting
Consider cessation support, including assistance from drug and alcohol services
Family and genetic history
Detailed genetic history and referral to genetics counsellor for positive family history, known genetic conditions or previous affected pregnancy
Carrier screening to be discussed
Environmental exposure
Assess for endocrine disrupting chemicals and reproductive toxin exposures
Workplace: chemical, metal, gas, radiation and animal exposures
Household: personal care products and plastics
Medication
Review prescription and over-the-counter medications for safety in pregnancy
Cease and prescribe alternative medications as required

Preventive health
Cervical screening and breast checks
Dental review
Obstetric history
Review previous pregnancy outcomes: miscarriages, stillbirth, disorders of placentation

[A]Family history or previous pregnancy affected, body mass index (BMI) ≥30 kg/m^2, diabetes, on anticonvulsant medication, malabsorptive condition.
[B]For patient information resources, refer to Food Standards Australia and New Zealand for patient fact sheets.
[C]Fish containing high levels of mercury: shark (flake), orange roughy (deep sea perch), marlin, swordfish, catfish, broadbill.
[D]For those who request a sexually transmissible infection (STI) screen, have a new sexual partner, previous STI or exposure in the past 12 months, partner from a high-risk population, those who live or travel to areas with high STI prevalence.
[E]Those with increased risk of exposure, childcare workers, those with a child in nappies attending childcare.
AUDIT-C, alcohol use disorders identification test consumption.

Table 2. Tools to discuss pregnancy intention	
Preconception (future pregnancies)	
One Key Question*: assesses pregnancy preferences in next 12 months	
Single question: Would you like to become pregnant in the next year?	Four possible answers: Yes I don't mind I'm not sure No
Desire to avoid pregnancy scale: assesses preference to avoid pregnancy in next 3 months (higher score = higher desire to avoid pregnancy)	
14 questions	Answer options
I wouldn't mind it if I became pregnant in the next 3 months	Five possible answers to each question (scored 0–4): strongly agree; agree; neither agree/disagree; disagree; strongly disagree For negatively worded questions, 4 = strongly agree For positively worded questions, 4 = strongly agree
It would be a good thing for me if I became pregnant in the next 3 months	
Thinking about becoming pregnant in the next 3 months makes me feel unhappy	
Thinking about becoming pregnant in the next 3 months makes me feel excited	
Becoming pregnant in the next 3 months would bring me closer to my main partner	
I want to have a baby within the next year	
If I had a baby in the next year, it would be bad for my life	
It would be a positive addition to my life to have a baby in the next year	
It would be the end of the world for me to have a baby in the next year	
Thinking about having a baby within the next year makes me smile	
Thinking about having a baby within the next year makes me feel stressed out	
I would feel a loss of freedom if I had a baby in the next year	
If I had a baby in the next year, it would be hard for me to manage raising the child	
I would worry that having a baby in the next year would make it harder for me to achieve other things in my life	
Pregnancy and postpartum (current or recent pregnancy)	
Single question of pregnancy intention: Is/was this pregnancy planned?	Two possible answers: Yes No
London measure of unplanned pregnancy	
Six questions:	Answer options
In the month that I became pregnant	Three possible answers to each question (scored 0–2):
0 – Always used contraception	Scores 0–9 unintended
1 – Sometimes used contraception	Scores 10–12 intended
2 – Did not use contraception	
In terms of becoming a mother	
0 – Wrong time	
1 – Okay, but not quite the right	
2 – Right time	
Just before I became pregnant	
0 – Did not intend to get pregnant	

1 – My intentions kept changing	
2 – I intended to get pregnant	
Just before I became pregnant	
0 – Did not want a baby	
1 – Mixed feelings about a baby	
2 – Wanted a baby	
Before pregnancy, had you and your partner	
0 – Never discussed pregnancy	
1 – Discussed, but no firm agreement	
2 – Agreed to get pregnant	
Preparation for pregnancy	
0 – No actions	
1 – One action	
2 – Two or more actions	

Table 3. Genetic carrier screening

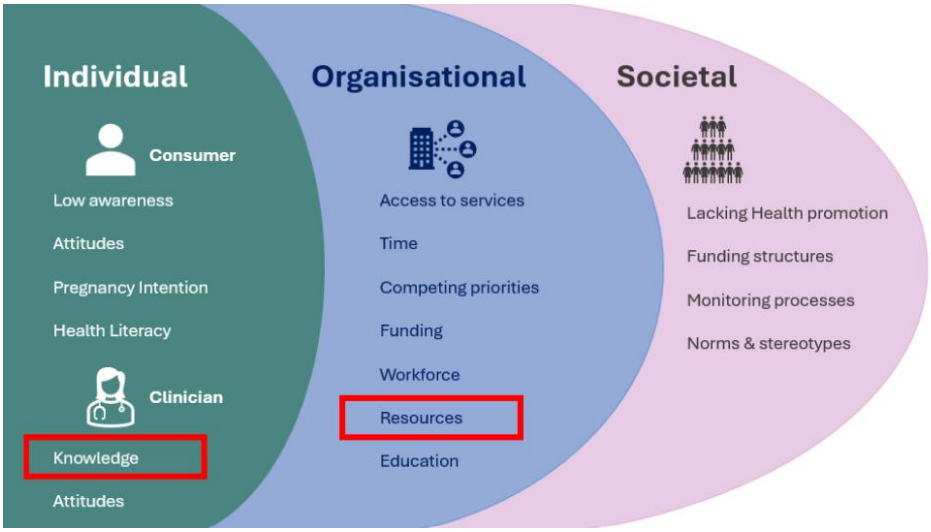
Preconception and pregnancy		
All people planning a pregnancy and pregnant should be provided with information on genetic carrier screening		
Three-gene panel		
Genetic conditions screened: spinal muscular atrophy, cystic fibrosis, fragile X	Considerations • 5% of individuals will carry a gene • 1 in 240 couples affected • Medicare rebate available	
Expanded panel		
Genetic conditions screened: >400, >500, >1000 gene options	Considerations • 75% of individuals will carry a gene • 1 in 20 couples affected • Medicare rebate only for spinal muscular atrophy, cystic fibrosis and fragile X testing	
Offering the test		
Sequential: One person offered screening; screen partner as indicated	Couple screening: both people screened	
Potential pathways for individual or couple with confirmed genes		
Preconception	Pregnant (antenatal testing)	Postpartum
• Spontaneous conception • IVF, own sperm and egg, with pre-implantation genetic diagnosis • IVF, donor sperm or egg from non-carriers • Decision to not have a pregnancy	• No antenatal testing • CVS from 11 weeks • Amniocentesis from 15 weeks	• Postnatal testing on baby (newborn screening)
CVS, chorionic villus sampling; IVF, *in vitro* fertilisation.		

Table 4. Priorities and enablers for preconception care in primary care
For consumers
Health promotion activities to increase awareness among consumers
Improved equity of access to care for preconception and contraception consultations
For clinicians
Health promotion activities to increase awareness among clinicians
Available clinical guidelines to support delivery of high-quality, evidence-based care
Available resources of appropriate health literacy to support delivery of preconception care
Financial support and health service reform including Medicare rebates for primary care, and practice nurses to enable the timely delivery of preconception care
For policy makers
Data collection on preconception health and care indicators to allow deidentification and monitoring of policy for preconception health and care
Socioecological enablers for positive healthy eating and active living behaviour change, such as fiscal and regulatory measures to support healthy food choices including taxes and improvements to the built environment to support physical activity

Chapter 2: Guidelines for preconception care

2.1 Chapter Aim

Clinical practice guidelines (CPGs) are evidence-based documents that can assist health care providers to deliver high-quality clinical care. A lack of CPGs for preconception care is a barrier at the organisational level. Availability of CPGs can also influence the barrier of lack of knowledge for clinicians at the individual level.



This systematic review sought to identify existing, freely accessible, international CPGs for preconception care. It assesses guideline quality by using the AGREE II tool and assesses the summary recommendations and the evidence level on which they are based.

2.2 Publication details

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2.3. Author contribution

ED was responsible for the design and registration of the Systematic review. ED led the search, screening, and data extraction. ED led the writing of the manuscript. All authors read and approved the final manuscript.

2.4 Manuscript

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A Systematic Review of Clinical Guidelines for Preconception Care

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Abstract

Preconception care (PCC) involves a wide-ranging set of interventions to optimize health prior to pregnancy. These interventions seek to enhance conception rates, pregnancy outcomes, childhood health, and the health of future generations. To assist health care providers to exercise high-quality clinical care in this domain, clinical practice guidelines from a range of settings have been published. This systematic review sought to identify existing freely accessible international guidelines, assess these in terms of their quality using the AGREE II tool, and assess the summary recommendations and the evidence level on which they are based. We identified 11 guidelines that focused on PCC. Ten of these were classified as moderate quality (scores ranging from 3.5 to 4.5 out of 7) and only one was classified as very high quality, scoring 6.5. The levels of evidence for recommendations ranged from the lowest possible level of evidence (III) to the highest (I-a): the highest quality evidence available is for folic acid supplementation to reduce risk of neural tube defects and the role of antiviral medication to prevent HIV transmission. This systematic review identified that high-quality guidelines on PCC are lacking and that few domains of PCC recommendations are supported by high-quality evidence.

Keywords

- preconception
- pre-pregnancy
- clinical practice guideline
- policy
- systematic review

What Is Preconception Care and Why Is It Important?

Preconception care (PCC) entails a comprehensive set of interventions that aim to optimize health prior to pregnancy.[1] These include the identification, education, and modification of behavioral, biomedical, and social risk factors that can adversely affect the health of parents and their offspring.[2] While many women seek care when pregnant, interventions delivered during pregnancy alone

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do not achieve the best health outcomes for women and their babies.[3] Optimizing the health of women and their partners prior to pregnancy improves conception rates, pregnancy outcomes, childhood health, and the health of future generations.[3]

Who Needs Preconception Care?

While the entire population stands to benefit from good preconception health, certain priority groups endure higher risk and therefore require targeted attention. Priority populations are considered to be populations that experience health inequity and disadvantage in accessing health care.[4] This can be due to demographic, social, and cultural factors, and the broader social determinants of health. Priority populations experience increased rates of adverse health outcomes, and their needs must be recognized in the health service delivery and policy implementation to reduce health disparities.[4]

However, several barriers have been identified in the delivery of PCC for those who are able to access it. In the primary care setting, these barriers include time constraints, lack of access to health care providers, and a lack of resources for assisting in the delivery of PCC.[5,6]

Clinical Practice Guidelines and Impact on Clinical Care

In 2008, the clinical workgroup for the select panel on PCC identified over 80 clinical content areas to be addressed in PCC.[7] Given there is such range of care areas to be covered in the provision of PCC, education and resources for health care providers are required to facilitate the provision of PCC. Clinical practice guidelines (CPGs) are evidence-based resources designed to assist health care providers deliver high-quality clinical care.[8] They promote supported, shared decision making for specific clinical scenarios. High-quality, accessible CPGs can enhance the delivery of PCC by providing health care providers with evidence-based recommendations and increase consistency of care.[9] Global resources that facilitate the sharing of knowledge and information have been suggested as a means to improve education and support practitioners in low- and middle-income countries to deliver PCC.[10]

Rationale and Objectives

This systematic review aims to identify and assess the quality of existing CPGs for PCC. It also aims to appraise the level of evidence underpinning these guidelines and assess if they support the delivery of equitable PCC by incorporating the needs of priority populations. The findings can inform strategies to improve delivery of comprehensive PCC.

Methods

This review was registered with the International Prospective Register of Systematic Reviews (PROSPERO, CRD420212 68130) and follows the recommendations in the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA-2020) guidelines.[11]

Inclusion Criteria

CPGs, or documents providing guidance on PCC to health care providers, such as consensus or position statements from a national or international organization, were eligible for inclusion if they were evidence based (reference list available), published since 2008 in English, or an English translation was available, and freely accessible to an international audience. Documents authored by private organizations or that were local or regional in their focus were excluded. Eligible documents were grouped into five categories determined by their practical application for the health care providers providing PCC.

Search Strategy

We conducted a systematic, online search across four academic health databases (OVID Medline, EBM Reviews Complete, EMBASE, and CINAHL), nine international clinical guideline registers (National Institute for Health and Care Excellence [NICE] Guidelines, Scottish Intercollegiate Guideline Network, National Guideline Clearinghouse [Agency for Healthcare and Research Quality], National Health and Medical Research Council Australia Guidelines Portal, International Guidelines Registry, World Health Organization, International Practice Guideline Registry Platform, Geneva Foundation for Medical Education and Research—Obstetrics and Gynecology Guidelines), ten related professional organizations (Centers for Disease Control and Prevention [CDC], National Academy of Medicine [NAM], American College of Obstetricians and Gynaecologists [ACOG], American Academy of Family Physicians [AAFP] Royal College of Obstetricians and Gynaecologists [RCOG] United Kingdom [UK], Faculty of Sexual and Reproductive Health UK, College of Family Physicians of Canada, Royal Australian and New Zealand College of Obstetricians and Gynaecologists [RANZCOG], Royal Australian College of General Practitioners [RACGP], Federation of Obstetric and Gynecologic Societies of India [FOGSI]), and two widely available online platforms (Google and Google Scholar).

Professional organizations searched were in the fields of primary care, reproductive health, public health, or family medicine, from the United States, the United Kingdom, Canada, Australia, and India. These professional organizations were selected as they are organizations from nations with a demonstrated interest in PCC and established PCC programs. The complete list of search terms used for PCC and CPGs for each platform is outlined in **Supplementary Material A** (online only). Search terms were adjusted to align with different database requirements. Searches were conducted in August 2021.

Review Process

Titles and abstracts were screened by two independent reviewers (E.D. and R.W., K.H., or L.M.) and any conflicts resolved by a third reviewer (K.I.B.). Full-text review was conducted by E.D. and R.W., K.H., or L.M., and any conflicts were again resolved by K.I.B. Reference lists and available supplementary files for CPGs were examined to identify any additional documents for inclusion.

Assessment of Guideline Quality

The AGREE-II tool was used to assess the quality of each guideline.[12] The AGREE II tool assesses 23 aspects of guideline quality across six domains, and two overall assessments of guideline quality with a maximum possible score of 7. Three reviewers appraised each guideline (E.D. and R.W., K.H., or K.I.B.). AGREE-II domain scores were calculated individually, and all domains were weighted equally. The threshold for determining a high-quality domain score was set at greater than 80% (equates to domain scores of 5.5–6) as adopted by other studies using the AGREE II tool.[13,14]

Data Extraction

The following data were extracted from each document: guideline authorship and publication information, target population, inclusion of men, inclusion of priority populations, consumer input, and summary of recommendations.

Table 1 Level of evidence and grade of recommendation

Level of evidence	
I-a	Evidence was obtained from at least one properly conducted randomized controlled trial that was done before pregnancy
I-b	Evidence was obtained from at least one properly conducted randomized controlled trial that was done not necessarily before pregnancy
II-1	Evidence was obtained from well-designed controlled trials without randomization
II-2	Evidence was obtained from well-designed cohort or case–control analytic studies, preferably from one center of research
II-3	Evidence was obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments could also be re-graded as this type of evidence
III	Opinions were gathered from respected authorities, based on clinical experience, descriptive studies and case reports, or reports of expert committees
Grade of recommendation	
A	There is good evidence to support the recommendation that the condition be considered specifically in a PCC evaluation
B	There is fair evidence to support the recommendation that the condition be considered specifically in a PCC evaluation
C	There is insufficient evidence to recommend for or against the inclusion of the condition in a PCC evaluation, but recommendation to include or exclude may be made on other grounds
D	There is fair evidence to support the recommendation that the condition be excluded in a PCC evaluation
E	There is good evidence to support the recommendation that the condition be excluded in a PCC evaluation

Assessment of Level of Evidence

We assessed the level of evidence informing each recommendation and determined the grade of each recommendation. For recommendations that were not directly referenced within the text, the reference list for the guideline document was searched and all related citations assessed. For consistency and comparison, we used the criteria shown in ►**Table 1** which was previously employed in a review of the components of PCC to assess the levels of evidence for each recommendation.[15] Each component was extracted by one reviewer (E.D.), and cross-checked by a second reviewer (J.A.B.).

Results

Guideline Identification and Selection

Searches identified 6,340 documents for screening. Of these, five documents were found in searches across international guideline registers and three on professional organizations' Web sites. Of the 188 documents selected for full-text review, 8 could not be retrieved. Some CPGs were not freely available to an international audience including two CPGs focused on PCC, one from China,[16] and the NICE Clinical Knowledge Summary on PCC from the United Kingdom.[17] A further 110 documents were excluded with reasons shown in ►**Fig. 1**. The remaining 70 documents were classified under the following headings determined by their content and how they are relevant to health care providers.

- PCC-focused CPG.
- Relevant but not a focused PCC CPG.
- Condition-specific CPG with a brief section on PCC.
- Condition-specific CPG with a comprehensive section on PCC.
- Health behavior issue that can be incorporated in PCC.

Given the variation in these guideline categories, and the extensive processes required to analyze their content, we limited our analysis for the current review to the 11 documents identified as PCC-focused CPGs.

Characteristics of PCC-Focused CPGs

The characteristics of the 11 PCC CPGs are shown in ►**Table 2**. Five documents were from the United States,[18–22] two each from Canada[23,24] and Australia,[25,26] one from India,[27] and one was an international collaboration from the International Federation of Obstetrics and Gynecology (FIGO).[28] Four guidelines had limited scope with two offering guidance on Zika virus only,[21,22] one guideline related to non-communicable diseases,[28] and one for people living with human immunodeficiency virus (HIV).[23] Three included guidance specifically for priority populations,[23,24,26] three acknowledged additional needs of priority populations,[19,27,28] and the remaining five guidelines did not differentiate care for priority populations.[18,20–22,25]

Assessment of Guideline Quality

The scaled scores for each domain of the AGREE-II tool are shown in ►**Table 3**. There was significant variation in all aspects of guideline quality, with the minimum range of 47

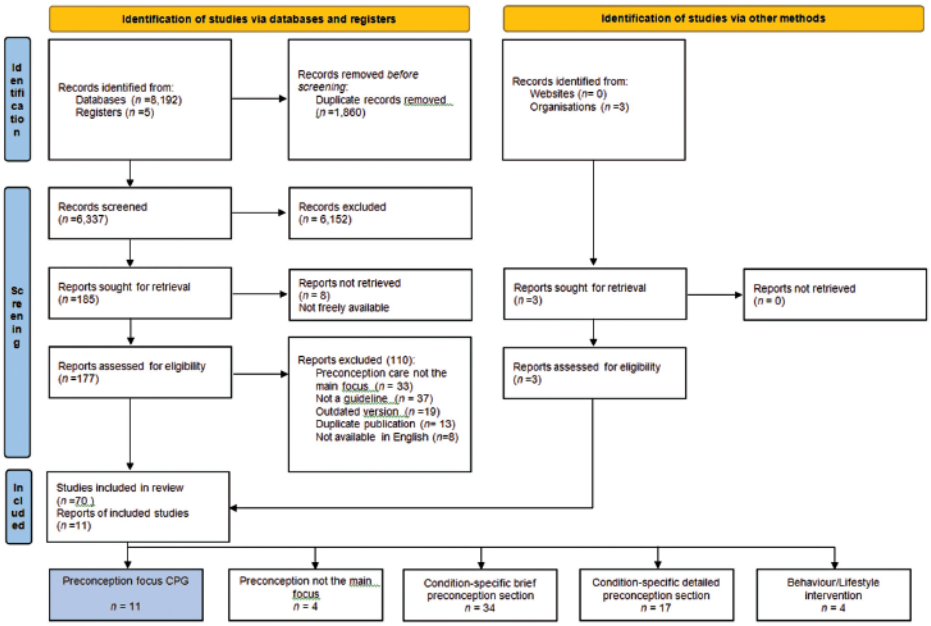

Fig. 1 Search results of international clinical practice guidelines for preconception care.

percentage points across the six domain scores. Domain 6, Editorial Independence, had the widest range of 86 percentage points. Domain 3, Rigor of Development, and domain 5, Applicability, were the lowest scoring domains across the sample.

Ten guidelines were classified of moderate quality (overall assessment: 3.5–4.5) with only one guideline classified as very high-quality scoring (6.5).

Guideline Content

The content and number of recommendations varied significantly across the guidelines. The number of recommendations from the CPGs ranged from 2 to 113 (►**Table 4**), which posed some challenges in drawing comparisons and summarizing the guideline advice. Given this variation, an analysis was made using the previously defined 82 clinical content areas of PCC and is shown in ►**Table 5**.[7] Only one new clinical content area of Zika virus was identified, bringing the total number of content areas to 83 (the guideline with 113 recommendations had several recommendations within a given content area). No CPG addressed all 83 content areas, and the range of content areas addressed ranged from 3 to 58.

Assessment of Level of Evidence

The level of evidence supporting each recommendation within each guideline is shown in ►**Table 4** (the full data extraction template is available in **Supplementary Material B** [online only]). Where a CPG referenced a lower level of evidence to support a recommendation, even when there is known higher-level evidence to support the recommendation (e.g., a level III document was cited, rather than a level I-a), the cited level of evidence was used. Where a CPG referenced the document by Jack et al on the clinical content of PCC,[7] we used the stated level of evidence within this document, as the lead author (B.J.) is an author for this review and we could be certain of the level of evidence. Where a CPG had more than one content area within a recommendation, the range of the level of evidence was provided, with documentation of the content area that had the highest level of evidence. One guideline could not be assessed because it did not reference its recommendations and had a limited reference list.[27]

Given that there was significant variation in the phrasing and categorization of recommendations across the 11 included CPGs, data for the levels of evidence have been reported in the following ways: level of evidence within a given CPG (►**Table 4**), and level of evidence to support each clinical content area of PCC (►**Table 5**). The levels of evidence in ►**Table 5** were compared with the levels of evidence for each clinical content area reported in 2008[7] to assess if there has been advancement in the evidence to support PCC. This occurred across the six clinical content areas of family planning and reproductive life planning, weight status, HIV, diabetes mellitus, vitamin D, and Zika virus.

The levels of evidence ranged from I-a to III with the highest quality evidence available for folic acid supplementation to reduce the risk of neural tube defects and antiviral medication to prevent HIV transmission.

Table 2 Characteristics of the included guidelines

Guideline title	Year of publication	Authorship/Organization	Intended audience	General or specific scope of guidance	Inclusion of men	Inclusion of priority populations	Consumer input
Prevention of non-communicable diseases by interventions in the preconception period: a FIGO position paper for action by healthcare practitioners	2020	Jacob et al[28] International Journal of Gynecology and Obstetrics	All health care providers, health care delivery organizations, public health policy makers	Specific Non-communicable diseases	Yes	Acknowledged (social determinants of health, LMICs)	No
Committee opinion no. 762: Prepregnancy counselling	2019	ACOG	Obstetricians and gynecologists	General	Acknowledged	Acknowledged LGBTQIA+, socioeconomic status	No
Zika virus and sexual transmission: updated preconception guidance	2018	Chen LH and Hamer DH Journal of Travel Medicine	Travel medicine specialists	Specific Zika virus	Yes	No	No
No. 354—Canadian HIV pregnancy planning guidelines	2018	Loutfy M et al Journal of obstetrics and gynecology Canada	All health care providers seeing women and men of reproductive age living with HIV	Specific People living with HIV	Yes	Yes Social determinants of health, sexual diversity, ethnocultural backgrounds and religion	No
Update: Interim guidance for preconception counselling and prevention of sexual transmission of Zika virus for men with possible Zika virus exposure - United States, August 2018	2018	Polen KD et al Morbidity and mortality weekly report; USA	Medical professionals	Specific Zika virus	Yes	No	No
Preconception care in family-centered maternity and newborn care: national guidelines	2018	PHAC	All health care providers, community health centers, allied health	General	Yes	Yes Social determinants of health, indigenous, ethnocultural backgrounds, LGBTQ	No
Pre-pregnancy counselling (G-Obs3a)	2017	RANZCOG	All health care providers providing care to women before pregnancy	General	No	No	Yes
Guidelines for preventive activities in general practice	2017	RACGP	Family physicians	General	No	Yes Indigenous, CALD, rural and remote, socioeconomic status	No
Good clinical practice recommendations on preconception care	2016	FOGSI	All health care providers seeing women and men of reproductive age	General	Yes	Acknowledged Socioeconomic status	No
Preconception care (position paper)	2015	AAFP	Family physicians	General	Yes	No	No
Recommendations for preconception counselling and care	2013	Farahi N and Zolotor A American Family Physician	Family physicians	General	No	No	No

Abbreviations: AAPF, American Academy of Family Physicians; ACOG, American College of Obstetricians and Gynecologists; CALD, culturally and linguistically diverse; FOGSI, Federation of Obstetric Gynecological Societies of India; LGBTQ, lesbian, gay, bisexual, queer; LGBTQIA+, lesbian, gay, bisexual, queer, intersex, asexual, and gender nonconforming; LMICs, low- and middle-income countries; PHAC, Public Health Agency of Canada; RACGP, Royal Australian College of General Practitioners; RANZCOG, Royal Australian and New Zealand College of Obstetrics and Gynecology.

Table 3 Scaled AGREE-II domain scores and overall guideline assessment

Guideline	Domain 1 Scope and purpose	Domain 2 Stakeholder involvement	Domain 3 Rigor of development	Domain 4 Clarity of presentation	Domain 5 Applicability	Domain 6 Editorial independence	Overall assessment score out of 7
Jacob et al: Prevention of noncommunicable diseases by interventions in the preconception period: a FIGO position paper for action by healthcare practitioners	78%	59%	27%	80%	29%	86%	4.0
ACOG: Committee opinion no. 762: prepregnancy counselling	91%	39%	6%	65%	18%	0%	4.5
Chen and Hamer: Zika virus and sexual transmission: updated preconception guidance	76%	17%	25%	83%	21%	50%	4.0
Loutfy et al: No. 354-Canadian HIV pregnancy planning guidelines	100%	89%	72%	98%	64%	83%	6.5
Polen et al: Update: interim guidance for preconception counselling and prevention of sexual transmission of Zika virus for men with possible Zika virus exposure - United States, August 2018	94%	24%	28%	65%	11%	61%	4.0
PHAC: preconception care in family-centered maternity and newborn care: National guidelines	48%	63%	24%	54%	25%	0%	4.0
RANZCOG: pre-pregnancy counselling (C-Obs3a)	58%	54%	24%	51%	9%	81%	3.5
RACGP: guidelines for preventive activities in general practice	72%	53%	17%	61%	6%	54%	4.0
FOGSI: good clinical practice recommendations on preconception care	69%	24%	19%	80%	13%	0%	3.5
AAFP: preconception care (position paper)	43%	30%	15%	69%	15%	0%	3.5
Farahi et al: recommendations for preconception counselling and care	63%	50%	26%	67%	3%	17%	4.5

Table 4 Level of evidence and grade of recommendations

Guideline title	Number of recommendations	Number of references	Level of included evidence	Grade of recommendations
Jacob et al: Prevention of noncommunicable diseases by interventions in the preconception period: a FIGO position paper for action by healthcare practitioners	10	77	I-b–III	A
ACOG: Committee opinion no. 762: prepregnancy counselling	16	75	II-2–III	A–C
Chen and Hamer: Zika virus and sexual transmission: updated preconception guidance	2	11	II-3	A
Loutfy et al: No. 354 - Canadian HIV pregnancy planning guidelines	36	103	I-a–III	A–C
Polen et al: update: interim guidance for preconception counselling and prevention of sexual transmission of Zika virus for men with possible Zika virus exposure - United States, August 2018	5 scenario-based recommendations	42	II-3	A
PHAC: preconception care in family-centered maternity and newborn care: National guidelines	12	228	I-a–III	A–B
RANZCOG: pre-pregnancy counselling (C-Obs3a)	4	13	II-2–III	A–B
RACGP: guidelines for preventive activities in general practice	15	39	I-a–III	A–B Unable to assess all[a]
FOGSI: good clinical practice recommendations on preconception care	113	8	Unable to assess[b]	Unable to assess[b]
AAFP: preconception care (position paper)	17 (women) 10 (men)	74	I-a–III	A–C
Farahi and Zolotor[20]: recommendations for preconception counseling and care	7	57	I-a–III	A–B

[a]Unable to assess with the specified criteria of this systematic review. Level of evidence and grade of recommendation provided within the guideline.
[b]Not all recommendations were referenced and some were unable to be graded.

Table 5 Components of PCC included in CPGs

Component of PCC (number of recommendations)	Documented level of evidence from Jack et al[7]	Highest level of evidence from CPGs	Increase in quality of evidence	Jacob et al[28] Prevention of noncommunicable disease	ACOG CO-762 Prepregnancy counseling	Chen and Hamer[22] Zika virus	Loutfy et al Canadian HIV pregnancy planning guidelines	Polen et al[21] Zika virus	PHAC Preconception care	RANZCOG Pre-pregnancy Counseling	RACGP Preventive activities prior to pregnancy	FOGSI Good clinical practice for PCC	AAFP Preconception care Position paper	Farahi and Zolotor[20] Recommendations for PCC
Health promotion[8]														
Family planning and reproductive life plan	III	II-2	Yes	Yes	Yes	Limited For Zika only	Yes	Limited For Zika only	Yes	No	Yes	Yes	Yes	Yes
Physical activity	II-2	II-2	No	Yes	Yes	No	Refers to other guideline	No	Yes	Yes	Yes	Yes	Limited For women of high BMI only	No
Weight status	III	II-2	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Nutrient intake	III	III	No	Yes	Yes	No	Refers to other guideline	No	Yes	Yes	Yes	Limited Overweight/ underweight	No	Limited Post-bariatric surgery only
Folate	I-a	I-a	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Immunizations	III	III	No	No	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Substance use	II-2 (tobacco) III (alcohol)	II-2 (smoking) III (alcohol)	No	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
STIs	III	III	No	No	Yes	No	Yes	No	Yes	No	No	Yes	Yes	Yes
Immunization[6]														
HPV	II-2	II-2	No	No	Yes	No	No	No	No	No	No	Yes	No	No
Hepatitis B	III	III	No	No	Yes	No	No	No	Yes	Yes	Yes	Yes	No	Yes
Varicella	III	III	No	No	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Measles, mumps, and rubella	II-3	III	No	No	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Influenza	III	III	No	No	Yes	No	No	No	Yes	Yes	Yes	Yes	No	Yes
Diphtheria–tetanus –pertussis	III	III	No	No	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Infectious disease[16]														
HIV	I-b	I-a (counseling on strategies to reduce horizontal and perinatal HIV transmission risk)	Yes	No	Yes	No	Yes	No	Yes	No	Yes	Yes	No	Yes
Hepatitis C	III	III	No	No	Yes	No	Yes	No	No	No	No	No	No	No
Tuberculosis	II-2	III	No	No	Yes	No	No	No	No	No	No	Yes	No	Yes
Toxoplasmosis	III	III	No	No	Yes	No	Yes	No	Yes	No	Yes	Yes	No	No
Cytomegalovirus	II-2	III	No	No	No	No	Yes	No	No	No	Yes	No	No	No
Listeriosis	III	III	No	No	Yes	No	No	No	Yes	No	Yes	No	No	No
Parvovirus	III	III	No	No	No	No	No	No	No	No	Yes	No	No	No
Malaria	III	III	No	No	No	No	No	No	No	No	No	No	No	No

(*Continued*)

Table 5 (*Continued*)

Component of PCC (number of recommendations)	Documented level of evidence from Jack et al[7]	Highest level of evidence from CPGs	Increase in quality of evidence	Jacob et al[28] Prevention of noncommunicable disease	ACOG CO-762 Prepregnancy counseling	Chen and Hame[22] Zika virus	Loutfy et al Canadian HIV pregnancy planning guidelines	Polen et al[21] Zika virus	PHAC Preconception care	RANZCOG Pre-pregnancy Counseling	RACGP Preventive activities prior to pregnancy	FOGSI Good clinical practice for PCC	AAFP Preconception care Position paper	Farahi and Zolotor[20] Recommendations for PCC
Gonorrhea	II-2	III	No	No	Yes	No	Yes	No	Yes	No	No	Yes	No	Yes
Chlamydia	I-a	I-a	No	No	Yes	No	Yes	No	Yes	No	No	Yes	No	Yes
Syphilis	II-1	III	No	No	Yes	No	Yes	No	Yes	No	Yes	Yes	No	Yes
Herpes simplex virus	II-1	III	No	No	No	No	Refers to other guideline	No	No	Yes	Yes	Yes	No	Yes
Asymptomatic bacteruria	II-1	N/A	N/A	No	No	No	No	No	No	No	No	No	No	No
Periodontal disease	I-b	III	No	No	No	No	Refers to other guideline	No	Yes	No	Yes	No	No	No
Bacterial vaginosis	1-b	N/A	N/A	No	No	No	No	No	No	No	No	No	No	No
Group B Streptococcus	J-2	N/A	N/A	No	No	No	No	No	No	No	No	No	No	No
Medical conditions[11]														
Diabetes mellitus	I II-2 (overweight and obese adults)	II-1	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Yes	Yes
Thyroid disease	II-1			Yes	Yes	No	No	No	Yes	No	Yes	Yes	No	Yes
Phenylketonuria	II-1	N/A	N/A	No	No	No	No	No	No	No	No	No	No	No
Seizure disorders	II-2			No	No	No	No	No	Yes	No	Yes	Yes	No	Yes
Hypertension	II-2	II-2	No	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Yes	Yes
Rheumatoid arthritis	III	III	No change	No	No	No	No	No	No	No	No	Yes	No	No
Lupus	II-2	III	No	No	No	No	No	No	No	No	No	Yes	No	No
Renal disease	II-2			No	No	No	No	No	No	No	No	No	No	No
Cardiovascular disease	II-3	III	No	No	No	No	No	No	NO	No	No	Yes	No	No
Thrombophilia	III (women not using warfarin) II-3 (women using warfarin)	III	No	No	Yes	No	No	No	No	No	Yes	Yes	No	Yes
Asthma	II-3	III	No	No	No	No	No	No	Yes	No	No	Yes	No	Yes
Psychiatric condition[3]														
Depression/Anxiety	III	III	No	No	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Bipolar disease	III	III	No	No	Yes	No	No	No	Yes	No	No	Yes	No	No
Schizophrenia	III	III	No	No	Yes	No	No	No	No	No	No	Yes	No	No
Parental exposure[3]														
Alcohol	I-a	II-2	No	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Tobacco	I-a	I-a	No	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Illicit substances	III	III	No	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes

Table 5 (*Continued*)

Component of PCC (number of recommendations)	Documented level of evidence from Jack et al[7]	Highest level of evidence from CPGs	Increase in quality of evidence	Jacob et al[28] Prevention of noncommunicable disease	ACOG CO-762 Prepregnancy counseling	Chen and Hamer[22] Zika virus	Loutfy et al Canadian HIV pregnancy planning guidelines	Polen et al[21] Zika virus	PHAC Preconception care	RANZCOG Pre-pregnancy Counseling	RACGP Preventive activities prior to pregnancy	FOGSI Good clinical practice for PCC	AAFP Preconception care Position paper	Farahi and Zadotor[26] Recommendations for PCC
Family and genetic history[5]														
All individuals	II	III	No	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Ethnicity based	II-3	III	No	No	Yes	No	No	No	Yes	Yes	Yes	Yes	No	No
Family history	II-3	II-3	No	No	Yes	No	No	No	Yes	Yes	Refers to other guideline	Yes	Yes	Yes
Previous pregnancies	II	III	No	No	Yes	No	No	No	Yes	No	Refers to other guideline	Yes	Yes	No
Known genetic conditions	II-3	II-3	No	No	Yes	No	No	No	Yes	No	Refers to other guideline	Yes	Yes NTDs only	Yes
Nutrition[12]														
Dietary supplements	II	III	N/A	No	No	No	No	No	No	No	No	No	No	No
Vitamin A	II	III	No	No	Yes	No	No	No	Yes	No	No	No	No	Limited Post-bariatric surgery only
Folic acid	I-a	I-a	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Multivitamins	II-2	III	No		Yes	No	Refers to other guideline	No	Yes	No	No	No	No	Limited Post-bariatric surgery only
Vitamin D	II-3	II-2	Yes	Yes	Yes	No	No	No	Yes	No	Yes	No	No	Limited Post-bariatric surgery only
Calcium	I-b	III	No	No	Yes	No	No	No	Yes	No	Yes	No	No	No
Iron	I-b	II-2	No	Yes	Yes	No	No	No	Yes	No	Yes	Yes	No	Limited Post-bariatric surgery only
Essential fatty acids	I-b	N/A	N/A	No	No	No	No	No	No	No	No	No	No	No
Iodine	II-2	III	No	Yes	No	No	No	No	No	Yes	Yes	Limited Thyroid section	No	No
Overweight	I-b	II-2	No	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Underweight	II	III	No	Yes	Yes	No	No	No	Yes	No	Yes	Yes	No	Yes
Eating disorders	II	III	No	No	Yes	No	No	No	No	No	No	Yes	No	Yes
Environmental exposure[5]														
Mercury	II	III	No	No	Yes	No	No	No	Yes	No	Yes	No	Limited Men only	Yes
Lead	II-2	III	No	No	Yes	No	No	No	Yes	No	No	No	Limited Men only	No
Soil and water hazards	II II (BPA avoidance)	III	No	Yes	No	No	No	No	Yes	No	No	No	No	No
Workplace exposure	II	III	No	No	Yes	No	No	No	Yes	Yes	Yes	No	No Discussed for men	Yes
Household exposure	II	III	No	No	Yes	No	No	No	Yes	Yes	Yes	No	No	Yes

(*Continued*)

Table 5 (*Continued*)

Component of PCC (number of recommendations)	Documented level of evidence from Jack et al[7]	Highest level of evidence from CPGs	Increase in quality of evidence	Jacob et al[28] Prevention of noncommunicable disease	ACOG CO-762 Prepregnancy counseling	Chen and Hamer[22] Zika virus	Loutfy et al Canadian HIV pregnancy planning guidelines	Polen et al[21] Zika virus	PHAC Preconception care	RANZCOG Pre-pregnancy Counseling	RACGP Preventive activities prior to pregnancy	FOGSI Good clinical practice for PCC	AAFP Preconception care Position paper	Farahi and Zolotor[20] Recommendations for PCC
Psychosocial risk[3]														
Inadequate financial resources	III	III	No	No	No	No	Yes	No	Yes	No	Yes	Yes	No	No
Access to care	III	III	No	No	Limited Screening for genetic conditions	No	Yes	No	Yes	No	Yes	Yes	No	No
Physical/sexual abuse	III	III	No	No	Yes	No	No	No	Yes	No	No	Yes	Yes	Yes
Medication[3]														
Prescription	II-2	II-2	No	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Over-the-counter medication	III	III	No	No	Yes	No	Yes	No	No	Yes	Yes	Checklist only	Yes	No
Dietary supplements	II-3	III	No	No	Yes	No	No	No	No	No	Yes	No	No	No
Reproductive history[5]														
Prior preterm birth infant	I-a	III	No	No	No	No	No	No	Yes	No	Yes	Checklist only	No	No
Prior cesarean delivery	II-2	III	No	No	No	No	No	No	Yes	No	No	Checklist only	No	No
Prior miscarriage	I-a	III	No	No	No	No	No	No	Yes	No	Yes	Yes	No	No
Prior stillbirth	II-2	III	No	No	No	No	No	No	No	No	Yes	Checklist only	No	No
Uterine anomalies	II-3	III	No	No	No	No	No	No	Limited	No	No	No	No	No
Special populations[4]														
Women with disabilities	III	N/A	N/A	No	No	No	No	No	No	No	No	No	No	No
Immigrant and refugee populations	III	III	No	Yes	No	No	No	No	Yes	No	Yes	No	No	No
Cancer	III	III	No	No	No	No	No	No	No	No	No	Yes	No	No
Men	III	I-b	Yes	Yes	Limited	Yes	Yes	Yes	Yes	No	No	Yes	Yes Detailed separate section	Limited Reproductive life plan
Additional component														
Zika	N/A	II-3	Yes	No	Yes	Yes	No	Yes	No	Yes	No	No	No	No
Number of content areas covered (85)				**17**	**57**	**3**	**27**	**3**	**58**	**25**	**53**	**58**	**26**	**45**

Abbreviations: ACOG, American College of Obstetricians and Gynaecologists; BMI, body mass index; BPA, bisphenol A; CPGs, clinical practice guidelines; HIV, human immunodeficiency virus; HPV, human papilloma virus; NTDs, Neural Tubes Defects; PCC, preconception care; PHAC, Public Health Agency of Canada; RACGP, Royal Australian College of General Practitioners; RANZCOG, Royal Australian and New Zealand College of Obstetrics and Gynecology; STIs, sexually transmitted infections.

Discussion

This systematic review aimed to assess the availability and quality of guidelines for PCC. While a plethora of guidelines that refer to preconception were identified, only 11 focused primarily on PCC. Most were of moderate quality with inconsistent adherence to AGREE-II criteria. Four of the 11 CPGs focused on particular areas of health such as Zika virus, non-communicable diseases, and people living with HIV. The number of recommendations varied significantly between the CPGs and no one document covered all the recognized clinical content areas of PCC. Several CPGs acknowledged content areas that were not covered and offered links to other guidelines for this information.

Guideline Quality

Ten guidelines were assessed as moderate quality with only one assessed as high quality. This was the Canadian HIV Pregnancy Planning guideline, which scored highly across five domains, receiving its lowest score in domain 5, Applicability. The authors note the additional development and publication of a best practice document in 2020 to address the application of the CPG.[29] This document repackaged the 36 guideline recommendations in five standards of care for ease of use. This best practice document was designed to further support health care providers in the application of this guideline and highlights the potential value of guideline implementation tools to increase use and consistent application of recommendations within CPGs. The AGREE-II provides a methodological framework for the development of high-quality CPGs. Future CPGs in PCC must adhere to this framework, across all six domains, to produce robust CPGs to enhance the delivery of PCC.

Level of Supporting Evidence

The level of evidence on which the recommendations were based was variable with high-quality evidence available for only a few recommendations, namely, folic acid supplementation and HIV transmission prevention. Six clinical content areas have seen an increase in the level of supporting evidence since the previous comprehensive assessment in 2008.[7] This aspect of the analyses highlighted areas where additional research is required. Recommendations for 54 of the 83 content areas were based on the consensus of clinical experience, descriptive studies and case reports, or reports of expert committees. It may not be feasible, ethical, or necessary to conduct RCTs in all these areas to attain the highest levels of evidence possible. Researchers and funding bodies should consider identifying and targeting aspects of PCC where the most significant gains can be made, particularly for priority populations. CPGs need to be updated with the most recent evidence to encourage uptake and translation to care. Monitoring the uptake of CPGs and improvements in population-level preconception health indicators is needed to track progress, and evaluate translation to care, health improvements, and reduced inequalities.[30]

Populations Addressed within PCC CPGs

The WHO acknowledges that PCC stands to benefit women and men, regardless of pregnancy intention.[1] Only 6 of the 11 included documents provided PCC guidance for men, with a further two documents acknowledging men's PCC health. The CPG from the AAFP contained a dedicated section for men, including a table outlining recommendations for preconception interventions for men. The CPGs pertaining to Zika virus and the HIV pregnancy planning guideline contained specific recommendations for men embedded within other recommendations. Evidence suggests that men of reproductive age are not receiving PCC.[31–33] A recent survey of over 500 men in the United Kingdom found that they wanted to engage in positive preconception health behaviors. Almost one in five of the men surveyed had visited a primary health provider for preconception health advice and those who had received advice were more likely to adopt positive health behaviors prior to pregnancy.[33] Therefore, not including men in strategies to improve provision of PCC is a missed opportunity to improve preconception health globally. Consistently including men's preconception health in PCC CPGs may support and empower health care providers to ask men about their reproductive intentions and provide them with PCC, along with their partner.

The degree to which guidelines included content relating to disadvantaged populations was assessed through data extraction and items within domains 1, 3, and 5 of the AGREE-II tool. Only three CPGs included priority populations in their recommendations, with a further three CPGs acknowledging additional needs in care. The RANZCOG CPG detailed a section on health inequity, outlining strategies to assist family physicians to deliver equitable PCC. The CPG from Public Health Canada contained multiple segments addressing the needs of priority populations including a segment on the determinants of health, with other sections for indigenous women and women with specific needs. The HIV Pregnancy Planning guideline embedded recommendations for people from priority populations within other recommendations. Women and men from priority populations experience increased rates of adverse health outcomes.[4,34] They also face barriers to accessing health care. PCC guidelines must incorporate guidance on the specific needs of priority populations to allow health care providers to deliver equitable health care.

Women from priority populations are keen to engage in opportunities to receive PCC, yet challenges exist in its delivery.[35,36] Education and training for health care providers have been suggested to enhance the delivery of equitable PCC. Therefore, further work in education and training for health care providers and implementation guideline tools that promote culturally appropriate provision of PCC are required to address the needs of priority populations.

CPGs in Practice

The presentation of a CPG, from its title to its display of recommendations, is key to its accessibility, implementation, and use.[9] A study on guideline development in Australia demonstrated the importance of end-user input to develop focused clinical questions that respond to clinical need.[37]

Such input can help focus evidence-based recommendations thereby increasing their relevance, acceptability, and feasible implementation in clinical practice. Given that the target population for PCC is all people of reproductive age, and that PCC is often delivered opportunistically across different levels of care and even social care, it is necessary to have comprehensive CPGs that answer clinical questions and promote collaboration and provision of high-quality and consistent care. The scope of clinical content to be covered by PCC should be clear and where a CPG does not address all PCC content areas, acknowledgment of and reference to other guidelines that cover missing content should be included. As PCC needs of individuals vary widely, the care delivered using comprehensive CPGs can subsequently be tailored to an individual's physical and mental health conditions, health behaviors, and social context.[38]

Strengths and Limitations

Only guidelines that were freely accessible to an international audience were included in this systematic review. This was to mimic the clinical scenario of when a clinician may search for information to augment care within a consultation. However, these inclusion criteria limited the number of CPGs included in the study.

Strengths included the involvement of an international panel of PCC experts during protocol development, title and abstracts screening, study selection and assessment of quality, and level of evidence. Comprehensive data extraction and analyses aligned with the previously identified 82 clinical content areas of PCC[7] and built on existing understanding of PCC globally.

Conclusion

Preconception care is a key component of preventive health care that should be provided to all people of reproductive age, with care taken to ensure the inclusion of men and priority populations. This systematic review identified that current guidelines on PCC can be improved with inclusion of a more comprehensive set of clinical content areas, more rigorous development processes, and strategies to improve feasible and acceptable guideline application.

Authors' Contribution

The authors certify that:

All information is truthful and as complete as possible.

All authors have participated in planning of the project.

All authors have been responsible for the writing of the manuscript.

Research was conducted in accordance with the ethical and research arrangements of the organizational institutions involved.

Conflict of Interest

We declare that we received no financial or other support or any financial or professional relationships which may pose a competing interest.

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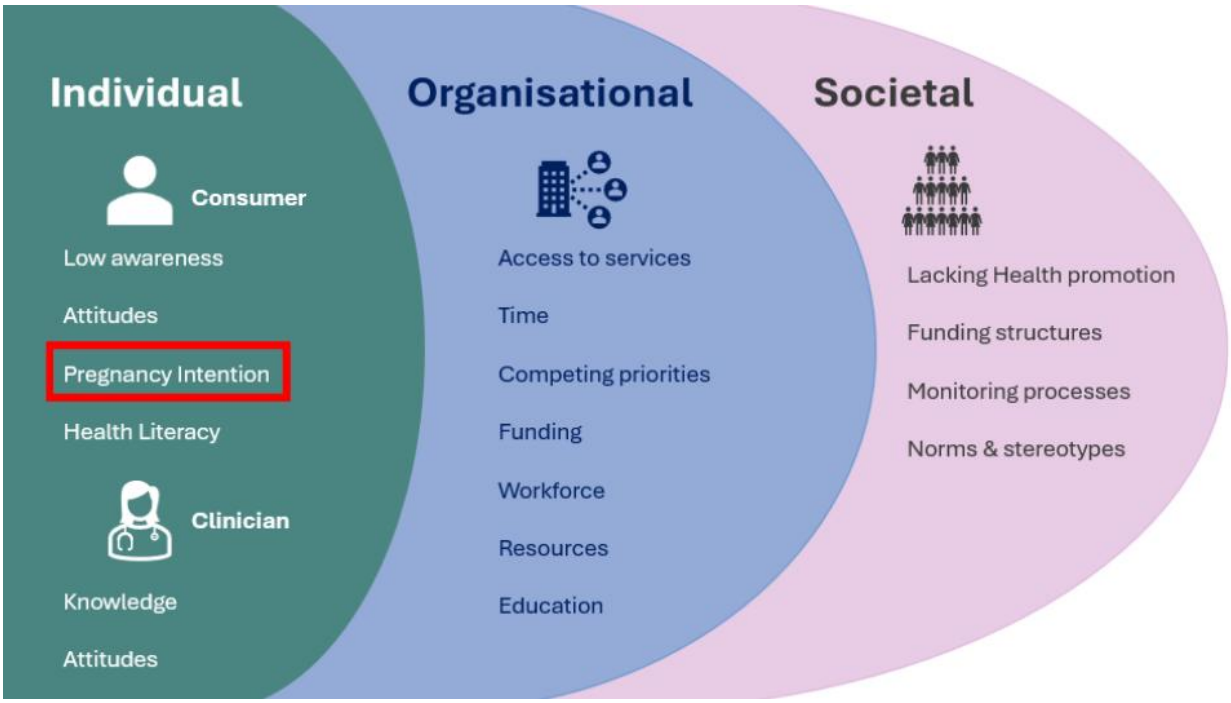
Chapter 3: Pregnancy Intention

3.1 Chapter Aim

Unintended pregnancies present a missed opportunity to optimise preconception health, as intended pregnancies are consistently associated with higher rates of preconception behaviours. As such, understanding and capturing pregnancy intention is an important step in recognising the extent of pregnancy planning, identifying those at risk of unintended conception and enhancing the delivery of preconception care. Thus, measuring unintended pregnancy can inform the design and development of family planning and preconception services and can influence the barrier of access to services.



This chapter is a review of measures of pregnancy intention. It explores how they can be used in clinical care and how they can inform policy and practice. There are three more publications in this section listed in the appendices as they were research

collaborations throughout the PhD candidature. These publications explore implementation of measures of pregnancy intention in Australia.

Two publications explore the implementation of the London Measure of Unplanned Pregnancy (LMUP) in the tertiary setting. The third publication explores the acceptability of the One Key Question® in the primary care setting. All were based in Sydney, Australia.

3.2 Publication details

Dorney E, Barrett G, Hall J, Black KI. Measures of Pregnancy Intention: Why Use Them and What Do They Tell Us?. Semin Reprod Med. 2022;40(5-06):229-234. doi:10.1055/s-0042-1760118

3.3 Author contribution

ED designed the structure of the manuscript. ED led the writing of the manuscript with review and editing from all authors.

Publications in Appendices

Appendix A: Black KI, **Dorney E**, Hall JA, Pelosi M, Ahmed Khan S, Cheney K. Using a validated instrument to assess pregnancy planning and preconception care at antenatal booking visits: a retrospective cohort study. Medical Journal of Australia. 2023;219 (8):366-70.

Appendix B: Cheney K, Black K, Pelosi M, **Dorney E**. Introduction of the London Measure of Unplanned Pregnancy at the booking visit and the midwives' perspective. BMJ Sex Reprod Health. 2023;49(2):112-7.

Appendix C: Fitch J, **Dorney E**, Tracy M, Black KI. Acceptability and usability of 'One Key Question'® in Australian primary health care. Aust J Prim Health. 2023;29(3):268-75.

3.4 Manuscript

Measures of Pregnancy Intention: Why Use Them and What Do They Tell Us?

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Semin Reprod Med 2022;40:229–234

Abstract

Understanding pregnancy intention is an important public health measure that captures the ability of individuals to access information, resources, and services needed to plan the timing and spacing of pregnancies. Pregnancy intention is a complex construct impacted by social, emotional, financial, cultural, and contextual factors. In this review, we will examine the range of available tools for individuals and populations to evaluate pregnancy intention, the timing of the tools in relation to pregnancy, their interpretation, and use for policy and practice. Traditionally, pregnancy intention was only assessed in population health surveys; however, more sophisticated tools and measures have been developed. These tools can be used at several time points: before pregnancy, during pregnancy, or after the pregnancy has ended. It is important to appreciate the varied contexts globally for women and their partners when assessing pregnancy intention, and the ability of a given tool to capture this when used retrospectively or prospectively. These tools can inform targeted delivery of services for a person or couple before, during, and after pregnancy. This knowledge can inform strategies at an individual, community, and population level as an indicator of access to sexual and reproductive health information and knowledge and uptake of preconception health.

Keywords

- pregnancy intention
- pregnancy planning
- unplanned pregnancy
- preconception
- psychometric measure
- measurement

Capturing pregnancy intention is an important public health measure, as it can be used to identify and monitor trends in reproductive health behaviors, to inform areas of need, and to design health care services both for pregnancy prevention and pregnancy preparation.[1,2] The prevention of unintended conceptions is a critical reproductive health issue globally as over half of unintended pregnancies end in abortion,[3] many in unsafe circumstances that risk the mother's health and life. Women who continue an unintended pregnancy through to antenatal care and birth have been found to experience worse maternal, neonatal, and child health outcomes compared to planned pregnancies including preterm birth, low birth weight, postnatal depression, lower levels of breastfeeding, and poorer long-term child health, growth, and developmental trajectories.[4–9] Nevertheless, an estimated 48% all pregnancies are unintended globally.[3] Certain populations are at higher risk of unintended pregnancies: those of younger age, those without partners, those from socioeconomic disadvantage, and those from low- and middle-income countries (LMICs).[3,10,11] Higher parity is also associated with increased rates of unintended pregnancy.[12–14]

The concept of an unintended pregnancy is relatively recent, emerging only in the 20th century with the development, increasing availability, and uptake of effective methods of contraception.[15] Decreasing unintended pregnancy has been a frequent policy aim, and as a result there have been many attempts worldwide to measure the levels of intended pregnancy, varying from strategies in which the

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concept is assumed to be self-evident to more sophisticated measurement efforts. The United States has the longest history of asking about pregnancy intention, with national surveys from the 1950s onward, with the most recent federally sponsored National Survey of Family Growth (NSFG) beginning in 1973.[16,17] These surveys have used suites of questions to allocate pregnancies to the categories of "intended" (wanted at the time of conception), "mistimed" (a pregnancy that is wanted at some time but occurred sooner than was wanted), and "unwanted" (a pregnancy that was not wanted at any time). The "mistimed" and "unwanted" categories are then combined to estimate "unintended" pregnancies.[18] The U.S. approach to measuring pregnancy intention has been highly influential, with the concepts of "mistimed" and "unwanted" incorporated into many surveys, including the Demographic and Health Surveys (DHS) which are widely used throughout LMICs.[19] In developed countries outside the United States, there has been substantially more variation in ways of assessing pregnancy intention and since 2010 the National Surveys of Sexual Attitudes and Lifestyles (Natsal) in the United Kingdom has used a validated measure.[15]

Around the turn of the century, when it was clear that rates of unintended pregnancy were not falling in the way it had once been expected they would, there was growing recognition that pregnancy intention was a more complex construct, involving social, emotional, financial, cultural, and contextual factors.[2] The limitations of existing measurement strategies were also becoming apparent.[1,20,21] As a response, more sophisticated measurement strategies were developed, often capitalizing on more robust measurement methods such as psychometrics which is now often used to develop health measures.[22,23]

In this review, we will examine the range of tools available to evaluate pregnancy intention in individuals and populations, the timing of the tools in relation to pregnancy and their interpretation and implications for individuals, and public health policy and practice. It is important to define our focus on the measurement pregnancy intentions, by which we mean women's thoughts, feelings, and plans about a particular pregnancy either current, near future, or recent past. This is in contrast to fertility intentions, a demographic concept which relates to how many children a woman would like to have in total across her whole reproductive life course.

Why Do We Need to Know About Pregnancy Intention?

Pregnancy Intention and Pregnancy Outcomes

As previously noted, unintended pregnancies are associated with increased risks of adverse pregnancy and perinatal outcomes. They are more likely to end in abortion and expose women to unsafe abortion that contributes to 9% of global maternal mortality and many millions more are left with lifelong complications.[24] Interpregnancy intervals are shorter in women with unintended pregnancies resulting in increased rates of adverse pregnancy outcomes,[25,26] an issue that is potentially preventable with education and postpartum contraception.

Pregnancy Intention and Preconception Care

Women continuing unintended pregnancies demonstrate lower levels of healthy preconception and pregnancy care behaviors; they are more likely to smoke and have lower quality diets compared to women with planned pregnancies.[27] Of increasing importance in a world of rising noncommunicable diseases is the reduced opportunity for prepregnancy optimization of chronic medical conditions such as diabetes and obesity as well as the impact on mental health conditions such as depression, or of the chance to review potentially teratogenic medications.[28]

Pregnancy Intention and Health Service Use

Women with an unintended pregnancy are less likely to present for antenatal care or if they do, do so later and have fewer episodes of care compared to women with a planned pregnancy.[29,30] The World Health Organization (WHO) recommends a minimum of eight antenatal care visits to reduce adverse outcomes in pregnancy,[31] but for many women this target is unachievable, particularly so those with unintended pregnancies in LMICs.[29,30,32] In terms of other services use, they are also less likely to use postnatal contraception, or to access postnatal care and there have been mixed results for immunization uptake for the children of unintended pregnancies.[33,34]

Pregnancy intention has been proposed as one of the nine key indicators of a woman's preconception wellness and has been put forward as a marker of "*…access to and use of reproductive health care*."[35] The selection and understanding of such measures was developed to monitor the delivery and performance of health systems to improve the delivery of preconception care.

How (and When) Do We Measure Pregnancy Intention?

Pregnancy intention can be assessed at several time points, prospectively before a woman is pregnant, or retrospectively (asking about a pregnancy that has already happened) while a woman is pregnant, or after her pregnancy has ended. Tools used to assess pregnancy intention exist in several forms: individual questions with a dichotomous outcome, sets of questions on a topic, and psychometrically validated measures (►**Fig. 1**). A psychometrically validated measure is one that has undergone rigorous development and evaluation to confirm it fulfills its measurement aim and is effective for use in clinical care or research.[36]

To date, data on pregnancy intention have predominantly been collected during research or public health surveillance to provide information on the levels of unplanned pregnancy and inform service development.[17,19] There has been less implementation of pregnancy intention measures in clinical services, though this is gradually changing. It is important to understand the tools available to explore pregnancy intention at these different time points, their strengths and limitations, and how they may be utilized.

Retrospective Assessment

The field of measurement of intention relating to a pregnancy that has already occurred (retrospective) is more advanced,

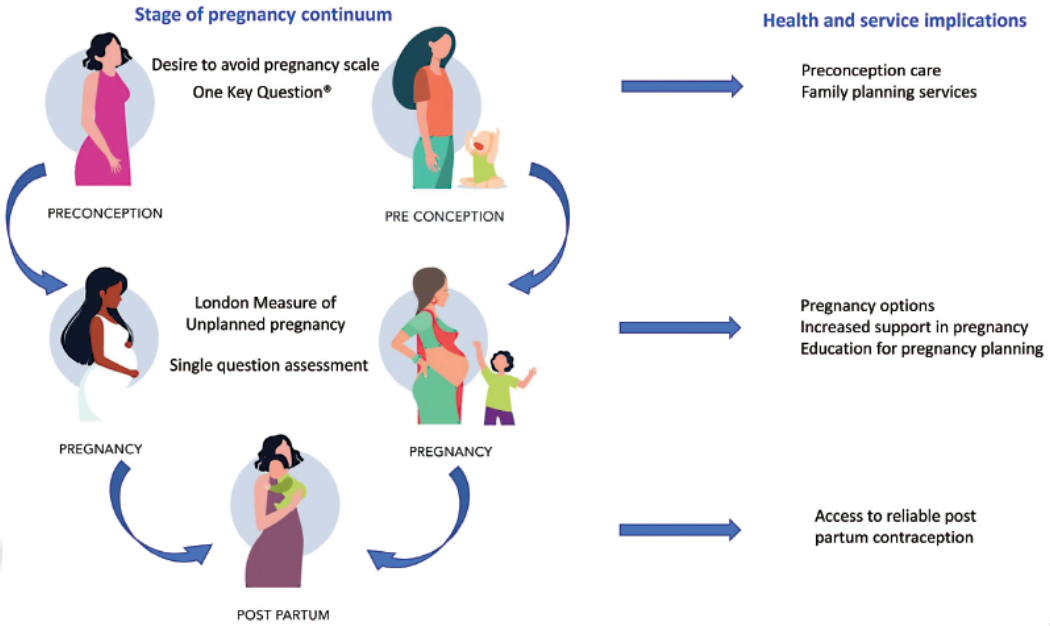

Fig. 1 Tools to assess pregnancy intention.

with tools that have been in use for decades. Assessment is ideally asked when a woman is pregnant or as soon after the end of pregnancy as possible, before long periods of time, or feelings about post-pregnancy circumstances affect recall.[37,38] For nonbiased population level assessment, it should be asked of all women attending for early pregnancy services, termination services, or antenatal care regardless of partner or contraception status, or of whether a pregnancy was achieved through assisted reproductive technology means. When asked in antenatal care, this has traditionally been with a dichotomous question of if a pregnancy was planned or unplanned. In research, sets of survey questions, the NSFG and DHS, have been widely used in the United States.[16,19]

The London Measure of Unplanned Pregnancy (LMUP) (also known as the "Circumstances of Pregnancy" questionnaire) is a psychometrically valid and reliable measure of pregnancy intention, based on lay views, that asks about a pregnancy that has already occurred.[23] It comprises of six questions and produces a score 0 to 12, a higher score indicating a more intended/planned pregnancy.[39] It has now been validated for use in many countries and is widely used.[40,41] Its advantages are that it is quick and easy to complete, is highly acceptable, makes no assumptions about the nature of women's relationships nor relies on women having fully formed childbearing plans, and it can be used with any pregnancy regardless of outcome. Several other measures and questions have been developed but have not been widely used.[42,43]

The routine use of the LMUP, in place of the single question with a binary outcome, is being piloted in antenatal care in selected centers in both the United Kingdom and Australia. Evaluations of this are exploring midwives' opinions on asking the LMUP questions and women's perspectives on being asked them in the booking appointment. If used nationally, and supplemented with data from termination services, this would form a population level surveillance system of unplanned pregnancy that would provide information on the scale of the problem, determinants, causal pathways, and consequences of unplanned pregnancy. This information could be used to further the case for investment in contraception and preconception health services. On an individual level, referral pathways can be implemented to support women with unplanned pregnancies to consider their options of whether to continue the pregnancy and, if they do, to support them and provide services to mitigate adverse outcomes.

Prospective Assessment

There has been less population-level research conducted on prospective pregnancy intentions. This is due in part to the fact that it was only in 2019 that a psychometrically validated measure was published.[22] The Desire to Avoid Pregnancy (DAP) Scale assesses 14 items across three domains to give an average score from 0 to 4, with a higher score indicating a higher desire to avoid pregnancy and therefore a lower pregnancy intention.[22] As a new measure, there is as yet limited published research, but it has already been adapted for use in a range of settings including the United Kingdom, Brazil, and Botswana and Kenya.[44] This is a potentially valuable research tool that will enable an exploration of the factors associated with pregnancy intention, how these change over time, and how pregnancy intention is related to

behaviors such as contraception use and other issues such as reproductive autonomy.[45]

For clinical use, a 14-item measure such as the DAP is unlikely to be appropriate in a face-to-face encounter, though could be used in pre-appointment questionnaires or other formats. A shorter version of the DAP would be preferable and could be used by health care professionals to identify who needs contraception advice, preconception advice, or both. For this, empirical cut points need to be developed and work needs to be done on how to translate the DAP score into useful information for clinicians and their clients. Other approaches to identifying patient's needs in this way, which are clinical tools rather than measures, include the One Key Question "*Would you like to become pregnant in the next year?*" with four possible response of "Yes, I'm not sure, I don't mind either way, No," or methods based on reproductive life planning.[46,47] Evidence suggests that these are feasible and acceptable but as yet there is little evidence of the impact of these on contraception use or pregnancy planning.

The Context of Measuring Pregnancy Intention

It is important to appreciate the varied contexts globally for women and their partners when assessing pregnancy intention, and the ability of a given tool to capture this when used retrospectively or prospectively.

The notion that women have the capacity to plan their pregnancies may not be universal. While intended pregnancies have been seen in all settings where pregnancy intention has been assessed, women's capacity to translate their own desires for pregnancy may be circumscribed by cultural expectations, limited access to health services and resources, or reproductive coercion.[48] Some research has found that the influence of partners on pregnancy intention and in general is not well captured[49] or that the desire to avoid pregnancy may relate to conception with a particular partner. While a single question, with a dichotomous answer, is potentially too crude to capture the complexity of pregnancy intention and may lead to misclassification, in certain care settings it may be all that is feasible to record with an appreciation of this limitation embedded in the interpretation.

Over time, an appreciation of the importance of ambivalence or uncertainty regarding pregnancy intention has also developed. Changes to survey questions to reflect this has seen such options chosen by 13 to 15% of women.[50] A study that applied a new, more relaxed construct concluded that current measures of unintended pregnancy may overestimate rates and that ambivalence may not be well captured.[41] The LMUP captures ambivalence in both the individual questions' responses and overall total score.

The importance of language choice for questions has also been identified, as a woman's desires and behaviors may not always be aligned. Even when women report that they wish to avoid pregnancy, their contraceptive behaviors are not always congruent with their stated desires.[51] A potential contradiction in pregnancy intention tools that only explore one aspect is that planning or intending to become pregnant may be distinct from wanting to be pregnant.[21] With a comprehensive measurement strategy, such as a psychometric measure, this should all be taken into account.

With all tools, consideration must also be given to the "changing realities" and that a person's prospective pregnancy intention may change over time with changing personal scenarios.[2] With prospective assessment, given a person's intention for pregnancy may change over time as circumstances change, this needs to be asked regularly to have meaningful health care impact. To understand the impact on health outcomes, this also needs to be compared with antenatal care and pregnancy outcomes, which is often difficult given the split in service delivery and data collection between primary and hospital care.

What Can We Do with the Information?

As previously mentioned, a prospective understanding of pregnancy intention can inform who needs which kind of advice and can empower individuals or couples to formulate and achieve their reproductive intentions.[2,52] Such assessment allows the health care worker to provide contraception information or preconception care which may prevent unintended pregnancy, or enable people to optimize their health prior to pregnancy.[53] Several pilot studies regarding One Key Question have shown feasibility and acceptability and formal studies are underway to assess the impact of this tool on reproductive health.[54]

Retrospective assessment allows identification of women who may require more targeted care in pregnancy, because they may be at risk of adverse pregnancy and postpartum outcomes. This can include a discussion on continuation of a pregnancy, increased psychological support while pregnant, education for subsequent pregnancy planning, and access to postpartum contraception. Using this information at a population level can identify populations with an unmet need for contraception and it has also been suggested a key metric to document preconception wellness.[35]

Regular assessment can also identify and monitor trends in pregnancy intention that may be associated with certain demographics or contextual factors.[55] A recent study in the United Kingdom explored the impact of COVID-19 lockdowns and the rates of unintended pregnancy.[56] This study showed that women reported increasing difficulty in accessing contraception post lockdown, and that these women that these women were more likely to have an unplanned pregnancy who could access contraception more readily.

Areas Requiring More Research

We recognize that there is still much to learn about the to learn about the measurement, and application of findings of unintended pregnancy. There has been limited work, for example, in assessing the intention of a potential partner in the pregnancy avoidance or planning process and most research to date has been conducted only on cis-gendered women. The association between unintended pregnancy and adverse health outcomes has been examined in LMICs,[9,13] but less so in

high-income settings. One of the key challenges with the use of these tools is to ensure that they do not only measure the issue but also inspire change in clinical care.

Conclusion

Assessing pregnancy intention is important for individual care and as a public health measure. It can inform targeted delivery of services for a person or couple before, during, and after pregnancy. If captured routinely, rather than a reliance on intermittent collection through surveys, this knowledge can inform strategies at an individual, community, and population level and serve as an indicator of a person's and population's preconception health.

Authors' Statement of Contribution

The authors certify that:

1. All information is truthful and as complete as possible.
2. All authors have participated in planning of the project.
3. All authors have been responsible for the writing of the manuscript.
4. Research was conducted in accordance with the ethical and research arrangements of the organizational institutions involved.

Competing Interests

We declare no financial or other support, or any financial or professional relationships which may pose a competing interest.

Conflict of Interest

None declared.

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3.5 Measures of pregnancy intention in Australia

3.5.1 The London Measure of Unplanned Pregnancy

The LMUP was implemented into routine antenatal care in two metropolitan maternity centres in Sydney, NSW at the end of 2019. Prior to this, pregnancy intention was assessed in a single question “Was this pregnancy planned?”. A mixed methods approach was adopted to assess the implementation of the LMUP. This involved a retrospective review of the first year of LMUP data entered in the electronic medical records and a qualitative study to investigate midwives’ attitudes to the LMUP and their understanding of its application to their scope of practice.

The retrospective data review included records from 4993 women who were booked for public antenatal care across the two sites between 1 January - 31 December 2020. The LMUP was completed in 2385 records (47.8%). Completion rates were higher in the secondary-level-care facility (96.3%) compared to the tertiary-level-care facility (32.0%). The unplanned pregnancy rate across the two centres was 29%, with unplanned pregnancies more likely in women who were aged 24 years or less, or of higher parity. In women who planned their pregnancies, less than half (40.9%) reported taking any health action in preparation for pregnancy.

In-depth interviews were held with ten midwives, five from each facility, and included senior staff to new graduates in their level of experience. Overall midwives supported the inclusion of the LMUP in the antenatal booking visit felt it aligned with their scope of

practice, however they identified challenges to the implementation of the tool across individual, organisational, and broader contextual factors (Figure 3.1).

Figure 3.1 Challenges to the implementation of the LMUP in two Sydney maternity centres.

Organisational factors, such as leadership, provision of professional education and support were associated with higher LMUP completion rates across the two facilities. While midwives supported the inclusion of the LMUP in their practice and saw its connection to the continuum of post-partum contraception and interconception care, this did always translate to care delivery. Indeed, amongst women with unplanned pregnancies 47.8% did not receive education regarding postpartum contraception. Midwives identified a lack of structured care pathways as a challenge to achieving this.

These two studies show that a validated tool to assess pregnancy intention can be systematically incorporated into routine maternity care. However, service barriers need to be addressed to enhance the potential of the LMUP. These findings can inform

service delivery, maternity policy and practice and ultimately enhance reproductive outcomes for women and their families.

3.5.2 One Key Question®

The One Key Question® (OKQ®) tool was piloted in two Sydney primary care practices to assess the acceptability and usability of the tool in the Australian setting. This was a mixed methods study that explored both consumer and clinician perspectives on the tool.

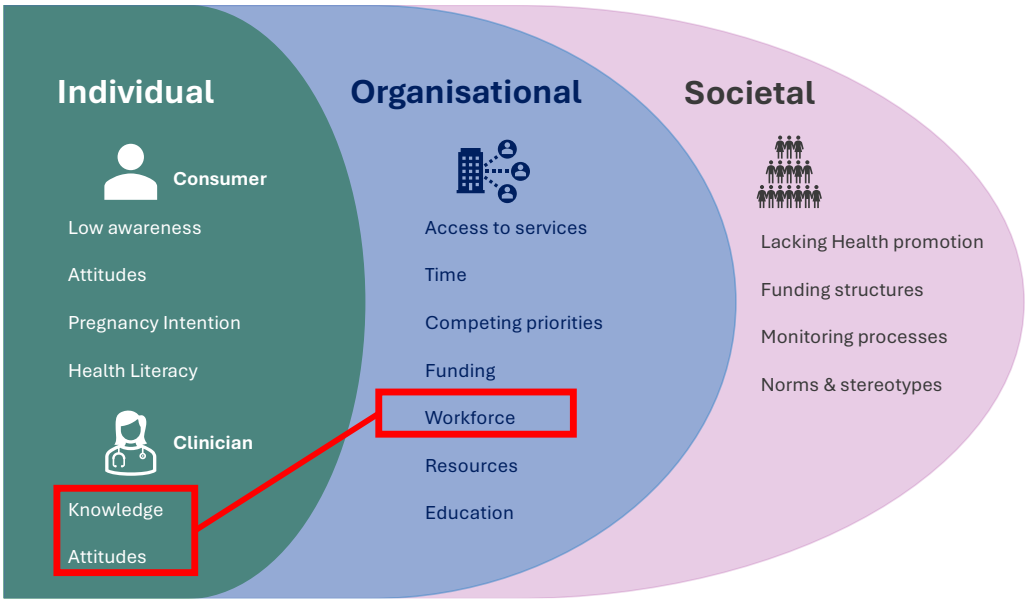
Findings from this study showed that women were happy to be asked about their reproductive choices and felt it was relevant to their general health. Half of the women reported being asked previously about their pregnancy plans.
In almost three quarters of the consultations, clinicians felt comfortable or somewhat comfortable asking the OKQ® to women. Clinicians also reported that OKQ® was easy to use without training. Asking OKQ® extended the consult in 62.5% of patient encounters, and of those the median length of time increase was 2 minutes. Clinicians felt that framing OKQ® helped introduce pregnancy intention discussions into the consult.

This pilot study showed that OKQ® is acceptable to women and easy for clinicians to use without training. Such a tool can facilitate a proactive and routine discussion to enhance the delivery of contraception and preconception care.

Chapter 4: Workforce - Primary Health Care Nurses and Preconception care

4.1 Chapter Aim

Workforce factors are a recognised barrier to the delivery of preconception care at both the organisational and individual level. Adequate staffing levels within an appropriately skilled workforce are considerations at the organisational level. Knowledge and attitudes towards the delivery of preconception care can be barriers at the individual clinician level.



There are health professionals from several disciplines who are appropriate to deliver preconception care. Primary health care nurses (PHCN's) are the largest group of clinicians working in primary care in Australia, and internationally they have been recognised as important providers of preconception care.

This chapter reports on a cross-sectional survey of PHCNs in Australia, to understand their knowledge, attitudes, and practice towards preconception care. This can inform workforce solutions to enhance the delivery of preconception care.

4.2 Publication details

Dorney, E., Millard, J., Hammarberg, K., Griffin, K., Gordon, A., McGeechan, K., Black, K. (2022). Australian primary health care nurses' knowledge, practice and attitudes relating to preconception care: learnings for service implementation. Australian Journal of Primary Health, 28(1), 63-68.

4.3 Author contribution

ED was responsible for the design of the cross-sectional survey and the survey tool. Survey dissemination was enabled by JM and the Australian Primary Care Nurses Association. ED performed the data analysis and synthesis of findings. ED led the writing of the manuscript. All authors read and approved the final manuscript.

4.4 Manuscript

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Research

Australian primary health care nurses' knowledge, practice and attitudes relating to preconception care: learnings for service implementation

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Abstract. Preconception care (PCC) entails counselling and interventions to optimise health before pregnancy. Barriers to this service delivery include access and time. Primary healthcare nurses (PHCNs) are uniquely placed to deliver PCC. The aim of this study was to understand PHCNs' knowledge, practice and attitudes to PCC. A cross-sectional study was performed of a convenience sample of PHCNs in Australia who were seeing people of reproductive age. Recruitment was via the Australian Primary Health Care Nurses Association (APNA) electronic communication platforms. The 18-item, online, anonymous survey captured demographics, as well as PCC knowledge, practices and attitudes. Descriptive statistics were used to describe our findings. In all, 152 completed surveys were received. Of all respondents, 74% stated they discuss PCC in their practice, although only 13% do so routinely. Of these, more preconception discussions are held with women than with men. In total, 95% of respondents identified at least one barrier to delivery of PCC, with lack of time and knowledge being the most common. The findings of this study can inform targeted strategies, including education programs and resources, and consideration of incentives to support PHCNs deliver PCC. This study identifies areas for improvement at the individual, organisational and health system levels to enhance the role of PHCNs in PCC.

Keywords: maternal health, preconception care, primary care, primary health care nurse, service implementation.

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Introduction

Preconception care (PCC) entails comprehensive counselling and interventions that aim to optimise the health of women and their partners before pregnancy (Dorney and Black 2018). Optimal parental health before pregnancy improves conception rates, pregnancy outcomes, childhood health and the health of future generations (Stephenson *et al.* 2018).

There is growing evidence to support the importance of PCC. 'Fetal programming' occurs in response to the periconceptional physiological and intrauterine environments, and this is known as the Developmental Origins of Health and Disease (DOHaD) concept. Obesity is an example of this process: children of mothers who are obese at the time of conception and during pregnancy are more likely than children of mothers in the healthy weight range to be overweight and develop cardiovascular and metabolic disease later in life (Jacob *et al.* 2020). Evidence also demonstrates that optimising preconception health improves pregnancy outcomes. The addition of a 400- to 500-μg folic acid supplement before pregnancy reduces neural tubes defects (spina bifida and anencephaly) by up to 72% (De-Regil *et al.* 2015). For women with diabetes, strict preconception blood glucose control decreases the incidence of congenital malformations, miscarriage, birthweight abnormalities and preterm birth (Guerin *et al.* 2007).

Given this evidence, there is growing recognition of the importance of PCC as a key preventative health strategy (World Health Organization 2016). PCC is promoted internationally by the World Health Organization and by the International Federation of Gynaecology and Obstetrics (FIGO), with a recent call to action for healthcare providers (Jacob *et al.* 2020). Locally, the Royal Australian College of General Practitioners (RACGP) provides guidance recommending that every woman (and their partner) of reproductive age should be considered for PCC (RACGP 2016). Issues to be addressed in PCC include an

assessment for behavioural, biomedical and social risk factors that can adversely affect the health of the parents and their offspring (Dorney and Black 2018).

There are several potential models for the delivery of PCC that vary according to the clinical setting (e.g. primary or specialist-level care) and the target population. Primary care has been cited as the most appropriate setting to lead the delivery of PCC because community-based services are the most likely point of contact for women and men of reproductive age (American Academy of Family Physicians 2016).

Primary care incorporates the provision of heath care to people outside of a hospital setting and is considered to be the first step on a patient's pathway to care (Australian Government Department of Health 2021). Primary care is delivered by GPs, primary health care nurses (PHCNs), midwives, pharmacists and allied health professionals.

Recent studies within Australia have found that most women and men of reproductive age are not receiving PCC (Hogg *et al.* 2019; Chivers *et al.* 2020). Several barriers have been identified in the delivery of PCC. In the general practice setting, barriers include time constraints, limited access to health professionals and a lack of resources for assisting in the delivery of PCC (Mazza *et al.* 2013). Clinicians' lack of knowledge of preconception guidelines is also a known barrier (Kizirian *et al.* 2019).

In Australia there are over 82 000 registered PHCNs, making them the largest group of clinicians working in primary care (Australian Institute of Health and Welfare 2020). PHCNs are uniquely placed to counsel women about PCC, with several studies recommending their involvement in this care (Mazza *et al.* 2013; Hurst and Linton 2015). Internationally, the Centres for Disease Control and Prevention (CDC) in the US stated that PHCNs have an 'equally critical' role in the delivery of PCC alongside specialists and GPs (Johnson *et al.* 2006). A recent study of 192 Australian maternal, child and family healthcare nurses reported that almost half (46%) discussed preconception health with their clients and that 65% agreed that it is within their role to promote preconception health (Hammarberg and Taylor 2019). Further, a recent study highlighted the importance of interprofessional collaborations in primary care for quality service delivery (Matthys *et al.* 2017). This has been extended to PCC, and a recent study from the Netherlands recommended such collaboration as the way forward for delivering PCC (Poels *et al.* 2017).

The aim of this study is to understand PHCNs' knowledge, practice and attitudes relating to PCC. This will inform solutions for improving access to quality PCC for women and men of reproductive age in Australia. This project is a collaboration between the National Health and Medical Research Council Centre for Research Excellence in Sexual and Reproductive Health for Women in Primary Care (SPHERE) and the Australian Primary Health Care Nurses Association (APNA). Such partnerships between research and healthcare worker organisations have been shown to improve research interventions and public health promotion (Israel *et al.* 1998).

Methods

This was a cross-sectional study of a convenience sample of PHCNs in Australia that explored their knowledge, attitudes, confidence and practices relating to PCC using an anonymous online survey.

Participants

Participants were eligible for inclusion in this study if they were PHCNs with Australian Health Practitioner Regulation Agency registration currently practicing in Australia and providing consultations with men and women of reproductive age in their practice.

Recruitment

Recruitment was via two group electronic communication platforms, the APNA electronic newsletter *TheConnect* and the private APNA Facebook page. Information about the study was provided, including that there was an opportunity to enter a draw to win an iPad or one of five A$30 retail store gift vouchers. Participants could then complete the survey by clicking on a link from either platform.

Materials

An 18-item survey that captured data on participant demographics and knowledge and practices of PCC was designed using the REDCap platform. Survey questions were informed by existing evidence about PCC (Hammarberg and Taylor 2019; Kizirian *et al.* 2019) and developed in collaboration with representatives from APNA. The survey was pilot tested on 10 primary APNA representative PHCNs before dissemination.

Data collection and analysis

Data were analysed using SPSS (ver. 24). Descriptive statistics (median values and percentages) are used to describe participant demographic factors, current PCC delivery, PCC knowledge and perceived barriers or enablers in the delivery of PCC.

Ethical considerations

This study was approved The University of Sydney Human Research Ethics Committee (Project no. 2020/430, 22 June 2020).

Results

In all, 152 complete survey responses were received. Using online analytical data (link clicks), this was a response rate of 82% for participants who clicked on the link for survey information. Of the participants, 97% (148/152) were female, which reflects the sex difference within the profession, and 74% (113/152) worked in the general practice setting. Participants' demographic characteristics are presented in Table 1.

Knowledge and practice

Only one in 20 respondents agreed that they had 'excellent' knowledge about PCC for women (8/152) and men (7/152). When asked to rate their knowledge on the importance of the woman's health in the preconception period, over half (54%; 82/152) reported average to below average levels. Regarding the importance of men's health in the preconception period, this increased to two-thirds of respondents (67%; 102/152) reporting average to below average knowledge.

Table 1. Participant demographics ($n = 152$)
Respondents could select more than one option for qualifications and clinical practice setting. RA1–5, Australian Statistical Geographical Classification – Remoteness Area (RA)

	No. respondents (%)
Sex	
Female	148 (97)
Male	4 (3)
Age (years)	
<35	31 (20)
35–44	23 (15)
45–54	49 (32)
55–64	45 (30)
>65	4 (3)
Postcode of practice	
Major city (RA1)	86 (58)
Inner regional (RA2)	29 (20)
Outer regional (RA3)	27 (18)
Remote (RA4)	1 (1)
Very remote (RA5)	1 (1)
Unclassified	3 (2)
Qualifications	
Registered nurse (tertiary trained)	88 (58)
Registered nurse (hospital trained)	57 (38)
Midwife	35 (23)
Nurse practitioner	6 (4)
Postgraduate Qualifications	32 (21)
Clinical practice setting	
General practice	113 (74)
Community health	27 (18)
Educational setting	13 (9)
Child and family health	11 (7)
Management/education	5 (3)
Domiciliary (custodial/detention, boarding houses)	4 (3)
Occupational setting	2 (1)
Other	18 (12)

Almost three-quarters (74%; 115/152) of respondents reported discussing PCC with their clients, although only 13% (20/152) did so routinely (Table 2). Respondents were threefold more likely to discuss PCC with women than men.

PHCNs' attitudes to the delivery of PCC

Most respondents felt that GPs were best placed to deliver PCC, both for women (53%; 74/152) and men (72%; 98/152).

Almost all respondents identified at least one barrier to the delivery of PCC, with time and lack of knowledge the most frequently cited (Fig. 1). Two-thirds of respondents (67%; 102/152) cited more than one barrier, and just over half (55%; 84/152) reported three or more barriers to the delivery of PCC. When asked whether other barriers were experienced, there was the opportunity for a free-text response. A lack of incentives was further raised:

> I wish I had more incentives from my employers to discuss this kind of topic with patients.

> GPs often fill nurses schedule with chronic disease management activities that provide a greater incentive to the practice to have nurses.

Table 2. Practice of PCC ($n = 152$)

Discussion of PCC in daily practice	No. respondents (%)
Routinely	20 (13)
Sometimes	30 (20)
Occasionally	65 (43)
Never	37 (24)

Most (87%; 126/152) respondents indicated that more education would increase their confidence in delivering PCC. However, only 12% (18/152) had completed a freely available APNA online learning module on PCC. Of those who wanted more education, most wanted evidence-based information to refer patients to, such as fact sheets and websites, or interactive modes where they could ask questions (Fig. 2).

Discussion

Our survey explored PHCNs' knowledge of, practice of and attitudes to PCC. We found that although most PHCNs reported discussing PCC at least occasionally, only a small proportion do so routinely, with many respondents identifying at least one barrier to the delivery of PCC.

Knowledge and practice of PCC

Lack of knowledge was identified as a barrier to the delivery of PCC, and most respondents reported average or below levels of knowledge of the importance of PCC for men and women.

Although most respondents (87%) expressed the need for more education to enable their delivery of PCC, only 12% had completed the online APNA preconception educational module, which is free and accredited for continuing professional development. This study did not explore the reasons for the low uptake of this online module. The most frequently accessed APNA online learning health topics were those that led to, or support, funding for care delivered by PHCNs in general practice, including telehealth, immunisations, chronic disease management and wound care. Another contributing reason may be a low awareness of the importance of PCC, given that it is not commonly taught in undergraduate nursing courses. Furthermore, nurses may not have been aware of the existence of the PCC module because it is a relatively new resource. It is also possible that the significant increase in workload caused by COVID-19 limited nurses' ability to devote time to online learning.

Most respondents reported wanting live, interactive learning platforms (both webinars and face to face) in which they could ask questions. The need for educational material to direct clients to was also identified, specifically fact sheets and trustworthy websites. Similar sentiments were demonstrated in a study by Walker *et al.* (2021), who found that nurses felt the need for additional education and training in order to expand their capacity to deliver PCC.

Unfamiliar referral pathways were a barrier identified by a significant proportion of respondents. This has previously been identified as a 'bottleneck' in the delivery of PCC in the Netherlands, with calls to improve this by developing a comprehensive protocol for the PCC pathway (M'hamdi *et al.* 2017; Poels *et al.* 2017).

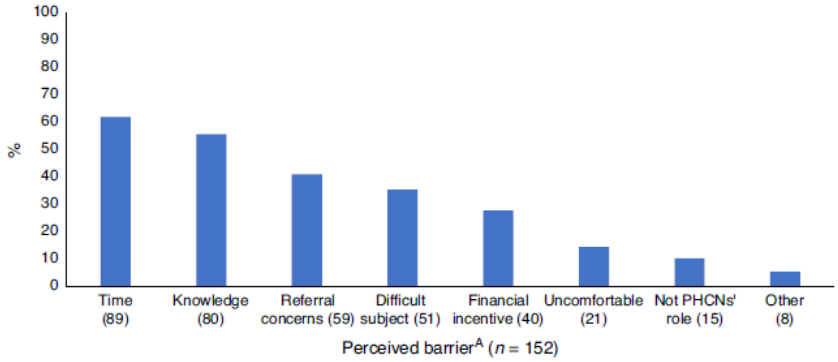

Fig. 1. Barriers to the delivery of preconception care. [A]Respondents could select more than one option. PHCN, primary healthcare nurse.

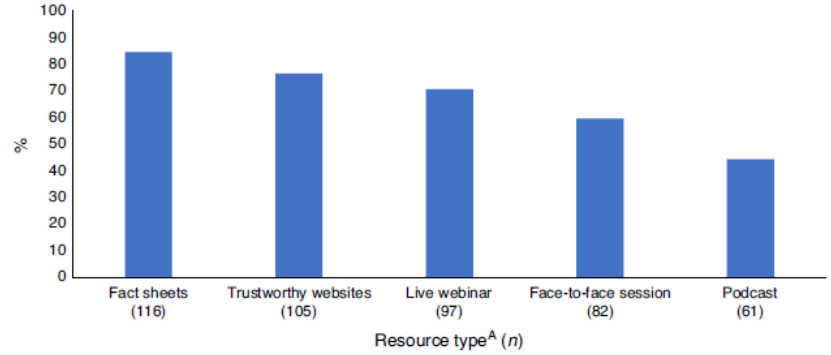

Fig. 2. Educational resources to enable preconception care. [A]Respondents could select more than one option.

Attitudes to PCC

Most respondents perceived that the GP is the best placed clinician to deliver PCC, followed by the PHCN. This study did not explore the reasons for this in detail, but several possible explanations are suggested in the literature. First there is a perceived medical focus of PCC, such as vaccinations and laboratory investigations, rather than an understanding of a holistic focus on health behaviours (Walker *et al.* 2021).

Second, we identified concerns about the feasibility pertaining to funding for PHCNs to deliver PCC, with more than one in four respondents reporting this as a barrier.

The Australian healthcare system is both publicly and privately funded, with Medicare being Australia's universal insurance scheme. The Medicare Benefit Schedule (MBS) is a list of services that can be rebated under this scheme. In 2010, nurse practitioners were given the right to bill for services under Medicare to increase access to high-quality primary care services, but the range of billable services available to nurses is limited (Currie *et al.* 2019). A recent Australian study highlighted the implications of these restricted MBS rebates, demonstrating they restricted nurses' scope of practice (Helms *et al.* 2015). This suggests that nursing care may be influenced by activities that increase a practice's financial reward rather than activities that are targeted to PHCNs' expertise, interest and population health needs.

In total, 40% of PHCNs responding to the APNA workforce survey in 2020 indicated their knowledge and skills were not being optimally utilised (Australian Primary Health Care Nurses Association 2020), which may suggest that their current scope of practice is limited by external factors. Currently there is no MBS item number for PCC, and it may not be viable for practices to allocate nursing time to these appointments when they cannot be billed. Financial burden to practices has been identified as a barrier to facilitating routine delivery of PCC both in Australia and internationally (Mazza *et al.* 2013; Poels *et al.* 2017).

A possible solution may be to adopt a collaborative health assessment model of care between PHCNs and GPs where the PHCN's time is included in the time-based item claim. A 'reproductive health assessment' for men and women using this model may increase the uptake of PCC by PHCNs. The GP–nurse

partnership would be enhanced as they would work together to provide comprehensive clinical care. Well-designed interprofessional collaborations between nursing and medical staff have been demonstrated to have positive outcomes for preventative health care (Matthys *et al.* 2017).

A recent Australian study demonstrated that both women and health professionals (GPs and nurses) supported PHCNs providing PCC (Walker *et al.* 2021). Some recommend that PHCNs provide PCC in specialist outpatient settings, such as for women with diabetes, and that this is done both opportunistically and in scheduled PCC appointments (Goddard and Claydon 2017). Such a model of care could potentially be extended to the primary healthcare setting.

In addition to enhancing the frontline delivery of PCC, a recent scoping review has proposed that PHCNs are the relationship link between primary care and public health, driving progress in preventative care (Swanson *et al.* 2020). Preventative health care is one of the key priority areas of both the National Women's and Men's Health Strategies, with aims to increase access to reproductive health care information and services (Australian Government Department of Health 2018). The National Primary Health Care Strategic Framework also lists improving access to primary health care as one of its four 'strategic outcome' measures to improve primary care (Australian Government Department of Health 2013). Recognising the vast impacts of preventative health care, the Australian Government is also developing a National Preventative Health Strategy with the goal of improving health at all stages of life. PCC embodies a life course approach, with health benefits that span across generations. Aligning with these three national strategies, the fragmented nature of current care could be changed to a systematic and structured approach to the universal provision of PCC.

Strengths

This is the first Australia-wide survey of PHCNs on their experiences of PCC. Our survey captured PHCNs from a range of locations, with good representation from inner and outer regional Australia. Respondents also included PHCNs from a range of clinical practice settings.

Limitations

Response rates were relatively small, which may reflect the many competing demands on PHCNs during the COVID-19 pandemic. We also had low representation of PHCNs from remote and very remote areas. Because this study was advertised as a survey about PCC, respondents may have had a special interest in PCC and may not be representative of all PHCNs.

Conclusion

The benefits of PCC are well recognised; however, the delivery of PCC needs to be improved and strategies for the implementation of PCC need to be strengthened. Enhancing the role of the PHCN with collaborative education programs, structured referral pathways and the development of educational resources is needed. Defining the role of the PHCN in the field of PCC must be done in collaboration with GPs and public health experts. This study identifies areas for improvement at the individual, organisational and health system levels to enable and enhance the role of the PHCN in the delivery of PCC.

Conflicts of interest

The authors declare no conflicts of interest.

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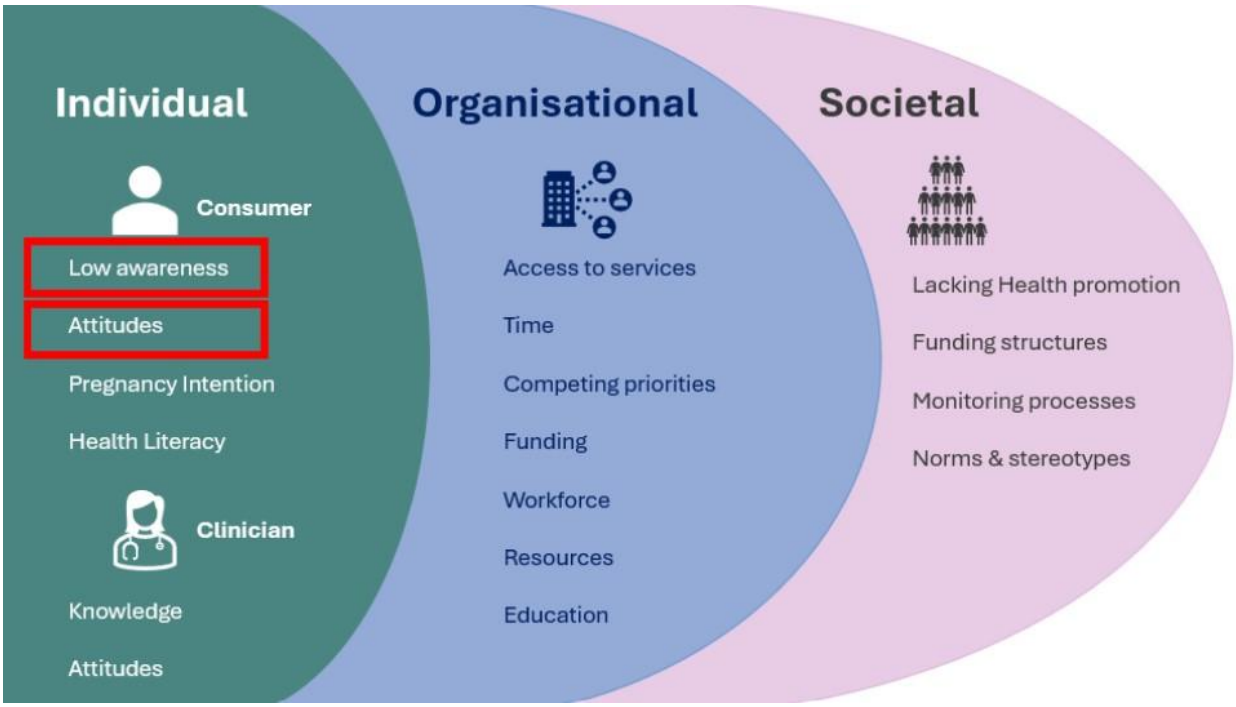
Chapter 5: Understandings of preconception health and care

5.1 Chapter Aim

Low levels of consumer awareness about the importance of good preconception health are a recognised barrier to the uptake of preconception care at the individual level. Additionally, a person's attitudes and understandings of who needs preconception care can also influence the uptake of positive behaviours before pregnancy.



This chapter is a qualitative study, using in-depth interviews with people of reproductive age in Australia to explore their understandings of "preconception health". These findings can inform the delivery of preconception health information and preconception care.

5.2 Publication details

Dorney E., Cheney K, Musgrave L., Hammarberg K., Rodgers R., Black KI. Understandings of preconception health in Australia; findings from interviews with people of reproductive age and the implications for care providers.
Submitted to *Women and Birth*. Currently Under Review

5.3 Author contribution

ED and KB established the Rural Women's Health Consumer Advisory Group (RWH-CAG) and ran the quarterly meetings. ED was responsible for the study design, recruitment and conducted the in-depth interviews. ED and KC performed the data analysis and synthesis of findings. ED led the writing of the manuscript. All authors read and approved the final manuscript.

5.4 Manuscript

Understanding preconception health in Australia through the lens of people of reproductive age: Implications for care providers.

Abstract

Problem: Limited awareness about the importance of preconception health is a recognised barrier to preparing for pregnancy.

Background: Opportunities exist to improve the health of future parents through preconception care. One of the recognised barriers to pregnancy preparation is a lack of knowledge and a lack of presentation for information and care.

Aim:

To explore the understanding of "preconception health" amongst people of reproductive age in Australia to inform the delivery of preconception care.

Methods:

A qualitative descriptive study using online interviews with people of reproductive age in Australia. Recruitment was via social media (Facebook). Interview transcripts were analysed thematically.

Findings: Of the 20 women and five men we interviewed, all acknowledged the importance of preparing for pregnancy. Despite broadly understanding the concept, most participants had limited understanding of the details of preconception health. To increase their knowledge, participants' preferred sources of information included education in schools, reputable online sources, primary and maternity healthcare providers, and community members with lived experience.

Discussion:

People in Australia are keen to learn about preparing for pregnancy and appreciate this as important. Suggested avenues to improve awareness and understanding about optimal preconception health included through school education, primary and reproductive healthcare providers, and online resources. This can improve understanding and behaviours before first and subsequent pregnancies.

Conclusion

Preconception care requires a life-course approach, beginning with universal education through schools, enhanced by readily accessible reputable online resources, and access to trusted primary and maternity care providers. Maternity care providers can be key drivers in this process.

Keywords

Preconception care, midwife, knowledge, health promotion, learning, rural population

Statement of significance

Problem

Good preconception health benefits parents and their children, yet half of all women report taking no health actions to prepare for pregnancy.

What is already known

Limited understanding about the importance of preconception health is a barrier to optimal pregnancy preparation behaviours

What this paper adds

People want to learn about preconception care and see this as an important health issue. Both women and their partners want to receive advice about pregnancy preparation from reputable sources and primary and maternity healthcare providers, the latter which was reported to influence behaviours in subsequent pregnancies.

Introduction

Preconception care aims to optimise the health of women and their partners prior to pregnancy. (1) Optimal parental preconception health improves chances of conception, pregnancy outcomes, childhood health and the health of future generations. (1-4) Evidence exists for the benefits of a range of preconception interventions, from micronutrient supplementation including folic acid, to increasing physical activity and optimisation of chronic medical conditions including diabetes. (2, 3, 5, 6) While many women seek care when pregnant, interventions delivered in the pregnancy period alone are too late to achieve the best health outcomes for women and their babies. (1) Preconception and inter-conception care interventions can benefit future parents and children.

Preconception care and the impact on clinical outcomes

There is growing evidence to support the positive impact of preconception care as a person's health before pregnancy influences gametogenesis and the early intrauterine environment. (1) Folate supplementation three months before conception and continued in pregnancy decreases the incidence of neural tube defects by up to 70%. (2) Strict glycaemic control for women with pre-existing diabetes (target HbA1c < 6.5%) reduces the incidence of congenital malformations and early pregnancy loss.(3, 7) Smoking, alcohol consumption and use of recreational drugs remain important modifiable risk factors for adverse pregnancy outcomes especially in priority populations. Being above a healthy weight before pregnancy is associated with adverse short and long-term health outcomes for children, including being above a healthy weight in early childhood. (8) The preconception period has been identified by the World Health Organization as one of the six key areas to end

childhood obesity, and the International Federation of Gynecology and Obstetrics (FIGO) have released best practice advice stating reproductive care providers should support weight optimisation prior to pregnancy. (9)

Who needs preconception care?

All people of reproductive age stand to benefit from evidence-based preconception care. International data shows over 90% of women have at least one modifiable preconception health risk factor,(10) with a Canadian study showing that women have on average 15 modifiable preconception risk factors that can impact pregnancy outcomes. (11) Locally, one in four pregnancies in Australia is unintended and women receiving antenatal care report suboptimal rates of preconception folate supplementation. (12, 13) Across Australia, almost half of all women entering pregnancy are above a healthy weight and more than one in five women smoke prior to pregnancy. (14, 15) Data is lacking on the number of women entering pregnancy who take recreational drugs, with one recent Australian study finding 1.6% of women reporting cannabis use in pregnancy. (16) The incidence of chronic medical conditions, including diabetes and hypertension increases with increasing parity, highlighting the need for intervention in the interpregnancy period.(17) Certain priority groups, including those living in rural and remote areas, and from areas of socioeconomic disadvantage, endure higher risk of poor reproductive outcomes than others and therefore require targeted attention. (18) The prevalence of many modifiable risk factors, such as smoking, excessive alcohol consumption and being above a healthy weight is higher among those living in Australia's rural and remote areas than those living in metropolitan areas. (18)

Who delivers preconception care in Australia?

FIGO recently put out a "call to action" that all health care professionals who see women of reproductive age have a responsibility to deliver preconception care. (19) Primary health care has traditionally been proposed as the recommended setting for preconception care as ideally this care takes place before contact with hospital maternity services. (20, 21) Evidence shows that preconception care in Australia is provided opportunistically and not routinely in primary care. (22) More recently, antenatal and postnatal care have been identified as additional settings to deliver preconception care. Assessing pregnancy intention, and the incidence of obstetric complications can serve as an impetus to improve health before a next pregnancy. (23, 24)

Barriers to the delivery of preconception care

Barriers to delivering preconception care include people's lack of awareness of the importance of preconception health. (20) Additionally, it is reported that women do not see the need for formal preconception health checks. (21) Other barriers include time constraints, lack of access to health professionals and a lack of resources to support the delivery of preconception care. Cost has also been identified as a barrier improving preconception health, with recommendations to provide affordable options to enable women to adopt positive preconception behaviours. (25, 26) These barriers are more manifest for people living in rural and remote areas. (18)

Access to preconception health information

Across Australia strategies for maternity care identify access to information before pregnancy as a key action area. (27) Evidence suggests that Australian women want to learn about preconception care and adopt positive health behaviour changes. (21)

Most women report a preference for online information sources and use technology to find information on pregnancy health. (28, 29) Twenty-eight percent of Australia's population live in rural and remote areas (18) and The National Women's Health Strategy identifies "Women and girls from rural and remote areas" as one of its ten priority populations. (30) The aim of this study was to explore understanding about preconception health, and health information seeking behaviours among people of reproductive age in Australia, including from rural and remote areas in order to help inform preconception health promotion and education strategies.

Methods

This qualitative study to explore understandings of preconception health, was a key component of a project to optimise a pre-existing online preconception health self-assessment tool. (31) At the beginning a Rural Women's Health Consumer Advisory Group (RWH-CAG) was established to ensure person centred study design, guide recruitment strategies and inform the interview questions to be inclusive for people living in regional and remote Australia.

This comprised six women aged 19 – 30 years old from rural locations across Australia.

Study design

A qualitative descriptive study using in-depth interviews to gain insight into individual viewpoints and understanding of preconception health.(32) The study was designed in collaboration with the RWH-CAG, who co-designed recruitment materials, advised on recruitment strategies, and co-developed the interview guide.

Participants & Recruitment

People of reproductive age (18 – 41 years old), residing in Australia, who could speak and read English were purposively recruited between January and September 2021.

Given the COVID-19 pandemic restrictions enforced at that time, recruitment was via social media (Facebook) and sites for interview promotion were suggested by the RWH-CAG. Interested participants responded to the study advertisement and were contacted by the research team. Participant information statements were linked with the study advertisement and with correspondence to arrange interview times.

Facebook recruitment advertisements targeted regional and remote community parent groups and noticeboards, and parenting groups in lower socio-economic areas, as identified by postcode. Examples of the recruitment materials are shown in Figure1.

Provision of fifty-dollar gift certificates served as a gesture of appreciation.

Members of the research team met throughout the data analysis process to refine the interview questions, and adjust recruitment as required. Recruitment of women ended when no new data emerged, and previously identified themes were repeating. (33) Interim analysis showed that women viewed partner involvement as critical to improving attitudes to preconception care. This led to the extension of recruitment to include men.

Figure 1: Recruitment materials

Are you aged 18-41 years living in Australia? We want to learn about how you might get healthy for pregnancy. You don't need to be planning or wanting a pregnancy now – it is about what you might do in the future!

You will receive a $50 VISA gift card as a thank you for participating. To learn more please visit here

Data Collection

Interviews were conducted via telephone or online videoconferencing at the participants request. As interviews were not performed face-to-face, verbal informed consent was gained prior to data collection. Participants were offered the opportunity to bring a support person(s) and were assured that withdrawal from the study could occur at any time. Interviews were completed by one researcher (ED) using an interview guide developed by the research team. (Supplementary File 1)

Interviews explored people's understanding, knowledge, and perceptions of the importance of preconception health, and their preferences for learning about preconception health. Reproductive health information-seeking behaviours were also explored. To establish clarity regarding the study's objectives, participants were reminded of the purpose at the outset of the interview, and inclusive, participant-led discussions encouraged explorative dialogue.(34)

Interviews were recorded, deidentified and transcribed, and all data saved as per protocol on the Sydney University Data Dashboard with an endorsed Research Data Management Plan and will remain confidential until destroyed in due course.

Data Analysis

A qualitative analytic approach of reflexive thematic analysis was adopted. (35, 36) An analytic approach is not limited to answering a single research question and allows for the discovery of more than one content focus. (32) This allowed for not only the appraisal of the preconception self-assessment tool, but an exploration into attitudes and understanding of preconception care. This approach was framed within this study as the development of a coherent understanding of patterned meaning

across the whole dataset. (37) Through reading the transcriptions for thematic and implicit material, patterns of shared and differing meanings were inductively identified and interpreted. (37) The process, first described by Braun and Clarke (38) involved iterative repeated steps to ensure comprehensive conceptualisation faithful to the patterns of meaning in the data. Coding and thematic development evolved through cyclical engagement with the data and within shared researcher discussions. The involvement of experts in women's health enhanced critical reflexivity among the researchers during analysis.

Interview data was analysed by two researchers (ED and KC) who have reproductive and public health expertise. The researchers met regularly to review and discuss findings. Data was coded, manually without assistance of software programs, to detect key concepts and constructs to organise the findings.(38, 39) All coding documentation has been securely stored in line with governing institution's research data management processes. Constructs were further discussed between all members of research team to identify themes. The researchers have both personal and professional experience with pre-pregnancy care and were conscientious to actively separate their experiences from the analysis. The researchers applied a reflective lens, in which they were actively aware of any potential biases that could influence data analysis. An example of this was in synthesising the finding that women were not aware about preconception folate supplementation. The researchers had to reflect that such information is known to them from their professional background but is not known to others. Additionally, the researchers consulted with the broader research team, and the RWH-CAG to get different perspectives and ensure that their assumption did not influence coding and theme generation.

Additional analysis by pregnancy intention (those planning a pregnancy in the next 12 months "planners" and those not planning a pregnancy in the next 12 months "non-planners") and gender was also performed. This involved a separate analysis of transcripts for these cohorts, to explore for any additional insights that could inform potential preconception interventions.

Ethics

This study was approved the relevant Ethics Committee Project Number 2020/430 (22 June 2020).

Findings

Forty-six women and six men responded to the recruitment advertising. Interviews were conducted with 20 women and five men between February and September 2021. All participants were interviewed individually and did not bring a support person, the interviews ranged in time from 31 to 53 minutes. Participant characteristics are shown in Table 1. Participants resided in metropolitan, rural and remote locations, and were from a range of socio-economic backgrounds. None of the participants identified as Aboriginal or Torres Strait Islander. Thirteen participants were parents, and an additional three women had been pregnant previously, one participant was in a same-sex relationship. At the time of the interviews, nine women and one man were planning a pregnancy in the next 12 months.

Table 1: Participant Characteristics

Characteristic	Number (%)
Gender	
Female	20 (100%)
Age (years)	
Range	19-40
Median	29.5
Postcode of residence*	
Major Cities of Australia (Metropolitan)	6 (30%)
Regional Australia	9 (45%)
Remote & Vey Remote	5 (25%)
SEIFA ISRAD Quintile**	
Quintile 1	5 (25%)
Quintile 2	3 (15%)
Quintile 3	3 (15%)
Quintile 4	4 (20%)
Quintile 5	5 (25%)
Education	
Secondary	3 (15%)
Vocational	1 (5%)
Tertiary	16 (80%)
Reproductive status	**20**
Parent	11 (55%)
Previous Pregnancy	14 (70%)
Currently Pregnant	1 (5%)
Planning Pregnancy next 12/12	9 (45%)
Heard of term preconception care	7 (30%)
Regular GP	17 (85%)

Characteristic	Number (%)
Gender	
Male	5 (100%)
Age (years)	
Range	24-32
Median	28
Postcode of residence*	
Major Cities of Australia (Metropolitan)	5 (100%)
Regional Australia	0
Remote & Vey Remote	0
SEIFA ISRAD Quintile**	
Quintile 1	1 (20%)
Quintile 2	1 (20%)
Quintile 3	1 (20%)
Quintile 4	0
Quintile 5	2 (40%)
Education	
Secondary	2 (40%)
Vocational	1 (20%)
Tertiary	2 (40%)
Reproductive status	**4**
Parent	2 (40%)
Previous Pregnancy	2 (40%)
Currently Pregnant	0
Planning Pregnancy next 12/12	1 (20%)
Heard of term preconception care	0
Regular GP	5 (100%)

*As defined by the Australian Statistical Geography Standard (ASGS)

**Socio-Economic Indexes for Areas, Index of Relative Socio-Economic Advantage and Disadvantage

Three key themes, informed by supporting constructs, emerged about information seeking and what impacts people's understandings of preconception health (Table 2). The first theme was about people's perceptions, awareness and understanding of preconception health. This revealed universal support for good preconception health,

but a superficial understanding of the topic. Preferences for learning about preconception health and current practices for health information seeking were the two other key themes identified.

Table 2: Key themes and supporting constructs for learning and understanding preconception health.

Theme 1	**Perceptions of preconception health and care**
Construct 1a	Preconception health is important
Construct 1b	The concept versus content of preconception health/or preconception health interventions
Theme 2	**Practices for reproductive health information seeking**
Construct 2a	Trusted online sources
Construct 2b	Role of the healthcare provider
Construct 2c	Trusted community sources
Theme 3	**Preferences for learning about preconception health**
Construct 3a	Teach everyone, early
Construct 3b	Accessible and available information as needed
Construct 3c	Community are a source of information

Theme 1: Perceptions of preconception health and care

Construct 1a. Preconception health is important.

All participants were keen to learn about preparing for pregnancy and saw this as a critical issue. This was the case irrespective of gender, previous pregnancy experience and planning status.

"it's definitely something that should be very much front of mind and very common knowledge." (female, non-planner, previous pregnancy)

"Yeah, I think it's quite important, especially as a man." (Male, non-planner, no previous pregnancy)

Participants also viewed preconception health as an acceptable topic to discuss with people of reproductive age as part of routine health care. Non-planners identified that not all people may be considering pregnancy, and that the topic therefore should be raised sensitively.

"I think it's something that potentially is good to raise with people. But I think it's also very sensitive as well. So, just being more of a gently, gently approach… raising it as more of a general health concern." (female, non-planner, previous pregnancy)

Construct 1b. The concept versus content of preconception health/or preconception health interventions

All participants demonstrated a fundamental understanding of the concept of preconception health, as being "healthy" before pregnancy, with many identifying that this includes both physical and mental health. Being healthy was most often defined as exercising regularly and having a balanced diet. Beyond this basic understanding, participants had limited knowledge regarding the breadth and detail of the content of preconception care. Those who had experienced a pregnancy, appeared slightly more knowledgeable about positive preconception health behaviours despite not having adhered to these behaviours prior to their own pregnancies.

There was also limited knowledge around who needs preconception care, with almost half of all participants associating this with defined populations rather than all people of reproductive age.

Degree of knowledge about the components of preconception health including specific actions to improve preconception health, and their timing, was variable. All participants recognised exercise and smoking cessation as recommended

behaviours prior to pregnancy. However, several other interventions were not mentioned as part of preconception care, including the need for micronutrient supplementation and cessation of alcohol consumption.

Participants who had experienced more than one pregnancy reported a change in preconception actions having learned in antenatal care about the importance of preventive health behaviours prior to pregnancy. This was most frequently reported in relation to folate supplementation and alcohol.

"Yeah… I did not do anything – so, when I got to do the doctors to do the pregnancy test, he said, "Have you been taking Elevit?" And I said, "No, I've never heard of it." So, I didn't do any sort of preconception care. There was no journey to falling pregnant. It was literally just – yeah. I think it's time to fall pregnant. So, yeah, there was no talking about it or journey. (female, non-planner, previous pregnancy)

"Yeah, I guess about the alcohol. I guess I knew, obviously, you don't drink during pregnancy, but I didn't know that it's important to not drink beforehand. Even when you're trying." (female, planner, previous pregnancy)

When discussing target populations for preconception health and care, all participants felt that good preconception health was relevant and could benefit all people of reproductive age regardless of pregnancy intention. There was also a strong consensus that partners should be actively included in discussions about preconception care.

"I think everyone - I think all parents considering to have children would benefit from it. I think whether or not you considered to have children or not, the kind of information is important and should be in our education system. Because you don't have to plan to have children, it happens." (Male, non-planner, previous pregnancy)

Despite the perceived universal applicability of good preconception health, some participants reflected they did not seek preconception care before a previous pregnancy as they perceived themselves to be “healthy”. Several participants felt that preconception care was a fertility issue only, directly relating to the ability to conceive and therefore only necessary for those who experienced fertility difficulties. Others felt that preconception care is only important for certain population groups, including “older” women or those who have a health condition.

“I don't think it would have particularly crossed my mind to go and have a check-up before I fell pregnant Yeah, and you know I didn't go to my GP before I fell pregnant. Like, I was healthy” (Female, non-planner, previous pregnancy)

“I think elderly women, so I think maybe like women from their 30’s. I like to think that a lady in her 20’s is less likely to need it because of her age.” (female, planner, no previous pregnancy)

Terminology was raised as an issue as few participants had heard of the term "preconception care" despite understanding the concept. Participants indicated that the term was "medical", and "jargon", one participant identified this as a disconnect between language used by healthcare providers and the community. This sentiment was consistent across female and male participants, planners and non-planners, and those who had and had not experienced pregnancy. Participants identified that this impacted communication and subsequent awareness of this health issue.

“Yeah, whereas some people might not use the word preconception, that’s a real medical term for some people” (female, non-planner, no previous pregnancy)

“I think it’s really important to have it in normally words. I know it feels more professional and more important if it’s in proper academic words, but most people

don't understand that and they don't understand the concept. And if you're too busy trying to read the big words, you don't actually get the full story." (female, planner, no previous pregnancy)

Theme 2: Practices for reproductive health information seeking

Construct 2a. Trusted online sources.

All participants reported using the internet to seek reproductive health information, and that online sources were their first point of call. Most participants reported prioritising their online searches to what they perceive as reputable sources. They expressed a preference for web handles associated with government websites, but some also visited commercial and public forum sites. People who had experienced pregnancy before also identified hospital-based, and maternity child and family health information sites as trusted and valuable resources.

"I probably would Google first. I think that's my default – yeah" (female, planner, previous pregnancy)

"I look for does it come from a trusted source, is it from the Royal Children's Hospital website or is it from Breastfeeding Victoria's website, not just a mummy blog or a website that has obvious ads or links to creams that they want to sell you." (female, non-planner, previous pregnancy)

2b. Role of the healthcare provider

Healthcare providers were also identified as an important source for reproductive health information. Primary care providers were cited as a source of information by

all participants, regardless of pregnancy intention. Some participants acknowledged that for people in rural and remote locations seeking information about reproductive health from a healthcare provider could be challenging due to practitioner workload, travelling distance, and lack of privacy in a small community. For those who had pregnancy experience, maternity and early childhood care providers were also seen as valuable sources of information.

"Obstetrically, the maternity unit is fantastic, and the child and family health nurses, they're quite health-promotion, health-advocation kind of thing." (female, planner, previous pregnancy)

"Well, what I would do is I'd go straight to my GP but if she didn't have - she's a GP, not a specialist. The maternity clinic in [location] specifically is very, very good." (female, non-planner, previous pregnancy)

Construct 2c. Trusted community sources.

Participants also used trusted community sources such as a friend and family member for reproductive health information, particularly those with relevant experience. Participants were not mutually exclusive in their health information seeking behaviours, with many reporting seeking information from multiple sources.

"I do probably just Google it and then I ask my mum or my sister." (female, non-planner, previous pregnancy)

"First of all, we went online, Googled. Google tells you everything, doesn't it? But then also, we did also book appointments with our doctor and had that discussion, and then friends as well." (female, planner, no previous pregnancy)

Theme 3: Preferences for learning about preconception health

Construct 3a. Teach everyone, early.

Participants supported the universal promotion and education about preparing for pregnancy and identified several avenues to increase awareness. An early, foundational understanding of preconception health was viewed as critical and inclusion in school curricula was identified as an opportunity to increase awareness and knowledge of specific components of preconception health. This view was shared by male and female participants, planners and non-planners.

"I guess school, the issue of school education...is kind of a perfect chance to teach people just a bit younger than me about this. So that then it's not new to them, like the supplements were for me when I took the survey, I'd never heard of them before." (female, non-planner, no previous pregnancy)

"I think it's just really something that should be taught in schools." (female, non-planner, previous pregnancy)

Construct 3b. Accessible and available information as needed.

Participants identified having readily available, easy to find preconception health information as an enabler for those who were planning a pregnancy and seeking information. Active health promotion was also suggested to increase awareness about preconception health. Social media, including promotion within dedicated social media groups, health care settings, both primary and tertiary care, and Government health information websites were suggested avenues for health promotion and information resources.

"I think social media would be a good place to promote because usually partners are always browsing through phones together at the same time, and then they all can have that conversation together about it as well." (male, non-planner, no previous pregnancy)

"Give it out to the midwife clinics…that's where most people go to have their pregnancies. Also give it out to the Breastfeeding Association as well. That's where I would also start. Then your pharmacists and then your GPs" (female, non-planner, previous pregnancy)

"you'd probably have to run it on your hospital pages, or even your state medical websites." (male, non-planner, no previous pregnancy)

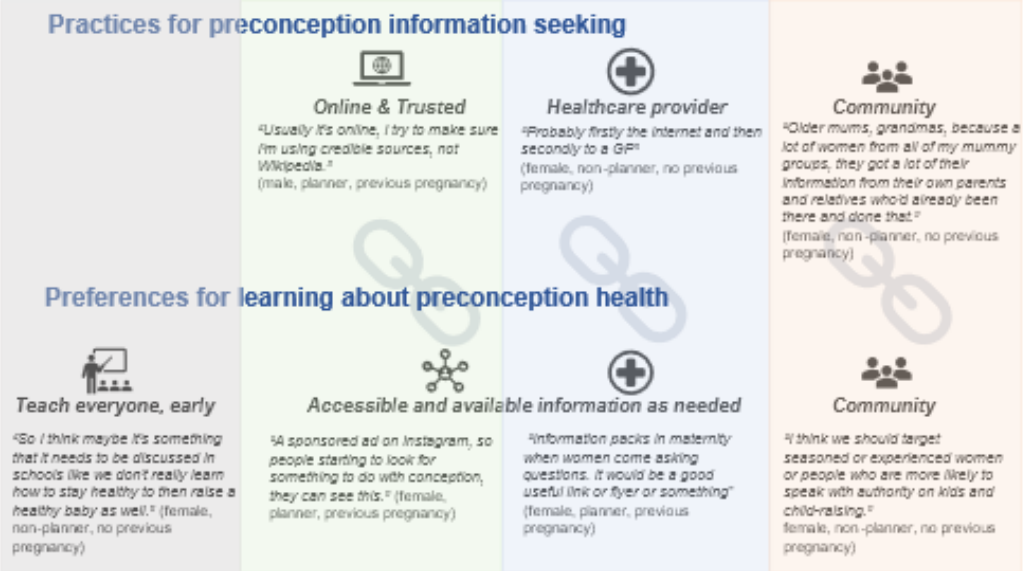
Construct 3c. Community are a source of information.

Participants also identified trusted community members as a valuable source of health information and advice. Over half of the participants cited family and friends with lived experience of pregnancy as valued communicators of health information and identified them as a source of trustworthy information. Some participants went on to express that those with lived experience should also be included in preconception health promotion efforts to ensure they provide current advice for future parents.

"Because I think it would be even beneficial for grandmothers to help understand the message, to deliver that message to when their daughters or granddaughters are trying to fall pregnant. So, even if they are - you know, have gone through menopause and are no longer able to reproduce, just having that knowledge and talking about it with their daughters or their daughters' daughters is going to help spread the message." (female, planner, previous pregnancy)

"The first thing I want to say is older mums, grandmas, because a lot of women from all of my mummy groups, they got a lot of their information from their own parents and relatives who'd already been there and done that." (female, previous pregnancy, non-planner)

Figure 2. Practices and preferences for preconception health information



Discussion

Our findings show that people of reproductive age across Australia, broadly appreciate the concept of preconception health and perceive that it is important to women and their partners. Despite this broad understanding, significant gaps in knowledge about preconception health and care were identified. Detailed understanding of the components of preconception health and care, the timing of implementing these components and which populations required preconception care were lacking. This is consistent with previous local and international research calling for increased health promotion efforts and availability of reliable evidence-based information for consumers. (25, 40) Our study identified opportunities to improve preconception health information at the individual and population level.

Increasing awareness of the importance of preconception health at the individual level.

Participants in our study identified the impact of preconception education provided by health professionals during antenatal care, reporting a change in preconception behaviours for subsequent pregnancies. The impact of preconception information provided in primary care has been shown to increase the likelihood of adopting a preconception health behaviour to those who are not currently pregnant. (41) Stephenson et al showed that women who received preconception advice from a health professional were twice as likely to take folic acid and adopt a healthier diet before pregnancy, compared to those who had not received advice. (41) Participants in our study also expressed confidence their maternity care providers and see them as trusted sources of reproductive health information during and after pregnancy.

This is supported by international data, including Vogels-Broeke et al's cross sectional study in over 1900 women in the Netherlands. They demonstrated over ninety percent of respondents identified midwives as a source of information for women during pregnancy, making them the most common source of information. . (42)

While participants acknowledged the role of primary healthcare providers for reproductive health information, most women stated they and their partners did not seek help from their GP prior to pregnancy even when they had good access to one. This presents a missed opportunity for preconception care. Additionally, women from rural and remote areas reported lengthy wait times to see their GP.

All participants in our study identified the need to include partners in discussions about pregnancy planning and preconception care. A survey of over 300 GPs in Australia showed that most do not discuss pregnancy intention or the importance of preconception care with men.(43) Midwives and maternity care providers also have a unique role in offering continuity of care to a woman and her partner on their pregnancy journey, which is often the first healthcare presentation for otherwise healthy individuals and couples. (44, 45) This presents an opportune time to deliver preventive health information that can benefit parents and their children for the current and future pregnancies.

Midwives, who are Australia's primary maternity care providers, also work across many settings in a variety of models of care, including primary care and community health services, Aboriginal and Torres Strait Islander medical services, hospitals and health clinics. A midwife's scope of practice involves providing care and preventive measures across the pregnancy continuum from before pregnancy (preconception),

during pregnancy, intrapartum an in the postnatal period. (46) There are over thirty thousand registered midwives in Australia, with 13.7% having their principal work setting in primary care. (47)

Recent studies have shown that midwives in Australia are keen and willing to provide preconception care and see that this is within their scope of practice. (23, 48) This endorsement of the importance of preparing for pregnancy from this study should encourage midwives, working in all models of care and healthcare settings to ask opportunistically about pregnancy intention and provide preconception care in health consultations. This was also supported by a recent population-based study that showed 74% of people of reproductive age felt it was acceptable to be asked about pregnancy intention. (49)

Increasing awareness of the importance of preconception health at the population level.

Both national and state-based strategies in Australia prioritise the provision of preconception information. (27, 30) One state-based strategy states that "*Information about how to optimise health before conception is evidence-based, easily accessible and understood.*"(27p9) Messaging about the importance of preparing for pregnancy must begin early and at scale, then be available opportunistically, and on demand, via reputable sources to those who are seeking it. Participants in our study indicated the need for school-based education on preparing for pregnancy, so that this was not a new concept when adolescents reach their reproductive years. The need to include preconception health education in the school setting, to reach people at the

beginning of their reproductive years, has been identified in other Australian studies (25) Internationally school-based preconception education sessions have proven to be effective in increasing knowledge about preconception health.(50) Charafeddine et al describe a preconception health education session to more than 7,000 students in years 10 – 12 in Lebanon. The session comprised of a 20-minute presentation, including visual resources that covered seven key preconception health areas and their impact on reproductive outcomes. Student's knowledge about preconception health was measured before and after the education session with students in all grades showing a 47% improvement in their test scores after attending the session. (50)

At the very core of health promotion and education is the need to communicate in a language that people understand. (51) Most participants in our study had not heard of the term "preconception care" and preferred more simple terms to describe the concept. This must be considered and adopted when designing messaging to improve health prior to pregnancy. Plain language terms, that resonate with the population must be tested and incorporated into health promotion efforts.

The finding that people seek out trusted sources of information is consistent with existing Australian research that found that women wanted reproductive health information from credible sources, and that they often looked to the web handle to prioritise such information sources. (21) Online preconception and pregnancy health resources in the United Kingdom have been successful in their reach and engagement, proving a valuable vehicle for the delivery of evidence based reproductive health information. (52) These sources have adopted jargon-free terminology, using everyday terms such as "Planning for pregnancy" to be easily found by people.

The importance of trusted community members for reproductive health information mirrors findings from research on breastfeeding advice, which demonstrates the importance to family members and grandparents for decisions to breastfeed. (53, 54) Recent international studies that explore awareness about and uptake of preconception health behaviours, have shown the influence of partners, friends and family as information resources. (40, 55)

People living in rural and remote areas face the inequity of poor access to health care providers. This can lead to a lack of opportunistic provision of advice on preventive initiatives, including preparing for pregnancy. Almost 30% of Australia's midwifery workforce practice outside of metropolitan centres, with the highest proportions of midwifery full-time-equivalent roles per 100,000 population being in remote and very remote communities. (47) Expansion of continuity-of-care models in these settings offers a key opportunity to improve preconception health and care for women and their partners in remote communities and the health of their future children.

Strengths and limitations

Strengths of this study include that it captured perspectives from both women and men and from people with different reproductive intentions and experiences. The findings support previous Australian research and demonstrate the urgent need to normalise conversations about pregnancy planning and incorporate advice about what people can do to give themselves and their children the best chance of good health into primary and antenatal care encounters.

We also acknowledge study limitations. Given most participants had a tertiary education, our sample may not have included those of lower health literacy and this

needs to be considered when developing strategies for health promotion and education. These findings in an educated population may underestimate the true limitations in knowledge among people of reproductive age hence suggesting more urgency to improve awareness about preconception health and care.(56) People from rural and remote areas are only one priority population and understanding the needs and preferences of other key priority groups, including those from Aboriginal and diverse backgrounds, people living with disability and people with language backgrounds other than English should also be explored.

Conclusion

Our study has shown the appetite of people in reproductive age in Australia to learn about how to best prepare for pregnancy and their preferences for how to receive this information. This embodies a life course approach, with universal foundation of education through school settings, enhanced by a combination of readily accessible and opportunistically provided information from trusted sources and healthcare providers. The findings from this study can inform strategies to improve promotion of preconception health, provision of preconception care, and reproductive outcomes. Partnerships between health and education sectors to deliver reliable health information needs to begin in schools. Positive health messaging from trusted healthcare providers, including midwives is required to support the delivery of preconception care.

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Chapter 6: Optimisation of an online self-assessment tool for preconception care

6.1 Chapter Aim

Prior to the commencement of this PhD work, an online self-assessment tool for preconception health, “The Healthy Conception Tool” (HCT) was in existence. The HCT was developed in 2016 by *YourFertility*; a Commonwealth funded fertility health promotion program. As an online interactive tool, the HCT had the potential to improve knowledge among people of reproductive age about the importance of optimal preconception health. This includes people who experience health inequities such as women and men in rural and remote areas and those who experience socioeconomic disadvantage. When the HCT was developed in 2016 there was no consumer input to the design or content, which is a missed opportunity to maximise reach and impact to the end-users of this tool. In addition, the tool was not readily available for the general public as it was housed on a website promoted more for issues of infertility.

In this chapter I outline the steps taken to assess and enhance the HCT. This work aims to increase the reach of the tool and thereby raise awareness and understanding about the importance of good preconception health.

6.2 Publication Details

Dorney E, Hammarberg K, Rodgers R, Black K. Optimisation of an online self-assessment tool for preconception health: user feedback and user-experience testing in people of reproductive age in Australia. (Preprint). JMIR Human Factors. 2024.

6.3 Author Contribution

ED and KB established the Rural Women's Health Consumer Advisory Group (RWH-CAG) and ran the quarterly meetings. ED was responsible for the study design, recruitment and conducted the in-depth interviews. ED and KB performed the data analysis and synthesis of findings. ED collaborated with design experts to co-ordinate user-experience testing and tool modifications. ED led the writing of the manuscript. All authors read and approved the final manuscript.

6.4 Manuscript

Original Paper

Optimization of an Online Self-Assessment Tool for Preconception Health: User Feedback and User-Experience Testing in People of Reproductive Age in Australia.

Abstract

Background

Good preconception health reduces the incidence of preventable morbidity and mortality for women, their babies and future generations. In Australia there is a need to increase health literacy and awareness about the importance of good preconception health. Digital health tools are a possible enabler to increase this awareness at a population level. The Healthy Conception Tool (HCT) is an existing online, preconception health self-assessment tool, that has been developed by academics and clinicians.

Objectives

To optimise the HCT and seek user feedback with the aim of increasing engagement and impact of the tool.

Methods

In depth interviews were held with women and men aged 18-41 years, who spoke and read English, and were residing in Australia. Interview transcripts were analysed, and findings were used to inform an enhanced HCT prototype. This prototype underwent user-experience testing and feedback from users to inform a final round of design changes to the tool.

Results

Twenty women and five men were interviewed; all wanted a tool that was quick and easy to use with personalised results. Almost all participants were unfamiliar with the term "preconception care" and stated they would not have found this tool online with its current title. User-experience testing with six women and five men identified eleven usability issues. These informed further changes to the tool's title, the information on how to use the tool, and the presentation of results.

Conclusions

Online self-assessment tools need to be easy to find and communicate health messages effectively. End-users' feedback informed changes to improve the tool's acceptability, engagement, and impact. We expect that the revised tool will have greater reach and prompt more people to prepare well for pregnancy.

Introduction

Preconception care aims to optimise the physical and psychological health of women and their partners prior to conception. [1] Good preconception health reduces the incidence of preventable morbidity and mortality for women and their babies. [1, 2] In Australia there is a need to increase awareness about the importance of good preconception health, and access to preconception care. [3] This is evidenced by the high proportion of women entering pregnancy above a healthy weight, the low proportion of women taking folic acid before conception, and the low rate of good pre-pregnancy glycaemic control in women with diabetes. [4-7]

Barriers to the delivery of preconception care include inadequate knowledge in the community about the importance of optimal preconception health and a lack of presentation to health care providers for preconception assessment. [8, 9] Additional barriers include women from low socioeconomic backgrounds having lower levels of functional health literacy. [10] This is associated with lower rates of consulting a health professional for preconception care and worse preconception health behaviour. [10, 11] Women also identify lack of time and living in rural and remote communities as prohibitive factors to seeking preconception care. [12]

Evidence suggests that people of reproductive age are keen to learn about preconception health and adopt positive health behaviour change before a pregnancy. Most women of reproductive age report a preference for online information sources [13] and use technology to find information on pregnancy health. [13, 14] Digital health tools, such as online self-assessment tools are a promising medium to increase knowledge and awareness about preconception health among people of reproductive age across geographical locations. [15, 16] This includes increased understanding of the benefits of good preconception health, the risks of poor preconception health and the opportunities to improve health before conception. [17, 18] Impacts of online preconception health self-assessment tools include reduced rates of preconception alcohol consumption, improved uptake of folic acid supplementation [19] and also be a catalyst for clients to initiate discussions with health care providers. [17]

The Healthy Conception Tool

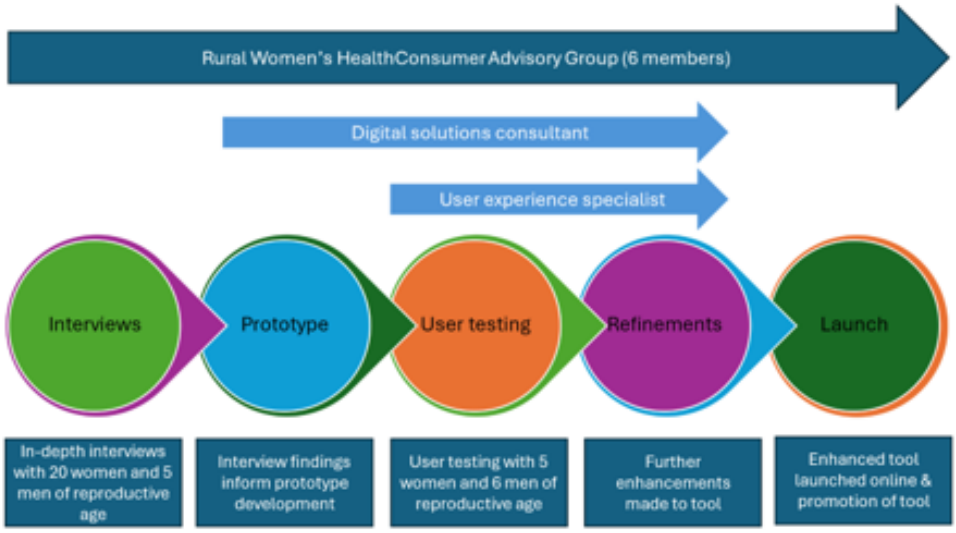
The Healthy Conception Tool (HCT) was an existing online preconception health self-assessment tool, developed by *YourFertility*, a Commonwealth funded fertility health promotion program in Australia. The HCT asks questions about a person's general and reproductive health from which people then get a personalised output of results. They are then encouraged to take the results to their doctor to discuss what they can do to optimise their health. The HCT contains a section for both women and men. The HCT was developed in 2017 in collaboration with academics, clinicians and researchers at the Robinson Research Institute. Some feedback from users was used in the initial development of the HCT, however formal usability testing was not performed. Exploring usability can identify issues with how people engage and interact with a tool, and findings can be used to improve experience to maximise the effectiveness and efficiency of the tool. [20]

As the HCT is a potential enabler to promote the importance of preconception health, particularly for people in rural and remote areas who face additional challenges in accessing health care, optimisation and usability testing can enhance a tool for these populations. This paper describes the process taken to engage with communities using a person-centred approach to assess usability and optimise an existing online preconception health self-assessment tool for people in Australia.

Methods

In-depth user interviews and usability testing were used to optimise the existing HCT. (Figure 1)

Figure 1: Process of optimising an online self-assessment tool for preconception care.



A rural women's health consumer advisory group (RWH-CAG) was established to oversee this body of work and ensure person-centred design in all aspects. Six women aged 19-30 years old, who resided in rural and remote locations in Australia were selected from a pool of 17 applicants. Selected applicants had lived experience and demonstrated knowledge of issues around the access of sexual and reproductive services to rural Australian women, particularly in the areas of family planning and preconception care. The role of the RWH-CAG was to inform the study design and recruitment methods. (Figure 1)

Recruitment

People of reproductive age (18 – 41 years old), residing in Australia, who could speak and read English were eligible to participate in both the interviews and user-experience testing. People of all relationship status were eligible to take part.

Recruitment for interviews was via social media with advertisements targeting regional and remote community parent groups and noticeboards. Recruitment for user-testing was coordinated through a user-experience agency (nomat Australia) with a registered pool of user-experience participants, Australia-wide. Participants meeting the recruitment specifications listed above were sent an invitation to take part.

Verbal consent was obtained prior to the interview and user testing. Recruitment for both processes ended when no new data were obtained, and previously identified themes were repeating. Participants were given a $50 VISA gift card in recognition of their time.

Process

In-depth interviews

In depth interviews to understand participants' experiences of using the HCT were performed from February – September 2021. In particular, what features of the HCT were most likely to increase their knowledge and influence behaviour change, and to explore ways in which the tool could be improved. Given COVID-19 quarantine restrictions, interviews were conducted via telephone or online videoconferencing at the participants request. Before the interview, participants were required to complete the HCT. Interviews were recorded and transcribed, and data were analysed by two researchers who have reproductive and public health expertise, using an inductive thematic approach. [21, 22] Data were coded, manually without assistance of software programs, to identify consumer likes and dislikes across content and design features of the self-assessment tool. These findings were further discussed between all members of the research team, and agreement reached on key domains and features for optimisation

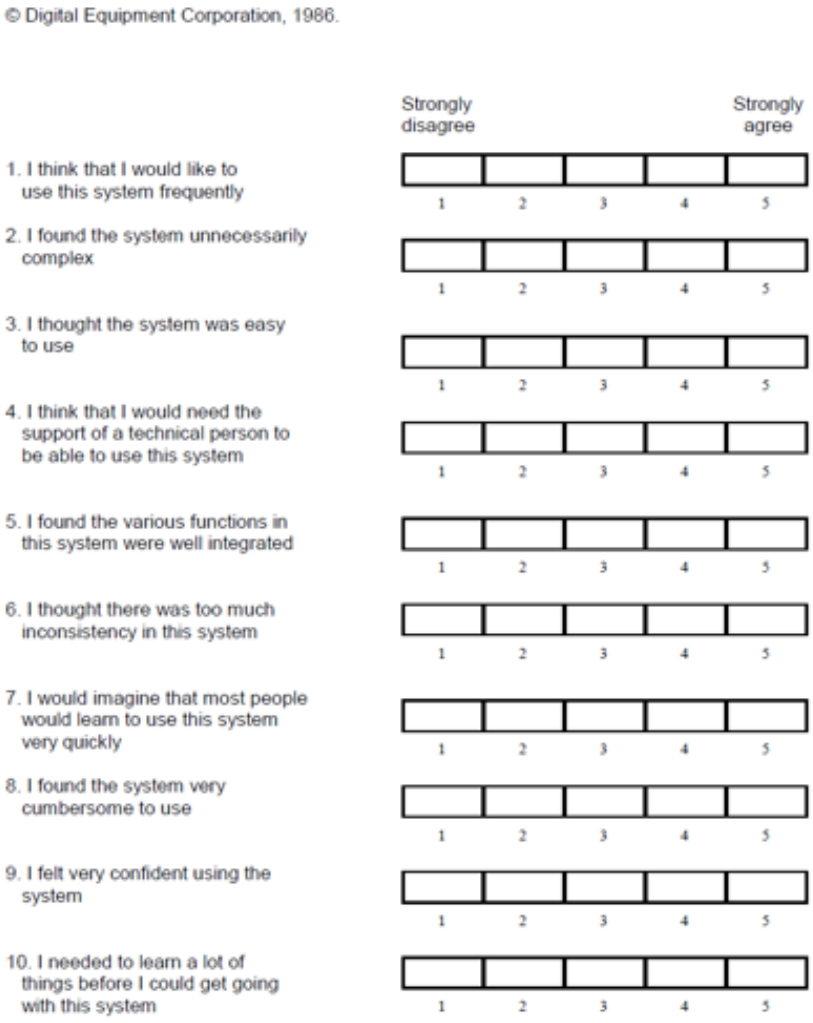
Prototype development

A series of strategy, planning and design workshops were held with a digital solutions consultant (Sentius Australia). These workshops aimed to develop creative and digital solutions for the new tool design, informed by the interview findings. A prototype was developed by Sentius and the research team, with a list of features identified for user testing.

Optimisation of prototype with user testing

The prototype underwent user-experience testing, conducted by a user-experience specialist to identify any usability issues and validate design changes that had been made from May-June 2022. Again, given the COVID restrictions, participants took part in a one-hour videoconferencing call for user-experience testing. In this call participants completed the HCT in their chosen setting, to reflect their typical context. Participants shared their smart device screen so that their tool navigation could be directly observed. Participants completed the System Usability Scale (SUS) and had the option to provide additional feedback on their experience. The SUS is a ten-item questionnaire to enable a standardised assessment of usability of an interface (Figure 2) and is an accepted tool to benchmark the usability of Digital Health Applications. [23] Usability problems were categorised as minor, moderate or critical relating to the impact they had on tool engagement and completion. (Table 1)

Figure 2 System Usability Scale



System Usability Scale

© Digital Equipment Corporation, 1986.

	Strongly disagree				Strongly agree
1. I think that I would like to use this system frequently	1	2	3	4	5
2. I found the system unnecessarily complex	1	2	3	4	5
3. I thought the system was easy to use	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this system	1	2	3	4	5
5. I found the various functions in this system were well integrated	1	2	3	4	5
6. I thought there was too much inconsistency in this system	1	2	3	4	5
7. I would imagine that most people would learn to use this system very quickly	1	2	3	4	5
8. I found the system very cumbersome to use	1	2	3	4	5
9. I felt very confident using the system	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this system	1	2	3	4	5

Table 1: Category definitions for identified usability issues

Classification	Definition
Minor	Causes some hesitation or irritation
Moderate	Causes task failure for some users
Critical	Leads to task failure. Issue inhibits users from completing core tasks and/or may impact core business objectives

Prototype refinement and enhancements

User-experience testing results informed additional changes to the tool. Another round of planning workshops was held to decide on the final changes to the tool. These were tested amongst the research group for quality assurance.

Launch

When all changes were made, the enhanced tool was launched online.

Ethics

This study was approved the University of Sydney Human Research Ethics Committee Project Number 2020/430 (22 June 2020).

Results

In depth interviews with 20 women and five men, and user- experience testing with six women and five men of reproductive age were performed. Participants included people planning and not planning a pregnancy in the next 12 months, from metropolitan, regional and remote locations in Australia. Participant demographics are shown in Table 2.

Table 2: Participant demographics

Interviews (N = 25)	
Gender	
Female	20
Male	5
Pregnancy intention	
Planner	10
Non planner	15
Place of residence	
Metropolitan	11
Regional and rural	14
User Testing (N= 11)	
Gender	
Female	6
Male	5
Pregnancy intention	
Planner	6
Non planner	5
Place of residence	
Metropolitan	9
Regional and rural	2

Interview results

All participants completed the HCT prior to their interviews. Participants used either a mobile device or laptop, with some completing the tool on both a mobile and laptop device. Attributes of the self-assessment tool, as identified from the interviews, are presented below.

General Features

Overall participants were very positive about the HCT. Most participants liked that it was quick to use, taking on average five minutes to complete, and that it was a single source for multiple topics of pregnancy preparation.

Source credibility

Participants expressed that it was important to know the tool was from a credible source. This was attributed to endorsement from reputable professional organisations such as academic institutions.

"I look for does it come from a trusted source, is it from the Royal Children's Hospital website or is it from Breastfeeding Victoria's website, not just a mummy blog or a website that has obvious ads or links to creams that they want to sell you." (P19, Female, regional, non-planner)

Target audience

Participants liked that the tool was inclusive of partners with information for both men and women. *"I liked that it had a section for men and women, I think that's really good, that men are included in it as well."* (P6, Female, regional, non-planner)

Finding the tool

Participants identified that a good tool is one that is intuitive to find on a simple online search. Almost all participants stated that they would not have found this tool online with its current title.

Information gained

Participants liked the links to further information, particularly the multiple and varied topics that were collated together. *"And I think the link that it had when you clicked on the little info icon, they took you to places, and there was like so much information in those places."* (P6, Female, regional, non-planner)

Presentation of results

Participants stated the presentation of their results was too general and that they wanted more personalised results. Consistently participants conveyed that the results must be meaningful to the individual to encourage behaviour change.

User experience

Four key domains for exploration in the user-experience testing were identified from the interviews:

1. The user interface
2. navigation
3. usability
4. results communication

Interview findings relating to these domains and how they informed user experience are shown in Table 3.

Table 3: Domains and features of an online self-assessment tool for preconception care to be assessed in usability-testing.

	on it and it will help you find out more info about how you can change things or whatever. **(Female, non-planner regional)**	
Results		
Timing of results display within the tool	*"That was the overwhelming sense I was getting, going through it. It was like, "I keep seeing red; that means I'm not going to be able to do it."* **(Female, non-planner, metropolitan)** *"I like seeing them just on the screen, straight away. You know when you've finished something, I like to see the results straight away."* **(Male, planner, metropolitan)**	Give result with each individual question answered Give all results at the end of the tool
Visual and text display of results	*"...then seeing a green tick versus a red exclamation mark, I find that really quite confronting, because that could lead you down, just from a visual perspective, really lead you down the path of green means good, read means bad."* **(Female, non-planner, metropolitan)** *"But yeah, I think definitely highlighting it, whether it be through a traffic light system, or another way, yeah."* **(Female, non-planner regional)**	Visual l display of results in traffic light system (orange not red colour) Explanation of results no colour coding system.
Prioritised ordering and personalisation of results	*"Yeah, I think because it didn't - like if I remember correctly, it doesn't say any areas of concern. So even though, for example I didn't drink alcohol, that result is given kind of equal weighting to me saying that I don't exercise. So I can't kind of gage which one's good or bad."* **(Female, non-planner, regional)** *"Like a little bit of more prioritising of what is and isn't important."* **(Male, non-planner, metropolitan)** *"I'm not sure if it gave me any specific details about me personally. I just thought it was very generalised."* **(Female, planner, regional)**	Prioritised display of results
Mechanism to receive and keep results	*"Being able to download the information was handy for later reference, or even to take to your pre-conception appointment kind of thing – that was good, yes. I like the way it was listed in table format."* **(Male, non-planner, metropolitan)**	Email Print

User-experience testing

All participants completed all questions in the prototype on their first attempt and responded well to its simplicity. The amount of information provided was considered appropriate, the supplied links were determined to be valuable, and information was perceived to be presented in a way that was easy to digest and use. The average SUS score was 91.82, which is a high score compared to an industry average in Australia of 68. Participants responded well to the given colour scheme.

Eleven usability problems were identified, four moderate and seven minor (Table 4)

Table 4: Findings on user-experience testing for an online self-assessment tool for preconception care

Issue	Observation	Recommendation	Severity
Results			
Presentation of results -traffic light system colours	Consistently, the colour coding on the results page was not obvious to participants. Particularly, the use of orange instead of red was misunderstood. "I don't understand why they've done that...maybe change the choice of colours to red, yellow and green? I would be fine with red" **(P36, male, planner, metropolitan)**	Update to green, orange, red and introduce descriptive headings within the results page.	Moderate
Grouping preference	Consistently, participants indicated that they preferred the layout of the second version of the results page (order as per traffic lights). Specifically, participants suggested that grouping results led to increased understanding of the content grouping. *"Now it makes more sense to see the colours categorised in groups."* **(P28, female, non-planner, metropolitan)**	Implement grouping of results as the standard.	Moderate
User experience			
Help icon: visibility	The help icon was deemed to be of value to participants, however it was not immediately obvious to all participants. The visual hierarchy needs to be increased, in order to prompt a higher use rate. *"No, I don't recall seeing these help icons, that would have been good to know for this question [fertile window]."* **(P26, female, non-planner, metropolitan)**	Consider making the help icon 15% larger and changing the colour to HEX #14c797 to increase prominence.	Moderate
Answer clarification: smoking and alcohol	For both the smoking and alcohol use questions, some participants answered 'no' despite describing infrequent use. This indicated that just having two possible answers causes misreporting in some instances. *"It's a tad confusing, the smoking and drinking. It's a yes and a no answer but there's a lot of gradations in there...someone might have two glasses a week."* **(P34, male, planner, metropolitan)**	Include help icon to explain how to answer the question.	Moderate
Question clarification: Chemicals	Participants often displayed confusion as to what kind of chemicals this question referred to. *"I don't know much about chemical exposure...maybe a Tefal pan? I'm not sure. That would have been a question I could use some extra information for."* **(P28, female, non-planner, metropolitan)**	Include help icon text to expand on the types of household chemicals that could impact fertility.	Minor

Question clarification: STI check	On occasion, participants expressed surprise at the inclusion of the STI check question. Specifically, participants did not feel it was relevant to them if they were in a long-term relationship. *"Why is this question relevant to pregnancy?"* **(P30, male, planner, metropolitan)**	Include help icon text to explain the relationship between STI checks and future fertility. Reiterate STIs can be asymptomatic	Minor
Question clarification: Prescription meds	Participants indicated confusion around the types of prescription medication that would be included here. *"I'm on the mini [contraceptive] pill, but I wouldn't tick yes here."* **(P27, female, planner, metropolitan)**	Add help icon text to explain prescription medications	Minor
Question clarification: Folic acid	Folic acid prompted some additional discussion from participants, with questions raised about what it was, the dose required, and the function it served. *"I would answer no to taking folic acid...I haven't even heard that mentioned. Now I wonder if that is important or not...I am not sure what it is."* **(P33, female, planner, regional)**	Add help icon text to give a brief explanation of the importance of folic acid. Mention that folic acid is included in pre-natal supplements.	Minor
Results page: BMI information	Participants indicated that the BMI information required additional context to be more effective. *"The BMI information is good, but you just want a quantified benefit. You always hear about eating healthy and being healthy...it just becomes noise. Unless there's a real benefit, what's the point?"* **(P30, male, planner, metropolitan)**	Expand results section to include specific statistics connecting BMI with fertility. Include more targeted exercise suggestions.	Minor
Language: Male version	Throughout the text on the male pages, some of the wording occasionally confused male participants. Some male participants did not feel that this was relevant to them and questioned whether the results were actually targeted towards the male user.	Tailor copy for participant gender.	Minor
User interface			
Image: Sperm regeneration	Without being prompted, male participants consistently drew attention to the sperm regeneration fact at the top of the results page. Participants indicated that this statistic was new to them, and that they valued having this information included.	On the results page, incorporate this information within the main content.	Minor

Additional observations of significance were the impact of the organisational logos at the bottom of the tool. Without prompting, several participants commented on the organisation logos and indicated that seeing this added credibility to the tool. New features to increase reach of the tool were also noted and included the option to share the tool with the user's contacts.

Additional refinements were made to the tool following user-experience testing to address the problems identified. Some key changes are shown in Figures 3 and 4.

Question clarification: STI check	On occasion, participants expressed surprise at the inclusion of the STI check question. Specifically, participants did not feel it was relevant to them if they were in a long-term relationship. *"Why is this question relevant to pregnancy?"* (**P30, male, planner, metropolitan)**	Include help icon text to explain the relationship between STI checks and future fertility. Reiterate STIs can be asymptomatic	Minor
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Language: Male version	Throughout the text on the male pages, some of the wording occasionally confused male participants. Some male participants did not feel that this was relevant to them and questioned whether the results were actually targeted towards the male user.	Tailor copy for participant gender.	Minor
User interface			
Image: Sperm regeneration	Without being prompted, male participants consistently drew attention to the sperm regeneration fact at the top of the results page. Participants indicated that this statistic was new to them, and that they valued having this information included.	On the results page, incorporate this information within the main content.	Minor

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Additional refinements were made to the tool following user-experience testing to address the problems identified. Some key changes are shown in Figure 3.

Figure 3: Enhancements to the self-assessment tool questions

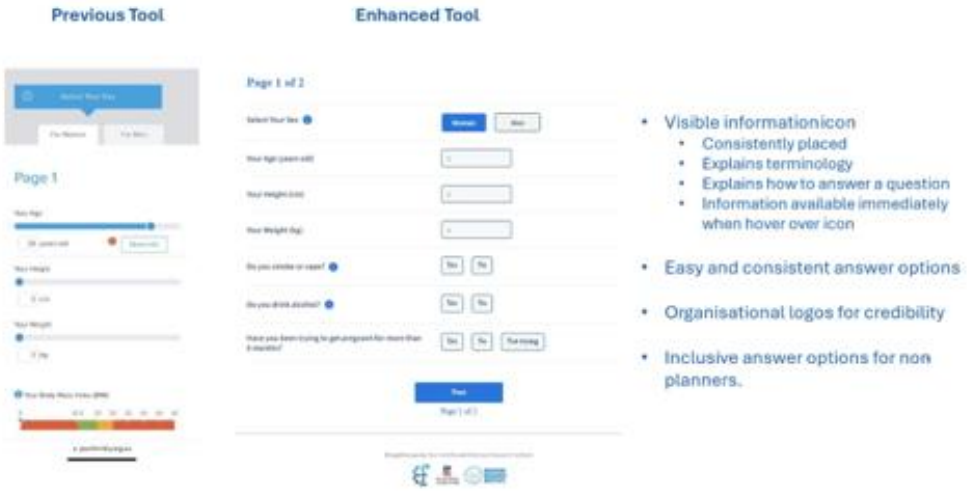
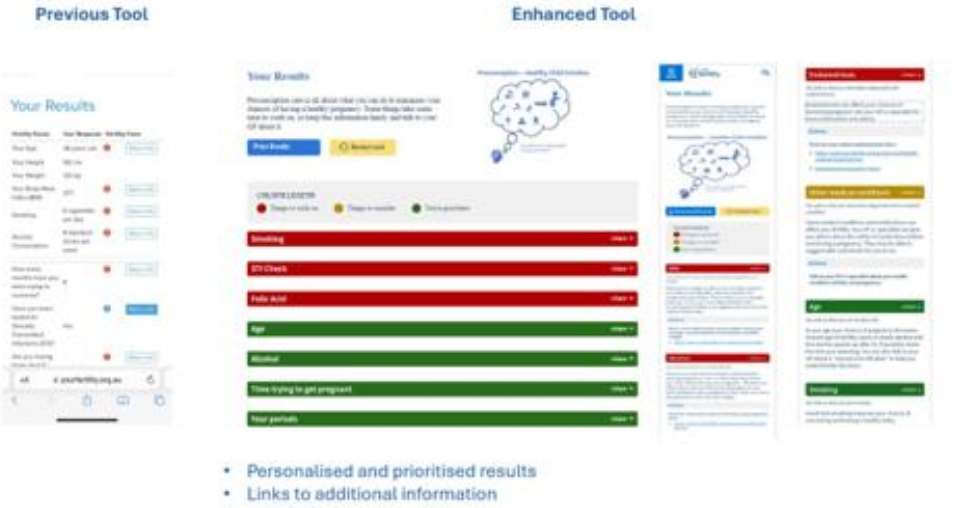


Figure 4: Enhancements to the self-assessment tool results



Discussion

This work explored what features of an online self-assessment tool for preconception care are important to people of reproductive age. In particular, what features will increase engagement and completion of the tool, and what are the best ways to present the results and information so that a user will act upon them.

Our findings showed that participants value a tool that is intuitive to find in an online search and is quick and simple to use. This is consistent with findings of other eHealth modalities, where ease of use and simplicity is a determinant in user engagement. [24, 25] Clear information about what each question is asking was important to maintain engagement in the tool. For questions that were not intuitive, or required explanation, an information icon was placed adjacent to the question text, in a different colour to emphasise its presence. The information was visible by hovering over the icon, as participants indicated they did to want to be directed to an additional page, as this interfered with user experience. Having information presented in a way that is easily understood by the user has been identified as a key quality indicator of online health sites. [26]

A key finding in both the interviews and user-experience testing was the need to have information clearly presented and easy to digest at an appropriate health literacy level. The International Reproductive Health Education Collaboration (IRHEC) recently devised recommendations for developing and implementing tools to improve fertility literacy. [27] This included the recommendation to understand the target population and include user perspectives when developing education tools. In both the interviews and user-experience testing there was a balance of planners and non-planners (those not planning a pregnancy in the next 12 months) to ensure the information presented was accessible and relevant to all people of reproductive age regardless of pregnancy intention. This also led to some key changes including to the title of the tool. Almost all of the interview participants would not have found the tool online, and as such the tool was renamed with a plain English title as informed by participants of *Healthy you, Healthy baby.*

Another key feature for users was the personalised and ordered presentation of tool results. Results were grouped into categories that required the user's attention and action. These were colour-coded to convey visual priority and accompanied by explanatory text, in a positive tone to complement the colour scheme.

Participants expressed the importance of knowing that a source is credible, and this is acknowledged by the inclusion of logos from trusted organisations. Trust in eHealth sites is a recognised determinant of user engagement with online health information sources. [28] Accreditation or endorsement with recognised logos from reputable institutions can increase trust in a platform. [29]

eHealth platforms have been shown to be effective in improving user health knowledge, behaviour change and health outcomes. [30, 31] Several eHealth platforms have been shown to be effective for the communication of preconception health information. [32-34] A web-based application for people with sickle cell disease and sickle cell trait providing information about pre-pregnancy health was found to be acceptable and usable and increased consumer knowledge. [32] An eHealth lifestyle coaching program for women prior to pregnancy has been shown to increase healthy eating behaviours. [33, 34]

Studies have suggested improvement in eHealth intervention designs to increase their effectiveness. [31] This includes adopting a holistic approach to promote user engagement. [35] Our approach, informed by a rural women's health consumer advisory group, of in-depth interviews followed by user-experience testing enabled a detailed understanding of our target audience needs and expectations. The opportunity to test the consumer, informed prototype and validated design has delivered an enhanced tool for people of reproductive age in Australia.

Strengths

The use of both interviews and user-experience testing techniques are a strength of this study and provided additional iterations to enhance the self-assessment tool. The involvement of the RWH-CAG from conception to completion of this project also ensure a person-centred approach.

Limitations

The tool was only explored in people who can speak and read English, and therefore does not capture the preferences of people from culturally and linguistically diverse backgrounds. As these populations can face challenges with access to care, this is a priority area for future research. This study used the SUS as an instrument within the usability testing. Further enhancements may be achieved by using additional tools such as Neilsen's guidelines in combination with the SUS. [36]

Conclusion

As an online tool, Healthy You, Healthy Baby has the potential to improve knowledge among people of reproductive age about the importance of optimal preconception health including those who experience health inequities such as women and men in rural and remote areas. The tool can be adapted to other priority populations, including people from culturally and linguistically diverse background to further improve the delivery of preconception care.

Acknowledgement Statement

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All authors contributed to this manuscript as follows

ED: Conceptualization, methodology, investigation, data curation, formal analysis, writing original draft, review and editing, visualization, project administration and funding acquisition.

KH: Conceptualization, formal analysis, writing: review and editing

RR: Conceptualization, writing: review and editing

KB: Conceptualization, Data curation, formal analysis, writing: review and editing, supervision, funding acquisition.

Conflict of Interest Statement

All authors of this paper have no conflicts of interest to declare.

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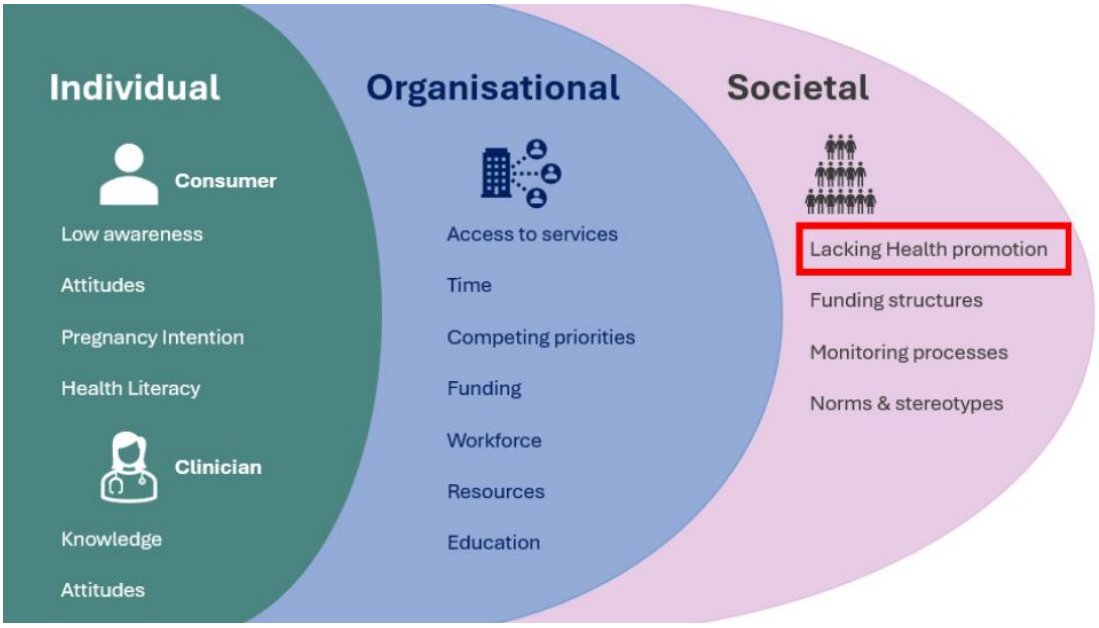
Chapter 7: Health promotion for an online preconception self-assessment tool

7.1 Chapter aim

A lack of health promotion activities, including those that raise awareness and provide education about the importance of good preconception health, have been identified as a barrier for preconception care at the societal level. This chapter explores health promotion activities to communicate the importance of good preconception health.



This begins with the process and results of a discrete choice experiment (DCE) to understand what features of an advertisement for preconception health people prefer and would influence their engagement with an online self-assessment tool.

This is followed by the development of health promotion activities to communicate the enhanced ***Healthy You, Healthy Baby*** online self-assessment tool for preconception care.

7.2 Publication details

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7.3 Author contribution

The DCE project was a collaboration with the Centre for Health Economics, Research and Evaluation at the University of Technology Sydney (JC, MH, DS). ED and KB defined the attributes and levels for the DCE. JC, MH, and DS designed the DCE choice tasks and led the analysis. ED led the writing of the manuscript in close collaboration with JC. All authors read and reviewed the manuscript.

7.4 Manuscript

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The preferences of people in Australia to respond and engage with advertisements to promote reproductive health: Results of a discrete choice experiment

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ABSTRACT

Objectives: The health of people prior to pregnancy impacts pregnancy outcomes and childhood health, making the preconception period an important time to optimise health behaviours. Low awareness of the importance of this issue is a recognised barrier to achieving good preconception health. Public health messaging can help to address this barrier.

Methods: A discrete choice experiment to assess the preferences of people of reproductive age for a health promotion advertisement for preconception health was conducted. Attributes of the advertisement image, title, additional text content and positioning, and the location of advertisement were assessed by fitting a mixed logit model to the choices made.

Results: Three hundred and thirty-four responses were obtained, from people of reproductive age, both planning and not planning a pregnancy, in Australia. Participants placed most importance on the image, and the location in which they saw the advertisement. An image of adult and baby hands was preferred to adult hands only, and healthcare settings were preferred to more general media locations such as advertising online or on public transport. Preference was also given to the advertisement title of "Healthy you, Healthy baby", closely followed by "Are you ready for pregnancy?". The location and content of additional text did not significantly impact engagement with the advertisement.

Conclusion: The image and title on the advertisement, and the locations in which they are placed were the most significant features to impact engagement with a health promotion advertisement for preconception health. This can inform health promotion efforts for preconception health.

1. Introduction

Health before pregnancy, or preconception health, impacts pregnancy outcomes, childhood health and the health of future generations. (Stephenson et al., 2018) Preconception care (PCC) aims to improve the health of women and their partners before pregnancy by identifying and addressing social, behavioural, and medical risk factors. (World Health Organization, 2013) A reported barrier to delivering PCC is a general lack of awareness of the importance of preconception health, (Bortolus et al., 2017) and a subsequent lack of presentation for preconception health checks. (Khan et al., 2019) Communicating the importance of preconception health with people who might want to have a child gives them the opportunity to improve their health before trying for a baby.

Improving preconception health is centred on the behaviour change of individuals, partners and communities, and the provision of information is a key requirement for change to occur. Heath promotion activities are an effective mechanism for information communication at a population level and can also have indirect benefits such as increasing social supports for behaviour change. (Wakefield et al., 2010) Australia has demonstrated previous success with population level health promotion campaigns in smoking cessation and skin cancer prevention fields. (Bayly et al., 2019; Walker et al., 2022) These campaigns were supported by additional interventions such as school and workplace education initiatives and fiscal measures recognising that education

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alone is not always sufficient to achieve behaviour change. Health promotion campaigns have the potential to increase individual and community awareness about the importance of preconception health and care.

Much of the previous evidence that focused on women shows that Australian women are keen to learn about preconception health and report a preference for online information sources. (Khan et al., 2019; Musgrave et al., 2023) As such, digital health solutions, including the use of online self-assessment tools are one potential enabler for the delivery of PCC. Self-assessment tools involve a self-completion activity on a given topic and then information and advice on the next steps to improve health. (Griffith University) The "Healthy you, healthy baby" tool, is a freely available online preconception health self-assessment tool housed on the YourFertilty website. Previously called The Healthy Conception Tool, this tool has been recently evaluated and enhanced with input from people of reproductive age across Australia to increase awareness of the importance of preconception health. This process was led by clinical, public health and policy researchers, and consumers with the input of a Rural Women's Health Consumer Advisory Group (RWH-CAG), to ensure appropriate design to reach those who face geographical access challenges to care. (Black and Dorney, 2023) In- depth interviews and co-design activities as part of the enhancement process found that people of reproductive age want reproductive health digital tools that are easy to find, appealing and from credible sources. They also stated they were not familiar with the term "preconception care" and most would not have found the tool with the "Healthy Conception Tool" title. (Dorney et al., submitted for publication).

Developing an enhanced self-assessment tool is one step in the process of communicating the importance of preconception health. However, in the enhancement process, almost all interview participants stated that while they thought the tool was a good idea, that they would never have found it, and that it should be more widely and appropriately promoted. As such, health promotion, including the development of promotional material, to promote awareness and engagement with the enhanced tool, is also required. Currently, there is limited evidence that explores what influences a person of reproductive age to engage with a health promotion material on preparing for pregnancy.

The purpose of the current study was to gain an understanding into what features people value in a health promotion advertisement for a reproductive health self-assessment tool. A discrete choice experiment (DCE) will be used to assess the preferences of people of reproductive age for a health promotion advertisement for preconception health. In particular, what aspects of an advertisement would make them likely to engage with the self-assessment tool, thereby increasing knowledge and awareness about the importance of preconception health.

2. Methods

2.1. Study design

A DCE was conducted to understand the preferences of people of reproductive age in Australia for advertisements for a reproductive health self-assessment tool. Previous qualitative interviews highlighted the need to increase awareness of the self-assessment tool, with some individual suggestions for how this may be achieved. (Dorney et al., submitted for publication) A quantitative assessment, to understand the features of health promotion advertising and where this should be located, was required.

A DCE is a carefully constructed survey tool in which a hypothetical situation is described to respondents. Respondents are then shown sets of possible options, and for each set of options are asked to choose their preferred option given the hypothetical situation. The sets of options are known as choice tasks. Each option is described by attributes (features) and each attribute is presented at one of several possible levels. The choices made can be used to understand the preferences of respondents about the given attributes and their associated levels. This demonstrates how respondents are prepared to trade-off, or what they are willing to sacrifice in place for something else, across the presented attributes and levels. (de Bekker-Grob et al., 2012).

The attributes and levels used in a choice experiment can be decided upon by a review of existing literature and by scoping activities such as qualitative research to understand the attributes perceived to be relevant to a given health issue. (Reed Johnson et al., 2013) DCEs are traditionally used in health economics to understand the preferences of people for health interventions, inform health policy and program development. (Trapero-Bertran et al., 2019; Louviere and Lancsar, 2009) They have also been used to explore preferences for public health messaging. (Durvasula et al., 2019).

The design and development of the DCE involved several stages as outlined in Fig. 1.

2.2. Attribute and level development

The attributes and levels were informed by a review of current literature, consumer input from the RWH-CAG and qualitative research. This included in-depth interviews with 25 people of reproductive age on their perspectives of preconception health messaging. (Dorney et al., submitted for publication) These activities saw the identification of five key attributes to assess: image, name, text (that was seen as the "call to action" of the advertisement), positioning of text on the advertisement, and location where the advertisement is seen.

Selection of images as an attribute was informed from the qualitative interviews and then tested with the RWH-CAG. This process led to the decision to move away from images that depicted heteronormative relationships, defined age groups or implied socio-economic status. Two images, with hands only, where adult hands did not display wedding rings, were selected to be inclusive of all people of relationship statuses.

Qualitative interviews also showed that people were not familiar with the term "preconception care" with suggestions a plainer language term such as *"Are you ready for pregnancy?"* or "*Healthy baby"*. Interview participants also reported wanting more strengths based and empowering titles to encourage learning about preconception health. Possible titles were tested with the RWH-CAG, with four titles selected that tested across the words *"pregnancy"*, *"baby"*, and *"healthy"*.

Evidence demonstrates low levels of awareness of the importance of preconception health, particularly among those not planning a pregnancy. (Bortolus et al., 2017; Khan et al., 2019) Interview participants saw a key advantage, and drawcard of the self-assessment tool, being that it was quick to complete. These two messages informed the text on the advertisement to understand which message was more likely to invoke engagement with the advertisement.

In designing the advertisements, the research team identified the possibility for various locations of the text that was the call to action of the advertisement. Given the variability in this, this was added as an additional attribute to inform the development of the advertisement.

Evidence shows that people of reproductive age seek reproductive health information online, (Musgrave et al., 2023) and this was supported by the interview findings. The interviews also demonstrated appetite for self-assessment tools to be delivered in health care settings, such as primary care waiting rooms and as such this was included as a location for testing the advertisement.

2.3. Survey construction

The questionnaire was constructed in four sections. Section one collected background information about respondents. Section two consisted of an introductory task where participants first explored the preconception self-assessment tool, which was a mandatory requirement to complete the survey, and commented on additional desirable features for the Healthy Conception Tool. The choice tasks, with hypothetical situation, were completed in Section three, and Section four comprised a number of follow up questions that asked about the ease of completing

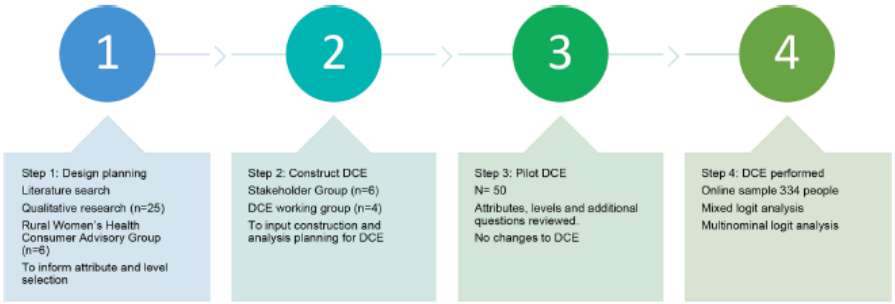


Fig. 1. Stages of Discrete Choice Experiment (DCE) development for an advertisement about preconception health.

the DCE, previous pregnancy information seeking, and name suggestions for the tool. The full DCE survey is available in Supplementary File A. Table 1 gives the attributes and levels for the DCE.

2.4. Designed experiment

Given the number of attributes and levels, 160 choice tasks were developed, divided into 16 versions of 10 choice sets each. The advertisement image, in which the first four attributes, image, name, text, location of name and text, were collapsed, resulted in a total of 116 distinct ads. The attribute of advertisement location was tested as an additional feature separate from the image. An example of a choice task is given in Fig. 2. Each respondent was randomly assigned to one of the 16 versions and completed 10 choice tasks, which were presented to respondents in random order. A pilot sample of 50 respondents was collected to check the data and test for survey consistency, and as this met requirements the survey proceeded to full launch without any changes.

The sample size was determined to allow for 20 responses per version. Although there are various approaches to determine sample sizes for DCEs, this has demonstrated reliable model estimates. (Lancsar and Louviere, 2008) Therefore, approximately 320 respondents were required.

Table 1
Attributes and Levels for the Discrete Choice Experiment for an advertisement about preconception health.

	Attribute	Level
1	Image	Adult hands in heart Adult's and baby's hands close
2	Names	Healthy you, healthy baby Be Baby Ready Are you baby ready? Are you ready for pregnancy?
3	Text	Learn about what you can do before pregnancy here In just a few minutes, learn how you can get ready for pregnancy here Even if you are not planning now learn what you can do for the future here Everyone needs to know. Learn how you can be ready for pregnancy here.
4	Location of name/ text	Name top/text top Name top/text bottom Name middle/text bottom Name bottom/text bottom
5	Location of ad	Poster in GP waiting room Poster in Pharmacy Ad at bus stop Ad appears online Social media ad

2.5. Participants and setting

The DCE was administered by Pureprofile, an online panel provider with over 1 million panel members. Within Pureprofile, panel members complete surveys to earn points which can be exchanged for money or rewards. Panel members who were 18–41 years of age, living in Australia and able to speak and read English, were invited to participate via an email link which granted access to the survey. Respondents were recruited to be representative of the general population of Australia by age (within 18–41 years) and gender, and sample quotas were used to ensure recruitment of participants from rural and remote areas and from lower socio-economic backgrounds.

Panel members were asked indicate consent at the end of the introduction which contained information about the content and purpose of the study, and they could exit the survey and any point. Data were collected in January 2023.

2.6. Statistical Analysis

Descriptive statistics of the respondents were calculated, including socio-economic and demographic characteristics. All analyses were performed using R Statistical Software (v4.1.3; R Core Team 2021). (R Core Team, 2021) A multinomial logit (MNL) model was initially used to explore the preferences for the attributes and levels within the preconception health promotion advertisements. A mixed logit (MIXL) model was also used to explore preferences, as it allows for preference heterogeneity across respondents. (Train, 2009) The MIXL model was estimated using 2000 Halton draws and all attribute levels were considered to be random and independent parameters. Additional models were conducted using an interaction with gender to account for variations in responses between males and females. Likelihood-ratio tests were used to compare goodness of fit between different models.

2.7. Ethics

This study was approved by the University of Sydney Human Research Ethics Committee Project Number 2021/942 (18 July 2022) and meets the institutions guidelines for protections of human subjects in research.

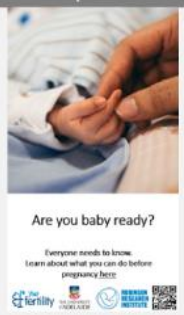
3. Results

3.1. Respondent demographics

The final version of the survey was completed by 334 respondents; the participant demographics, and sexual and reproductive health demographics are shown in Tables 2 and 3 respectively. Respondents were representative of the Australian population with regards to gender and

Question 1 of 10

Imagine you see these two advertisements, which one is more appealing to you?

	Option A	Option B
The ad you see:		
Where you see the ad:	Poster in GP waiting room	Poster in pharmacy
Which do you prefer?	○	○

Question 2 of 10

Imagine you see these two advertisements, which one is more appealing to you?

	Option A	Option B
The ad you see:		
Where you see the ad:	Poster in GP waiting room	Poster in pharmacy
Which do you prefer?	○	○

Fig. 2. Choice Task examples for the Discrete Choice Experiment for an advertisement about preconception health.

place of residence. Amongst respondents, 43 % (145/334) had children, 26 % (87/334) planned on having children in the next 12 months, and two-thirds reported having a regular general practitioner (GP).

3.2. Analysis of choice tasks

Responses to the choice tasks were first analysed using a MNL model, and then a MIXL model. The MIXL model showed that there was significant heterogeneity in the preferences for the image and the location of where they saw the ad. The likelihood ratio test comparing the MNL model and MIXL model showed that the MIXL model provided an improvement in model fit (p-value of Chi^2 test-statistic <0.001). (Table 4) Therefore this is the model that was used, the results of the MNL model are available in Supplementary File B.

The results of the MIXL model which accounted for heterogeneity in respondents' preferences (Fig. 3) show that the image on the advertisement was the most important attribute and there was a strong preference for the image with adult and baby hands compared to adult hands only. The results for the location attribute indicate that respondents had strong preferences for the health care setting where they saw the advertisement. There was no significant difference in preferences between the advertisement being located in a GP surgery or a

Table 2
Participant Demographics Descriptive demographic statistics for people of reproductive age who participated in the Discrete Choice Experiment for an advertisement about preconception health in Australia 2023.

Characteristic	Number	Percentage	Australian Population Statistics %
Age (years)			
Range	18–41		
Mean	30.4		
Median	31		
Age Group			
18–24 years	84	25.2	26.1
25–29 years	50	15.0	21.0
30–34 years	99	29.6	22.3
35 – 41 years	101	30.2	30.4
Gender			
Female	167	50	49.7
Male	167	50	50.3
Place of residence			
Metropolitan	269	80.5	72.2
Regional	65	19.5	27.8
SEIFA ISRAD Quintile			*
Quintile 1 (most disadvantaged)	28	8.4	18
Quintile 2	54	16.2	19
Quintile 3	72	21.6	20
Quintile 4	83	24.8	21
Quintile 5 (most advantaged)	97	29.0	22
Indigenous Status			
Aboriginal or Torres Strait Islander	22	6.6	3.2
Neither Aboriginal of Torres Strait Islander	312	93.4	96.8
Highest level of education attained			
Year 11 or less	25	7.5	21.7
Year 12	55	16.5	17.9
Vocational	92	27.5	27.6
Tertiary	113	33.8	20.4
Postgraduate	49	14.7	12.3

*SEIFA ISRAD Quintiles reported for non-indigenous population.

pharmacy. Showing the advertisement via social media, online advertising, or public advertising at a bus stop was significantly less popular than healthcare settings.

The most popular name for the advertisement was *"Healthy you, healthy baby"* closely followed by *"Are you ready for pregnancy?"* with the other two names being significantly less popular. Regarding the location of the name and text within the advertisement, having the name and text together was slightly preferred to options with the name and text apart. Only the text attribute had no significant levels, indicating this attribute was not important to respondents. Additional models controlling for gender did not show any differences in preferences between males and females. Another model, controlling for people planning to have children in the future and those who are not planning was also performed. The only finding between these two groups was a slight difference in preferences for text placement. Fig. 4 demonstrates the preferred features of the advertisement as informed by the DCE.

3.3. Results of follow up questions

Results of follow up questions showed that people were keen to have additional opportunities to access preconception information, with 43 %

Table 3
Sexual and Reproductive Health Demographics Descriptive sexual and reproductive health statistics for people of reproductive age who participated in the Discrete Choice Experiment for an advertisement about preconception health in Australia 2023.

Characteristic	Number	Percentage
Relationship Status		
Not currently in a relationship	94	28.1
Long term relationship	216	64.7
Casual relationship	24	7.2
Have Children		
Yes	145	43.4
Not currently in a relationship	189	56.6
Plan on having children in the next 12 months		
Yes	87	26.0
No	185	55.4
Don't know	62	18.6
Plan on having children in the future		
Yes	187	56.0
No	86	25.7
Don't know	61	18.3
Primary Healthcare – Regular GP		
Regular GP	224	67.1
Regular Practice but not same GP	80	24.0
Do not have Regular GP	30	9.0
Previously looked for information on getting healthy before pregnancy		
Yes	138	41.3
No	196	58.7

Table 4
Results of the Mixed Logit (MIXL) Models Discrete choice experiment survey results, about an advertisement for preconception health, from people of reproductive age in Australia in 2023.

Attribute and Levels	Mean (SE)	Std. Dev (SE)
Image (Reference: adult hands in heart)		
Image: Adult and baby hands close	0.44 (0.06)	1.62 (0.14)***
Name (Reference: "Healthy you, Healthy baby")		
Name: "Be Baby ready"	−0.27 (0.10)	0.55 (0.22) *
Name: "Are you baby ready"	−0.21 (0.10)	0.42 (0.27)
Name: "Are you ready for pregnancy?"	−0.13 (0.10)	0.52 (0.23)*
Text (Reference "Learn what you can do…")		
Text: "In just a few minutes…"	−0.06 (0.10)	−0.02 (1.93)
Text: "Even if you are not…"	−0.03 (0.10)	−0.36 (0.34)
Text: "Everyone needs to know…"	−0.10 (0.10)	0.004 (1.87)
Text Location (Reference: Name top/Text top)		
Location: Name top/Text bottom	−0.17 (0.10)	−0.51 (0.26)*
Location: Name middle/Text bottom	−0.21 (0.10)	0.58 (0.25)*
Location: Name bottom/Text bottom	0.02 (0.10)	−0.01 (1.76)
Place (Reference: Poster in GP Waiting room)		
Place: Poster in pharmacy	−0.12 (0.10)	−0.28 (0.48)
Place: Ad at bus stop	−0.74 (0.12)	1.37 (0.21)***
Place: Ad appears online	−0.56 (0.11)	−0.58 (0.34)
Place: Social media ad	−0.53 (0.12)	1.21 (0.24)***
Log Likelihood		−2078.5
AIC		4212.93

Significance levels.
* $p < 0.05$.
** $p < 0.01$.
***$p < 0.001$.
AIC: Akaike Information Criterion.

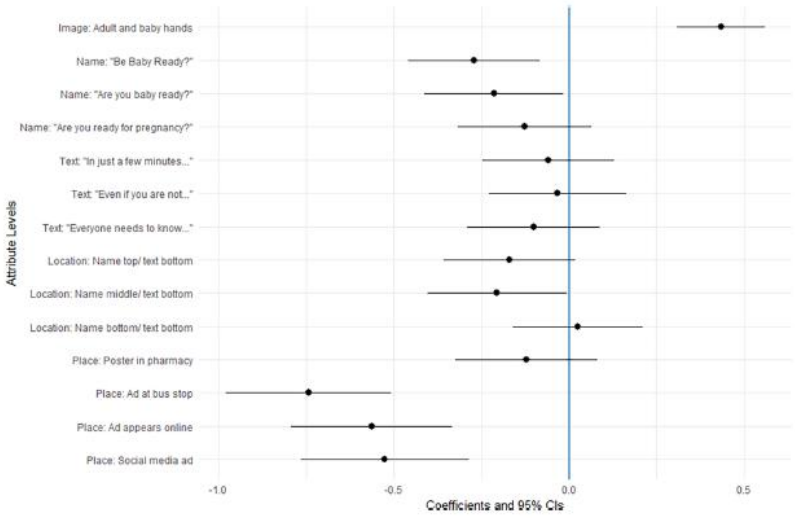


Fig. 3. Preferences for features of preconception health advertisements.

Fig. 4. Preferred advertisement features.

(143/334) of respondents selecting additional services related to supporting links to free services and research trials. The next most popular features were options to sign up for email reminders and links to additional tools and directories for health care providers.

Regarding the survey itself, most respondents (73 %, 244/334) indicated that they found the choice tasks either easy or extremely easy with only 4.2 % (14/334) finding the tasks difficult or extremely difficult. Open text comments about the survey also included positive feedback on the experience of completing the choice tasks. Many respondents (58.7 %, 196/334) indicated that they had not looked for information on getting healthy before pregnancy. Of those who had previously looked for information, most had looked online (85.6 %, 118/138) with GPs the next most frequent source (13.8 %, 19/138). Other sources were family, friends and government websites. Respondents were also invited to suggest names for the self-assessment tool, of the 55 suggested entries the most frequently cited words were "baby", "pregnancy", "healthy" (Fig. 5), which is consistent with the preferred titles from the DCE.

4. Discussion

This is one of the first studies to assess in detail the individual components of health promotion materials that are likely to influence engagement with educational materials for preconception health. A key step to enabling the delivery of PCC is health promotion to ignite individual and community awareness about the importance of preconception health. Currently, low levels of community awareness about preconception health, and a subsequent lack of presentation to health care providers for assessment and guidance are recognised barriers to PCC. (Khan et al., 2019).

Our study showed the choice of image significantly influenced the likelihood to engage with the preconception self-assessment tool. Use of images has been shown to increase attention to health information, and this is particularly important for people of low health literacy. (Houts et al., 2006) Increased impact on attention can be achieved if images are relevant to, and representative of, the target population. (Barros et al., 2014) As such it is recommended that consumer input is sought regarding the design of images for health communication to maximise reach and impact. (Sedeh et al., 2022).

The title on the advertisement material was also shown to significantly impact engagement, with respondents preferring a simple title of "Healthy you, healthy baby". This was also supported in the free text responses of the survey. Preliminary research into designing the DCE survey found that the term "preconception care" was not recognised or

Fig. 5. Word Cloud for suggested titles for preconception health tool.

understood by most people of reproductive age. Low health literacy levels have been shown to impact reproductive health knowledge, behaviours and outcomes. (Kilfoyle et al., 2016) This impact has been seen in relation to specific behaviours including accessing PCC and taking micronutrient supplements prior to and during pregnancy. (Endres et al., 2004; Poorman et al., 2014) These findings support the involvement of consumers in the design of health promotion material to ensure appropriate messaging that is easy to understand and resonates with the target audience.

The location for where respondents saw the advertisement was also a significant factor to drive engagement, with primary health care locations of General Practices or pharmacies preferred. This presents important opportunities to promote and offer PCC. Such opportunities have been piloted internationally where digital risk-assessment tools offered in primary care waiting rooms have been shown to increase the identification and assessment of preconception risk factors. (Montanaro et al., 2019).

While primary care locations were preferred, free text responses showed that most participants who had previously looked for preconception health information did so online. This is supported by existing evidence that shows young people use social media for reproductive health information. A recent Australian study showed that 32 % of women aged 18–24 use social media to access preconception health information, often at weekly intervals. (Skouteris and Savaglio, 2021) These patterns of use can inform targeted health promotion campaigns across both primary care locations and online sites.

The advertisement assessed in this study looks to target individuals and direct them to a self-assessment tool where they will explore their preconception health and enable behaviour change. Whilst this is important, health promotion campaigns should also include community and population health interventions to increase access and support for people to adopt positive preconception health behaviours. (Smith et al., 2017).

Increasing preconception health awareness in people not actively planning a pregnancy or "non-planners" is a significant challenge for preventive health. People planning a pregnancy are shown to be more receptive to preconception health information, where non-planners place greater significance on other priorities such as employment and financial stability. (Welshman et al., 2023).

It is increasingly recognised that involving consumers in health promotion design increases engagement and it has been recommended that such an approach underpins efforts in reproductive and maternity care. (Smith et al., 2017) This study has contributed to the enhancements to a previously existing online self-assessment tool for PCC. The name of the tool has been changed from "Healthy Conception Tool" to "Healthy you, Healthy Baby", a title that is easier to understand and resonates with people of reproductive age. The findings will also inform health promotion activities to disseminate the tool in primary care.

Health promotion campaigns have been shown to be effective in changing health behaviour patterns, from smoking cessation to cancer screening, increasing physical activity and vaccination uptake. (Wakefield et al., 2010) With any behaviour change, complementary strategies are also needed to enable actions such as increased access to affordable healthy foods, green spaces and health care. PCC is no exception and collaboration across government and policy makers is also required.

4.1. Strengths and limitations

A strength of this study was a good balance of respondents who had previously looked for preconception health information and those who had not, and across those who were and were not planning on having children in the next 12 months. Given the significant rates of unplanned pregnancies in Australia and internationally, (Bearak et al., 2020) it is important to capture the preferences of non-planners, which has not been reported before. DCEs are limited by the number of attributes and levels that is practical to include in the survey design. As such, this study only tested two images. The testing of more images for different population groups is an area for future research. The study population was representative of the wider Australian population in all demographic attributes except socio-economic status and education level attained, which is often a feature of such surveys. Hence further investigation into health promotion requirements in people from lower socio-economic backgrounds is an area for future work. Areas for future research also include the preferences for people with a chronic condition as this is known to influence information seeking prior to pregnancy. (Hammarberg et al., 2022).

5. Conclusion

This study demonstrates what people of reproductive age value the most in a health promotion advertisement for preconception health. The advert image and title, and the locations in which the adverts are placed were the most significant features to impact engagement. This was tested across people both planning and not planning pregnancy in the next 12 months. These findings can inform health promotion efforts for preconception health, which is a key step in influencing behaviour change to improve reproductive health outcomes for all.

Ethics approval statement.

This study was approved the University of Sydney Human Research Ethics Committee Project Number 2021/942 (18 July 2022).

CRediT authorship contribution statement

Edwina Dorney: Writing – review & editing, Writing – original draft, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Kirsten I Black:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Marion Haas:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Deborah Street:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Jody Church:** Writing – review & editing, Writing – original draft, Software, Project administration, Methodology, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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7.5 Health Promotion Activities for the enhanced preconception self-assessment tool *"Healthy You, Healthy Baby"*

The enhanced, online preconception self-assessment tool ***Healthy You, Healthy Baby*** was launched in June 2023. This was accompanied by a series of health promotion activities, run through *YourFertility*. These activities had the aim to:

1. raise awareness about the importance of good preconception health to consumers and clinicians,
2. raise awareness of the enhanced ***Healthy You, Healthy Baby*** tool to consumers and clinicians.

These activities were run via mainstream media channels, including paid advertisements (ads) on social media (FaceBook and Instagram platforms) for consumers, and an article and ads in health professional media channels for clinicians. The ads consisted of both still images (Figure 7.1) and an animation. The animation was created by Edwina Dorney and Kirsten Black with an animation designer, and the still images were designed by *YourFertility's* social media officer.

Figure 7.1 Social media health Promotion images for the *Healthy You, Healthy Baby* Tool

Ad copy version 1: Use the Healthy You, Healthy Baby tool to see how you can be baby-ready.

#YourFertility #HealthyYouHealthyBaby

Ad copy version 2: Have you heard of our Healthy Conception Tool? It's had an upgrade! Healthy You, Healthy Baby helps you get baby-ready, check it out now.

#YourFertility #HealthyYouHealthyBaby

Animation development

Findings from the in-depth interviews held with 25 people of reproductive age informed the development of a short animation about preconception health. This included content to explain why preconception health matters, and some key preconception behaviours. Visual cues included text to highlight key messages (as advised for scenarios where people may be watching with no volume), to include people of all relationship status and cultural backgrounds. The lead image was informed from the DCE and has an adult and child hand, with the personalised text *"How to be a Healthy You for a Healthy Baby".* The animation was tested with a *YourFertility* consumer group and the RWH-CAG. The animation is attached in a separate appendix file to this thesis, a selection of still images from the animation can be seen in Figure 7.2.

Figure 7.2 Still images from the Animation for the *Healthy You, Healthy Baby* Tool

7.5.1 Consumer health promotion activities

Ads ran on FaceBook and Instagram for two weeks (June 10-24) after the launch of the ***Healthy You, Healthy Baby*** Tool. The animation and three images were made into eight ads in a package using Meta Business Suite. The ads were placed differently across FaceBook and Instagram:

- eight placements on Facebook and Instagram feeds
- four placements in stories and reels
- two in-stream ads for videos and reels
- one placement in search results
- two placements in apps and sites.

The aim of this package was to maximise reach, and an “auction” strategy was used, meaning that ads that performed better were favoured and used proportionately more. The campaign generated 1,607,330 impressions, reached 1,373,965 people and 11,127 actions taken (Table 7.1). These results are based on data captured on the *YourFertility* pages only, and do not include engagement via shares of the posts by other organisations. It is possible that the performance results can continue to increase given the long life of social media posts.

The ads were intentionally set up to not favour distribution towards one gender and the was evenly distributed to women and men (noting that Meta Business Suite does not calculate results genders other than women and men).

The images were also posted to *YourFertility's* social media accounts (Facebook, Instagram, and Twitter) from June 22-24 for further promotion and engagement.

Table 7.1 Impact of social media advertisements for the *Healthy You, Healthy Baby* Tool

Post	Reach	Impressions	Action*
Animation (Copy 1)	51,705	53,793	3,692
Animation (Copy 2)	94,501	100,381	6,464
Image 1 (Copy 1)	54,806	57,316	45
Image 1 (Copy 2)	353,264	417,009	261
Image 2 (Copy 1)	224,140	272,721	247
Image 2 (Copy 2)	406,331	507,380	311
Image 3 (Copy 1)	56,922	59,206	38
Image 3 (Copy 2)	132,296	139,524	69
Total	**1,373,965**	**1,607,330**	**11,127**

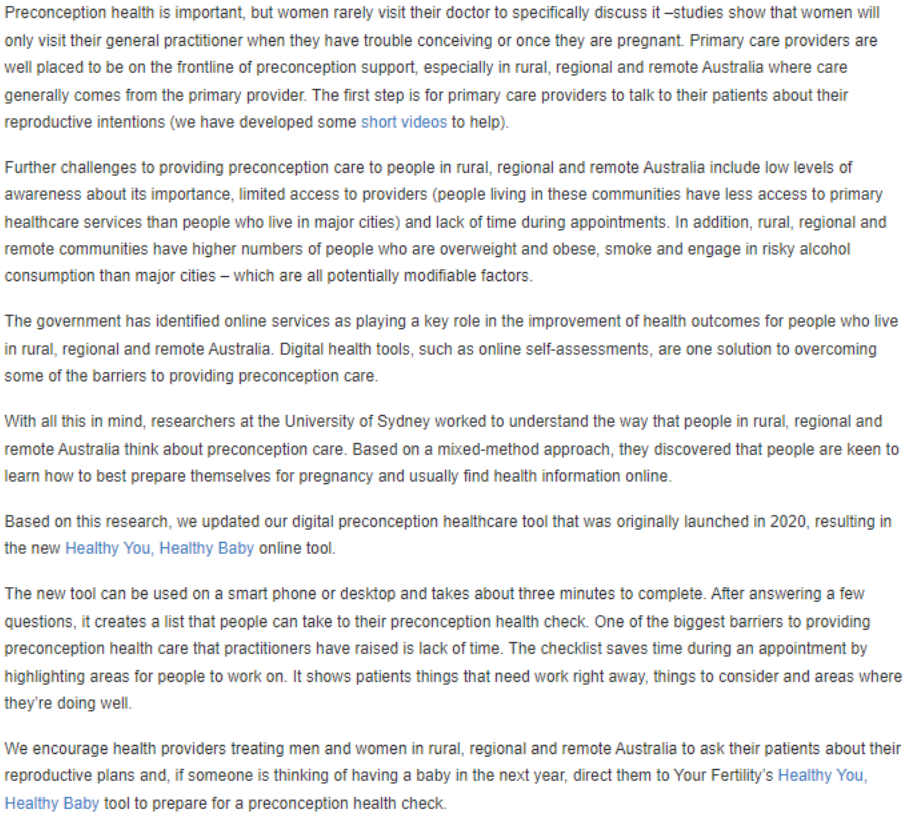
* Actions are the total number of actions people take that are attributed to the advertisements, including engagement, clicks or conversions.

7.5.2 Clinician health promotion activities

Two primary care communication channels, Partyline and the Australian Journal of General Practice were used to communicate the enhanced ***Healthy You, Healthy Baby*** tool to clinicians. These channels were selected to reach both p primary care, and regional/remote care clinician populations.

Partyline is the online publication for the National Rural Health Alliance (NRHA) organisation. The NRHA aims to improve health and wellbeing for people residing in rural and remote locations across Australia. *YourFertility* published a piece in Partyline promoting the upgrade of the tool, and focused on the research with people in rural, regional, and remote Australia that informed the tool redesign (Figure 7.3).

Figure 7.3 Partyline media article to promote the Healthy You, Healthy Baby Tool



Preconception health is important, but women rarely visit their doctor to specifically discuss it –studies show that women will only visit their general practitioner when they have trouble conceiving or once they are pregnant. Primary care providers are well placed to be on the frontline of preconception support, especially in rural, regional and remote Australia where care generally comes from the primary provider. The first step is for primary care providers to talk to their patients about their reproductive intentions (we have developed some short videos to help).

Further challenges to providing preconception care to people in rural, regional and remote Australia include low levels of awareness about its importance, limited access to providers (people living in these communities have less access to primary healthcare services than people who live in major cities) and lack of time during appointments. In addition, rural, regional and remote communities have higher numbers of people who are overweight and obese, smoke and engage in risky alcohol consumption than major cities – which are all potentially modifiable factors.

The government has identified online services as playing a key role in the improvement of health outcomes for people who live in rural, regional and remote Australia. Digital health tools, such as online self-assessments, are one solution to overcoming some of the barriers to providing preconception care.

With all this in mind, researchers at the University of Sydney worked to understand the way that people in rural, regional and remote Australia think about preconception care. Based on a mixed-method approach, they discovered that people are keen to learn how to best prepare themselves for pregnancy and usually find health information online.

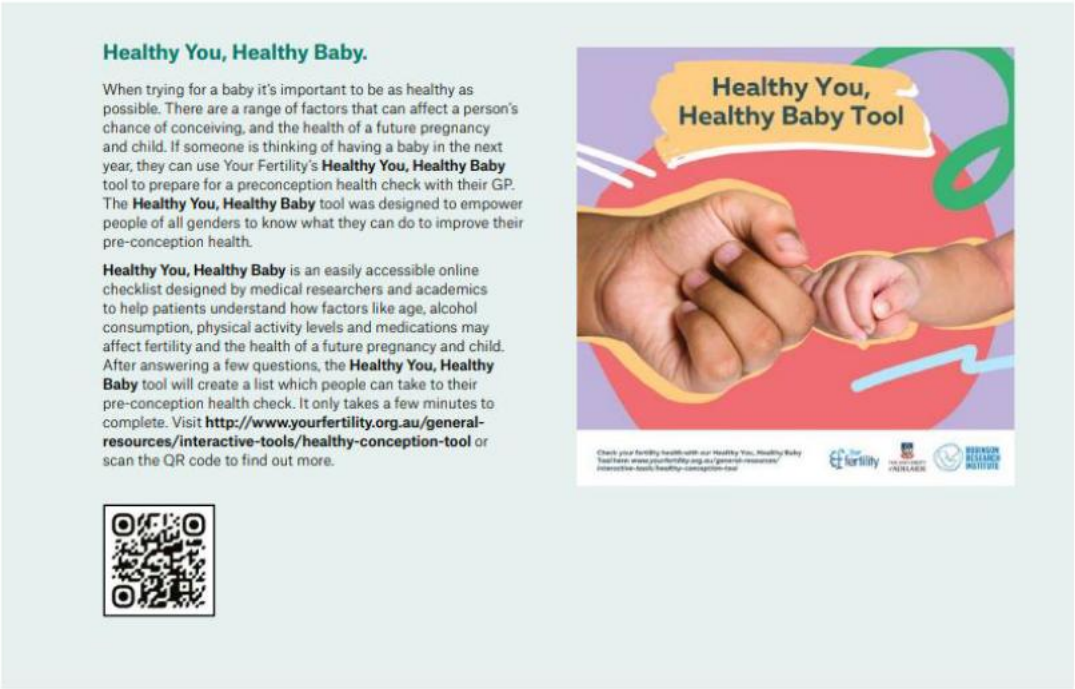
Based on this research, we updated our digital preconception healthcare tool that was originally launched in 2020, resulting in the new Healthy You, Healthy Baby online tool.

The new tool can be used on a smart phone or desktop and takes about three minutes to complete. After answering a few questions, it creates a list that people can take to their preconception health check. One of the biggest barriers to providing preconception health care that practitioners have raised is lack of time. The checklist saves time during an appointment by highlighting areas for people to work on. It shows patients things that need work right away, things to consider and areas where they're doing well.

We encourage health providers treating men and women in rural, regional and remote Australia to ask their patients about their reproductive plans and, if someone is thinking of having a baby in the next year, direct them to Your Fertility's Healthy You, Healthy Baby tool to prepare for a preconception health check.

The Australian Journal of General Practice (AJGP) aims to provide relevant and evidence-based information to GPs in Australia to assist them in providing the highest quality patient care. An ad was placed in the product news section of AJGP for three consecutive months (June-August 2023) to promote the enhanced tool (Figure 7.4).

Figure 7.4 Australian Journal of General Practice advertisement.



Healthy You, Healthy Baby.

When trying for a baby it's important to be as healthy as possible. There are a range of factors that can affect a person's chance of conceiving, and the health of a future pregnancy and child. If someone is thinking of having a baby in the next year, they can use Your Fertility's **Healthy You, Healthy Baby** tool to prepare for a preconception health check with their GP. The **Healthy You, Healthy Baby** tool was designed to empower people of all genders to know what they can do to improve their pre-conception health.

Healthy You, Healthy Baby is an easily accessible online checklist designed by medical researchers and academics to help patients understand how factors like age, alcohol consumption, physical activity levels and medications may affect fertility and the health of a future pregnancy and child. After answering a few questions, the **Healthy You, Healthy Baby** tool will create a list which people can take to their pre-conception health check. It only takes a few minutes to complete. Visit **http://www.yourfertility.org.au/general-resources/interactive-tools/healthy-conception-tool** or scan the QR code to find out more.

This chapter has informed the development of health promotion activities for preconception health and the enhanced ***Healthy You, Healthy Baby*** tool. This can influence the barriers of consumer awareness and clinician knowledge at the individual level.

Chapter 8: Priority Setting for Preconception Care in Australia

8.1 Chapter Aim

This chapter provides an overview of a priority setting exercise for preconception care in Australia in which care priorities, strategies to deliver them, and values to uphold them were defined. This complements the work from Chapters 2-7 of this PhD thesis, as the barriers that have been explored can be mapped to strategies identified in this work.

8.2 Referenced Publication

This publication is Appendix D

Boyle JA, Black K, **Dorney E**, Amor DJ, Brown L, Callander E, et al. Setting Preconception Care Priorities in Australia Using a Delphi Technique. Semin Reprod Med. 2022;40(3-04):214-26.

8.3 Author Contribution

Edwina Dorney (ED) is a member of the core working group of the Preconception Health Network. She contributed to the structure and content of the Delphi technique, the running of the workshops, writing and reviewing the manuscript.

8.4 Priority setting for preconception care in Australia.

As outlined in this PhD thesis, multiple barriers to delivering preconception care have been identified. Efforts to identify and prioritise which barriers to address are required. This is to ensure maximal gain to improve preconception health in Australia.

Several factors must be considered when prioritising health interventions, including effectiveness and cost effectiveness, feasibility, potential to scale, and sustainability. (1-3) Equity and cultural appropriateness of any intervention are also critical considerations. (4,5) As preconception health and care encompass broad population and content domains, a multi-sectoral approach with community engagement is needed.

The Preconception Health Network (The Network) is a national, cross-sectorial collaboration across health, social and education sectors with strong consumer engagement. (6) The Network is led by researchers, clinicians, academics, and consumers who aim to promote the best practice in preconception health and care.
In 2021 The Network undertook a priority setting exercise for preconception health and care in Australia. This involved:

1. the identification and prioritisation of preconception interventions,
2. the identification and development of strategies to implement the interventions,
3. the identification and development of values to underpin preconception activities in Australia.

The opinions of 24 experts, across four Australian states, from health, social and education sectors and consumers were gathered using a Delphi technique. The Delphi

consisted of an online questionnaire “Round One”, an online workshop to discuss the Round One questionnaire findings and a second-round online questionnaire.

In the first Delphi activity there was considerable variation in ranking preconception health priorities, with participants acknowledging this is a challenging exercise as *“...all priorities are important, and many are interconnected.”* This led to the grouping of priorities in the online workshop to acknowledge the relationships and dependencies between them. Ten priority areas were identified to form the care package for preconception care (Figure 8.1)

Figure 8.1: Results of the priority setting task from the Preconception Health Network’s priority setting for preconception care in Australia

1. Health behaviours (nutrition, physical activity, micronutrient supplementation)
2. Medical history (medical, obstetric & genetic history, medications)
3. Healthy weight
4. Reproductive health (reproductive life planning and contraception)
5. Mental health (mental health, support network and isolation)
6. Substance use, smoking, alcohol
7. History of trauma or family violence
8. Exposures
9. Partner health
10. Screening (sexually transmitted infections, cervical, genetic)

For the strategies to address preconception health priorities, six key strategies were developed;

1. Public health and social care campaigns
2. Health Service Reforms
3. Preconception Guidelines, health professional and social care education
4. Shaping Health Policy
5. Digital Technology as a platform for education, health promotion and health care
6. Education for the community and improving health literacy.

The development of these strategies is shown in Figure 8.2.

Figure 8.2: Development and results of the key strategies to address preconception care priorities from the Preconception Health Network's priority setting for preconception care in Australia.

Table 4 Results of key strategies to address PCC priorities (round one, workshops, round two)

ROUND ONE ONLINE QUESTIONNARE	WORKSHOPS	ROUND TWO ONLINE QUESTIONNAIRE
Most often raised	**Distinction between most and least often raised removed**	
Raising community awareness/health promotion/education	Public health campaigns: schools, workplaces, community, men, women	Public health and social care campaigns: schools, workplaces, community, men, women
Medicare and health service reform	Service reforms: Medicare item number, alternate funding models, nurses (including practice nurses, midwives, maternal and child health), access to care, resources available, improving health care safety and access	Health service reforms: Medicare item number, alternate funding models, nurses (including practice nurses, midwives, maternal and child health), access to care, resources available, improving health care safety and access
Existence of guidelines/national guidelines	Preconception guidelines	Preconception guidelines, health professional and social care education
Health professional education	Health professional education	
Less often raised	Recognition by government: health policy such as sugar taxes, increase floor price of alcohol and cigarettes	Shaping health policy
Collective strategies across sectors (key stakeholders, multi-College, integration of health and social care)	Digital technology – cross cutting	Digital technology as a platform for education, health promotion and health care
Recognition of the importance for public health by government, policies such as increased floor price on smoking and alcohol, sugar tax, include as part of women's health strategy	Education for the community and improving health literacy	Education for the community and improving health literacy
More digital technology		
Less traditional methods of delivery		
Culturally tailored solutions (communication barriers, early support for groups at risk, special consideration for First Nations)		
Improve equity of access to care with special consideration for Aboriginal and Torres Strait Islander peoples and their preconception health care needs is required to improve overall health outcomes	Note: Culturally tailored solutions (communication barriers, early support for groups at risk, special consideration for First Nations) AND Collective strategies across sectors (key stakeholders, multi-College, integration of health and social care) should be underpinning values. Explicit inclusion of practice nurses and midwives.	

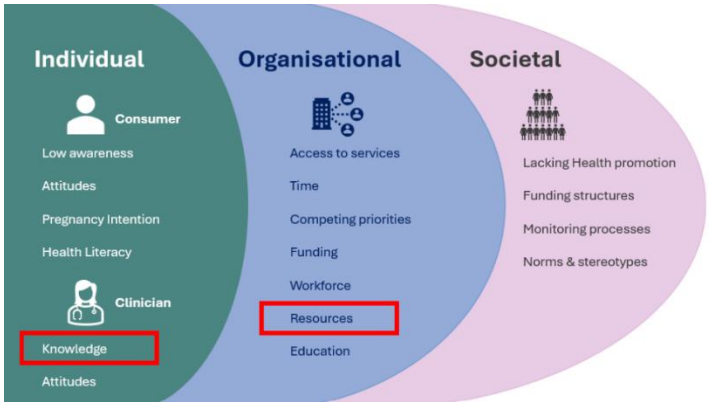
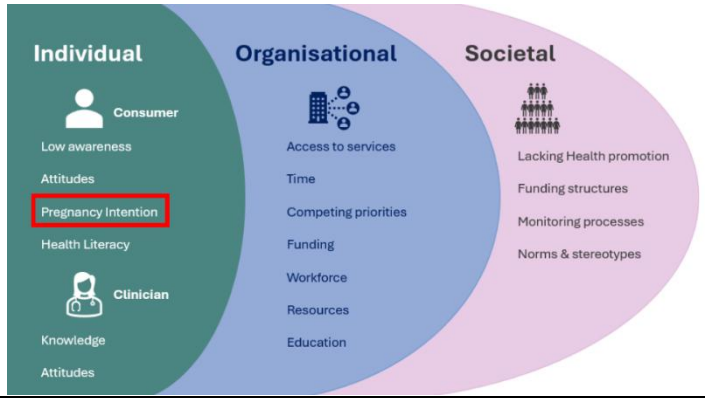
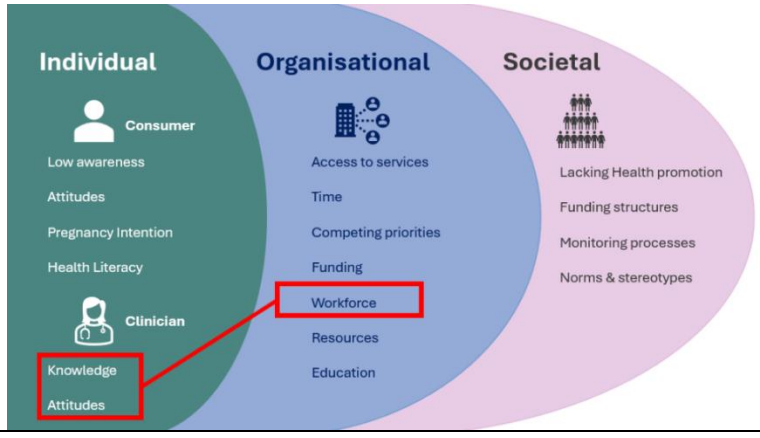
PCC: Preconception care

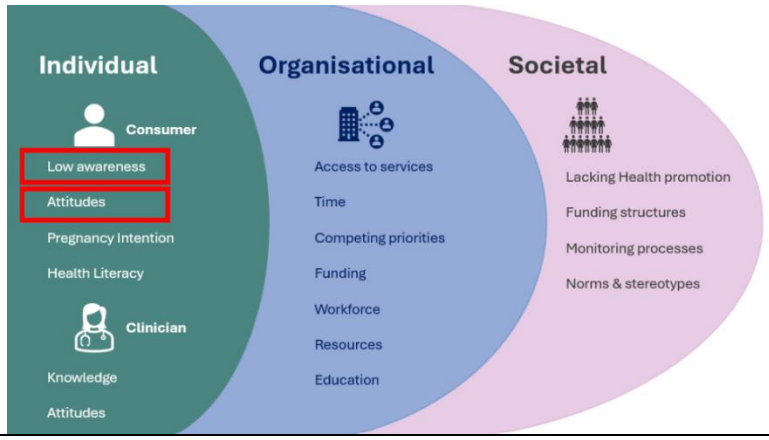
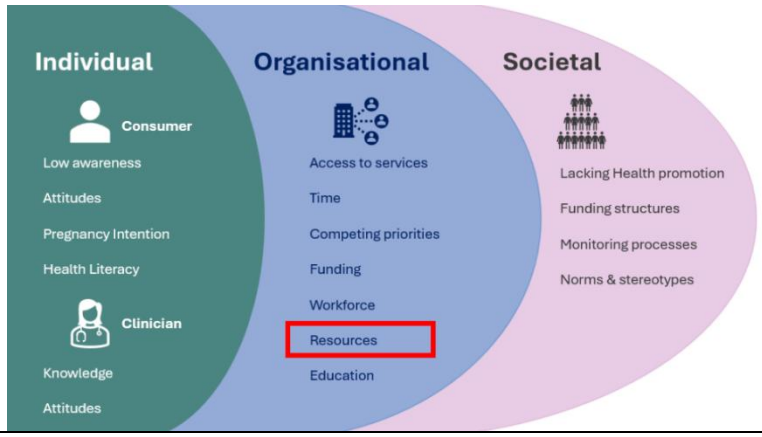
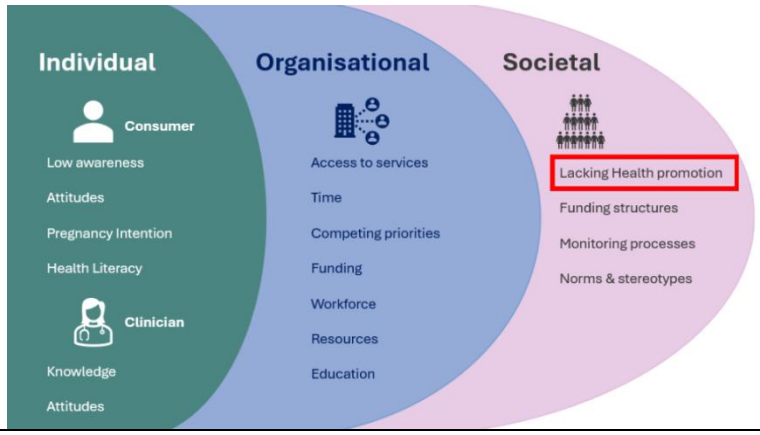
Nine values to underpin the priorities and strategies for preconception care were also defined. These were not ranked, as all were deemed important for all interventions in preconception health. The values are listed in alphabetical order in Figure 8.3.

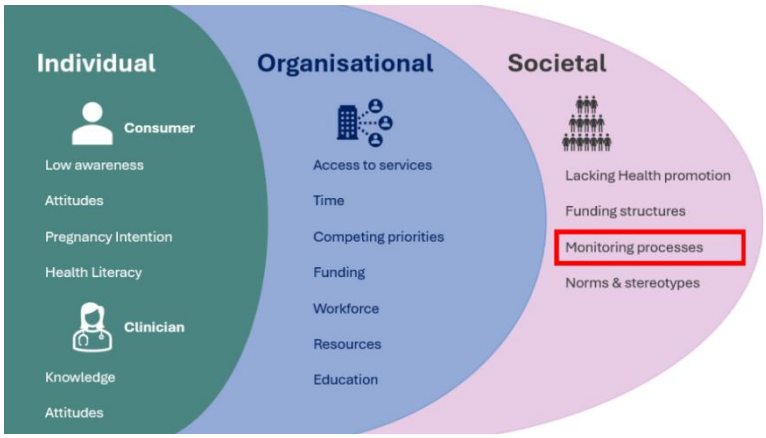
Figure 8.3: Results of the underpinning values task from the Preconception Health Network's priority setting for preconception care in Australia.

The barriers explored in this PhD thesis have been mapped to strategies identified in this priority setting exercise and are as follows:

Table 8.1: Barriers and aligned strategies for preconception care.

Chapter	Barrier	Strategy
2	**Preconception care guidelines** 	Preconception guidelines, health professional and social care education
3	**Pregnancy Intention** 	Health Service Reforms
4	**Workforce: Primary Health Care Nurses** 	Health Service Reforms

5	**Awareness & understanding of preconception health and care** 	Education for the community and improving health literacy
6	**Optimisation of an online self-assessment tool for preconception care** 	Digital Technology as a platform for education, health promotion and health care
7	**Health promotion for an online self-assessment tool** 	Public health and social care campaigns

9	**Population Indicators for preconception care**  	Shaping health policy Health Service Reforms

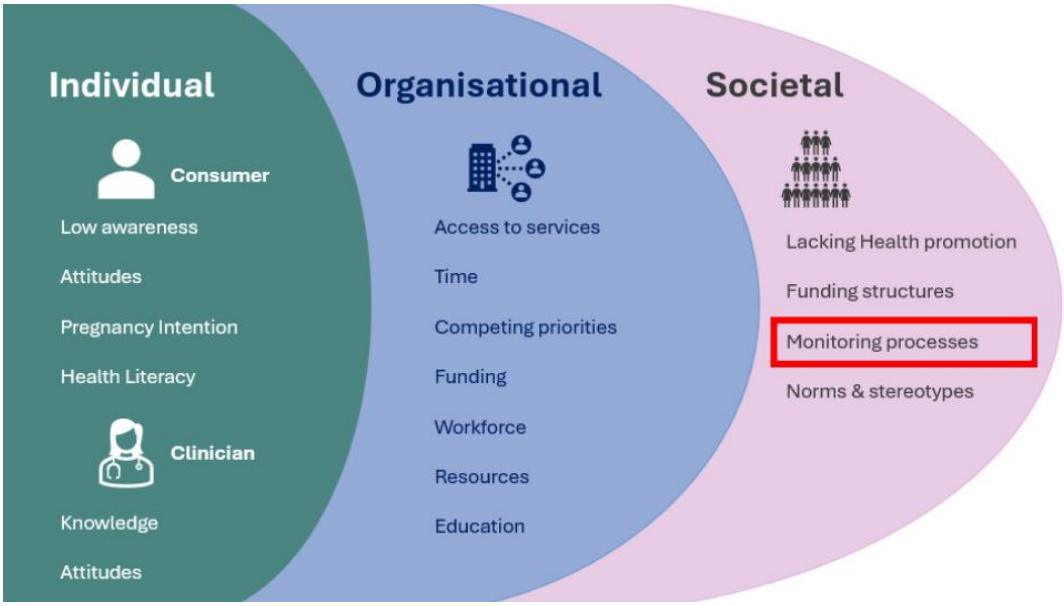
This priority setting exercise gathered experts from the health, education and social care sectors to identify ten important components of preconception health to focus on for people in Australia. These components reflect a biopsychosocial approach to preconception care for both a woman and her partner. In addition to identifying the priority areas, six key strategies that can guide the implementation of interventions within these priority areas were defined. These strategies have also been mapped to the barriers to preconception care explored in this thesis. This allows for a structured and systematic approach to improving the delivery of preconception care, that resonates with cross-sectoral stakeholders in the Australian setting.

Nine underpinning values were also defined, and these are recognised as key foundations for effective preconception care interventions. These values serve to achieve an equitable, person- centred and holistic approach to preconception care that can improve health outcomes for parents, their babies and future generations.

Chapter 9: Monitoring preconception health and care in Australia

9.1 Chapter Aim

Monitoring population health is important to identify risk factors and health issues so that effective interventions can be planned. A lack of monitoring of preconception health and health behaviours has been identified as a barrier to the delivery of preconception care at the societal level.



This chapter provides an overview of the development of a framework for monitoring preconception health and care in Australia.

9.2 Referenced Publications (Appendix E & Appendix F)

Appendix E: Subasinghe AK, Hill B, **Dorney E**. Black KI, Hailu H, Bowden M, Boyle JA. What are the preconception health and social care needs of Australians? Recommendations for action across research, policy and practice. Public Health Research & Practice Accepted 2024.

Appendix F: Subasinghe AK, Black KI, **Dorney E**, Boyle JA. Assessing preconception health in Australia to support better outcomes in the first 2000 days - A critical need for building a core indicator framework. Aust N Z J Obstet Gynaecol. Published online April 20, 2024. doi:10.1111/ajo.13815

9.3 Author Contribution

Edwina Dorney is a member of the core working group of the Preconception Health Network. She contributed to the structure and content and running of the workshops, writing, and reviewing of both manuscripts.

9.4 Monitoring of preconception health and care in Australia.

Globally there is increasing recognition about the importance of good preconception health. As such, frameworks to monitor preconception health have been developed in both the United Kingdom (UK) and the United States (US). (1,2) These comprise of core metrics across medical, behavioural, social, and broader environmental risk factors that can impact future pregnancies, that have been mapped to existing data sources.

Currently there is no national reporting process for preconception health in Australia. The Preconception Health Network identified improved monitoring of preconception health and care in Australia as a priority action (Chapter 8). This would serve to monitor the health of people Australia and the impact of preconception care policy, interventions, and research.

Developing a set of care indicators for preconception health in Australia

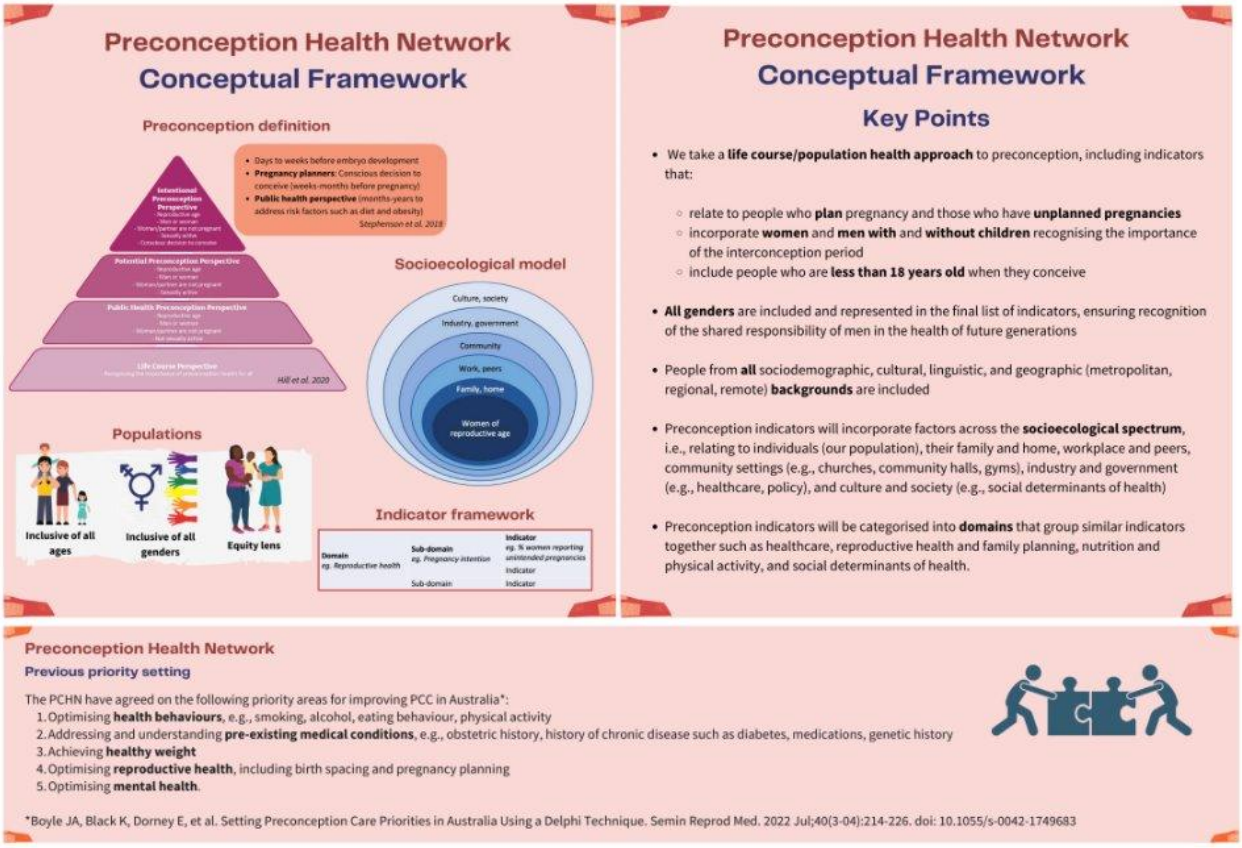
Preconception health indicators are defined as "*medical, behavioural and social risk factors or exposures as well as wider determinants of health that may impact potential future pregnancies among all women and men of reproductive age*". (1)

The Preconception Health Network ran a series of three workshops with key stakeholders and consumers in 2022 with the purpose to:

1. Build a conceptual framework for indicator development with stakeholders,
2. Define and prioritise preconception indicator with stakeholders,
3. Gain consumer perspectives on indicator development.

The first workshop with stakeholders from clinical, policy and research domains led to the generation of a conceptual framework. This framework (Figure 9.1) detailed a life course approach to preconception health, that includes populations of people currently planning and not planning a pregnancy, of all genders and all cultural backgrounds. It was also recognised that indicators need to exist across the socio-ecological spectrum.

Figure 9.1: A conceptual framework to develop preconception health indicators in Australia from the Preconception Health Network



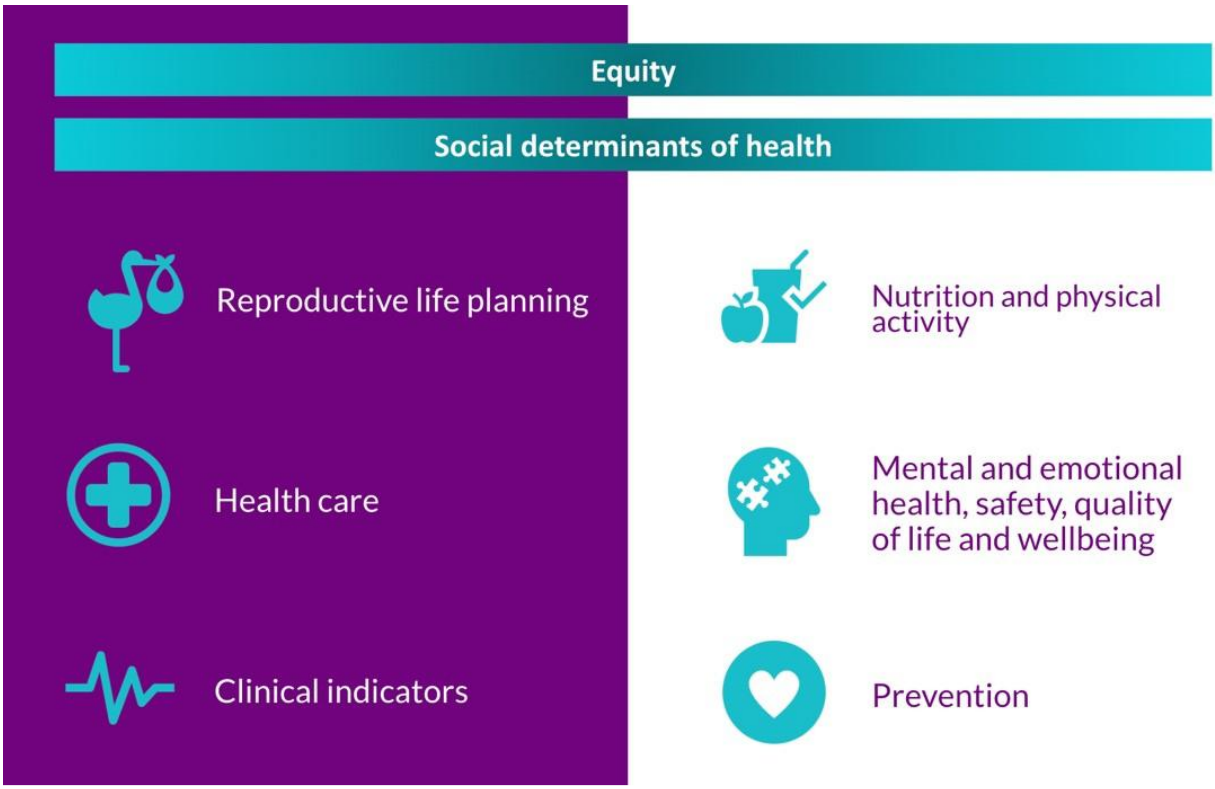
Before the second workshop a preliminary group of indicators were drafted from the literature, and indicators developed in the UK and US. (1-3) Participants were asked to rank the draft list and identify other indicators to then discuss in the workshop. The second workshop focused on defining and prioritising indicators and employed tools such as the 9Ps priority setting framework (Figure 9.2) (4).

Figure 9.2: 9Ps Priority setting framework (4)

Criteria	Definition
Criteria 1. Prevalence or burden attributable to the proposed problem	Consider the prevalence or attributable burden of the problem and its implications/complications. Is the problem a significant issue for the community, health system and key stakeholders?
Criteria 2: Prevention	Is there potential to prevent the problem, including complications or secondary impacts, in the general population or in a specific vulnerable target cohort?
Criteria 3: Position	Consider the geographical issues around the problem and the location of services/expertise. Are there inequities that can be improved through this initiative? Is there potential to improve health outcomes for the general population and/or regional populations and/or specific vulnerable target cohorts?
Criteria 4: Provision	Does the current approach or system align with evidence-based best practice? Is the current approach designed to deliver the best possible community health outcomes and health care system? Is there a clear gap to address in the area proposed?
Criteria 5: Potential	Is there a strong rationale/evidence base for the potential for improvement in patient outcomes and health system advancement through this initiative?
Criteria 6: Participation	Is a collaborative approach critical to success? Are there clear drivers for stakeholders to engage and collaborate? Are there existing relationships between stakeholders that can be leveraged to drive improvement and change?
Criteria 7: Policy	Does the problem or the potential solution align with current policy directions at a local, state, national or international level?
Criteria 8: Proposed Strategy	Does the proposal align with the purpose of the Health in Preconception, Pregnancy and Postpartum strategic alliance?
Criteria 9: Proposed Transformation	Will addressing this problem or taking this approach collaboratively support the development of an improved health system and health outcomes?

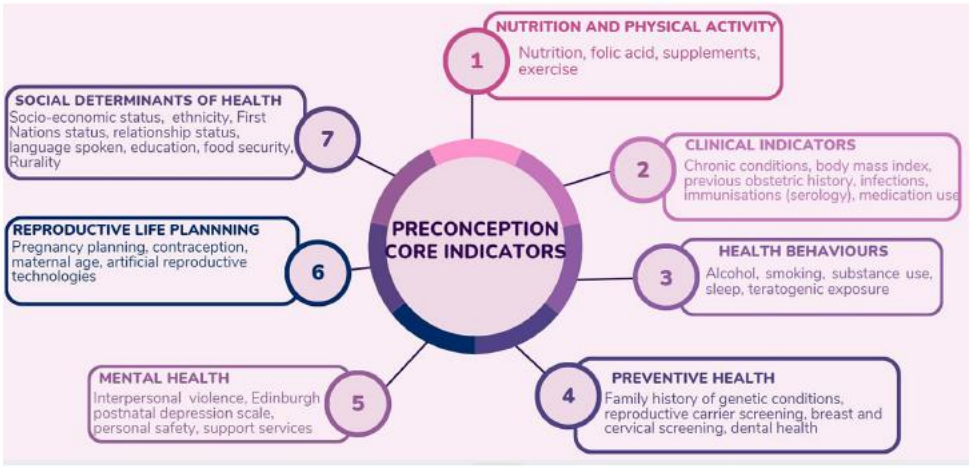
The outcome of the second workshop was that *equity* and *the social determinants of health* be considered across all indicators. Six key domains of indicators were formed and are shown in Figure 9.3.

Figure 9.3 The six preconception health indicator domains to monitor preconception health in Australia after two workshops.



The third workshop aimed to capture consumer perspectives on what matters in preconception health, and to ensure the proposed indicators from Workshop 2 aligned with this. Outcomes from the consumer workshop saw the inclusion of the social determinants of health as its own domain, giving seven preconception core indicator domains as shown in Figure 9.4.

Figure 9.4 The seven preconception health indicator domains to monitor preconception health in Australia after three workshops including consumer input.



This series of workshops saw the development of a framework and list of indicators, that aligns with consumer perspectives, to monitor preconception health in Australia. Following the development of the indicators, a mapping exercise was performed across pre-existing state and national datasets. This was to understand what data sources are available to monitor the identified indicators.

Mapping demonstrated that only some indicators are collected in state and national perinatal data. This is mainly within the clinical and health behaviours and mental health domains. Regarding the social determinants of health, data on postcode of residence was mostly available across all states. Data was not complete for some preventive health or reproductive life planning domains and was also lacking for nutrition and physical activity. Mapping only confirmed the existence of such data, not a report or analysis of the data.

Progress cannot be made in the monitoring of preconception health unless there is substantial change to current data collection practices in Australia. These changes ultimately require federal or state governments in Australia to commit to modifying and expanding data collection. Modifications can include the expansion of, and uniformity in preset data fields so that data can be easily collected, analysed and reported at the state or national level. An interim solution could also include the use of artificial intelligence to improve analysis of existing data collection methods.

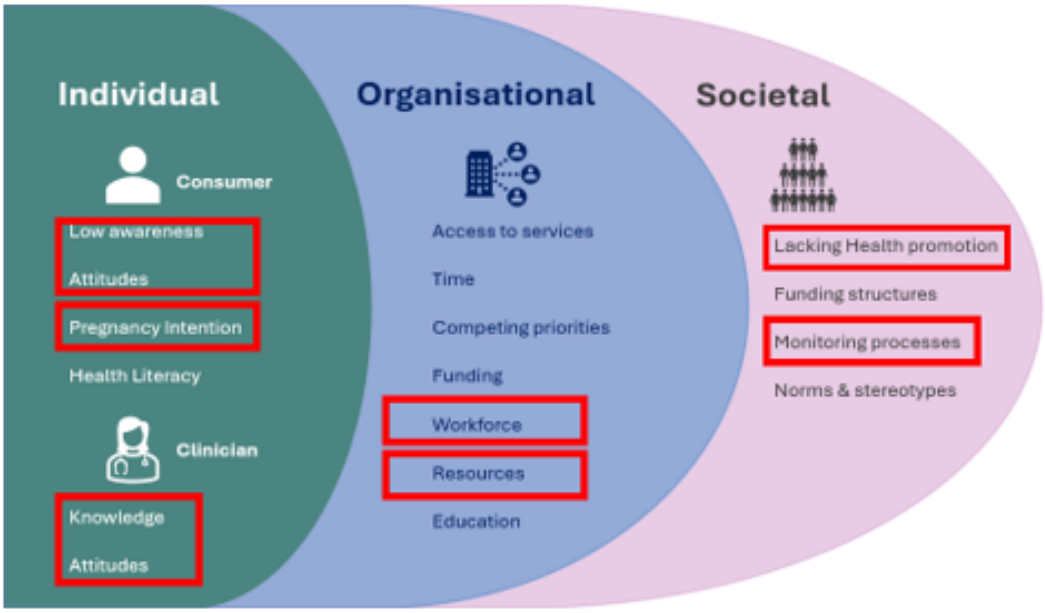
Monitoring preconception health and care for people in Australia can identify priority areas for intervention to improve health. Developing a national evidence-based framework, supported by available data sources can help to achieve this and to improve the delivery of preconception care.

Chapter 10: Summary of findings, strengths and limitations of the research

10.1 Thesis Objectives

The primary objective of this thesis was to enhance the understanding and delivery of preconception care in Australia. This was achieved by exploring nine identified barriers to the delivery of preconception care across the socio-ecological spectrum (Figure 10.1)

Figure 10.1: Barriers addressed in this PhD Thesis to enhance the understanding delivery of preconception health and care.



Barrier	Aspect explored	Research Methodology
Low consumer awareness Consumer attitudes	Understandings of preconception care Optimisation of a self-assessment tool	In depth interviews User-experience testing
Pregnancy intention	Measures of pregnancy intention	Review, retrospective data analysis, in-depth interviews
Clinician knowledge Clinician attitudes	attitudes and practice to preconception care	Cross-sectional survey
Workforce	Primary health care nurses' knowledge,	Cross-sectional survey
Clinician resources	Clinical practice guidelines	Systematic Review
Lacking health promotion	Preferences for advertisements for preconception care	Discrete choice experiment
Monitoring processes	A framework to monitor preconception health Data mapping for preconception health	Workshops, modified delphi technique Data mapping

10.2 Summary of the findings

In this chapter, I present the eight original and important public health findings from this thesis and discuss them in comparison with available literature. The findings are;

1. There is a lack of high-quality clinical practice guidelines (CPGs) to support clinicians in the delivery of preconception care. Development of future guidelines needs to include recommendations for men and priority populations.
2. Tools to measure pregnancy intention can inform the targeted delivery of services for a person or couple, before, during or after pregnancy. The implementation of the London Measure of Unplanned Pregnancy (LMUP) in routine antenatal care identified organisational and service level considerations to address for effective implementation.
3. Collaborative education programs, development of resources, and consideration of financial incentives for primary care practices can enhance the primary health care nurse's (PHCNs) capacity to provide preconception care.
4. Women and men in Australia are keen to learn about preconception care and see this as important. Despite this, there is limited understanding of the content of preconception care, and the term "preconception care" is considered medical jargon. Online resources are a preferred source to obtain reproductive health information amongst people of reproductive age.
5. An online self-assessment tool is a valued resource for preconception health information as it can present a breadth of information in a single convenient location. Such a tool must be intuitive to find, easy to use and communicate health messages effectively.
6. An image within an advertisement for reproductive health can significantly impact engagement, as can the location in which the advertisement is seen. People of reproductive age are more likely to engage with an advertisement if presented in a

healthcare setting compared to a more general media setting such as public advertising on transport.

7. Priority areas for preconception care encompass health and social care factors for women and their partners. Strategies to implement these include education, health promotion, policy and health service reforms.
8. Seven domains were identified as important to monitor the preconception health and health behaviours for people in Australia. There is limited data available at a state and national level to report on these indicators.

10.3 Key findings for each chapter and comparison with existing literature

Each key finding is presented with a summary and comparison to existing literature. The public health and clinical care implications of these findings are also discussed.

10.3.1 Guidelines for preconception care

There is a lack of high-quality clinical practice guidelines (CPGs) to support clinicians in the delivery of preconception care. Development of future guidelines needs to include recommendations for men and priority populations.

International research shows that evidence-based CPG's can improve health outcomes across multiple clinical disciplines (1-3). Prior to this PhD research, little was known about the availability and quality of CPGs for preconception care. The systematic review presented in this thesis offers evidence to address this knowledge gap. The review found that internationally there are 11 focused CPGs for preconception care, two of which are from Australia. (4) The 11 guidelines varied in their content, and some

guidelines did not cover all preconception content areas. The number of recommendations within the guidelines also varied and ranged from two to 113.

There are protocols that detail recommended procedures for developing a CPG. (5-7) Studies that have explored the role of CPGs in routine care have called for transparency in the development process. (8, 9) This allows for a quality analysis of the guideline and enables a clinician assessment to determine if the guideline is trustworthy and appropriate for their use. (8, 10) Our application of the AGREE-II tool for quality analysis of the 11 guidelines showed inconsistent adherence to the AGREE-II assessment criteria. Only one CPG was of high quality, with the remaining ten guidelines of moderate quality.

The only guideline assessed to be high-quality was the Canadian HIV Pregnancy Planning Guideline, which is targeted to people and couples living with HIV. (11) This identified the gap of high-quality guidelines to support clinicians providing care to Hill et al's potential preconception perspective. (12) A national study of CPGs in Australian healthcare called for consideration of the "burden of disease" as a determining factor in merit of developing a guideline. (9) Given the size of the potential preconception population, and the current suboptimal rates of preconception health behaviours, CPGs for preconception care are indeed appropriate and much needed.

The development of a high-quality CPG does not always translate into its implementation and use in practice. CPGs must be both appropriate and applicable to

the target population, and easily useable for the clinician. (8, 13) The Canadian HIV Pregnancy Planning Guideline received its lowest score in Domain 5 of the AGREE-II tool of “Applicability”. As such, the guideline team developed an additional best practice document that repackaged the 36 guideline recommendations into five standards of care for ease of use. (14) This best practice document was designed to increase usability and further support health care providers in the application of this guideline.

It has been suggested that strategies to improve applicability of CPGs begin at the development stage of a guideline. (1) The inclusion of multidisciplinary panels of stakeholders in addition to clinical content experts is one such strategy. (2, 3) This includes the input of consumers to ensure guideline recommendations align with the needs of the target population. (1) The systematic review in Chapter 2 also found that only six out of the 11 guidelines included advice for men, and only three guidelines offered specific recommendations for priority populations. Considered selection of stakeholders for guideline development could ensure that the needs of these populations are met in future guideline development.

In this chapter I have demonstrated the need to develop high-quality CPGs that support the delivery of comprehensive and equitable preconception care. Current CPGs for preconception care can be improved upon by strengthening of clinical content, and the inclusion of men and priority populations. This can be accomplished with appropriate stakeholder and consumer involvement. These guidelines also need more rigorous

development processes and strategies to improve their applicability, which can be achieved by following protocols for guideline development.

10.3.2 Measures of pregnancy intention.

Tools to measure pregnancy intention can inform the targeted delivery of services for a person or couple, before, during or after pregnancy.

The implementation of the London Measure of Unplanned Pregnancy (LMUP) in routine antenatal care identified organisational and service level considerations to address for effective implementation.

Unplanned pregnancies are associated with adverse pregnancy outcomes for women and their babies. (4, 5) Efforts to assess pregnancy intention present an opportunity to identify women and their partners who can benefit from family planning services. In my review in Chapter 3 of this thesis, I explored the available measures of pregnancy intention, when they can be used, and their impact for service delivery and health policy. I explored how assessment of these measures at population level can identify key associations and determinants of unintended pregnancies and inform both contraception and preconception health service development. I also contributed to the three supporting studies in this chapter that explored the implementation of measures of pregnancy intention in the Australian setting. (6-8)

My review describes how retrospective measures of pregnancy intention can identify women and their partners who may require additional care in pregnancy, including

education for subsequent family planning and provision of post-partum contraception. Two of my supporting studies in this chapter explored the novel implementation of the LMUP in antenatal care in Australia. (6, 7) These were the first studies to explore the implementation of the LMUP into routine maternity care and have only recently been supported by a similar implementation study in the United Kingdom (UK). (9)

Our retrospective review of the first 12 months of LMUP data showed an intended pregnancy rate of 70% which is consistent with previous studies of pregnancy intention in Australia. (10, 11) Completion rates of the LMUP varied across the two study sites and this was attributed to service delivery characteristics including clinical support and mode of delivery of antenatal appointments. The importance of providing education and support for implementation has also been demonstrated in the UK study. (9) In their implementation study across three maternity facilities, sites that had a clinical champion providing implementation support saw higher completion rates of the LMUP compared to sites that did not. (9)

Also of interest was our study exploring midwives' perspectives of using the LMUP and its application to their scope of practice. (7) Overall midwives supported the inclusion of the tool in the antenatal booking visit, and felt it was in their scope of practice to deliver care across the pregnancy continuum. Midwives identified organisational issues including a need for education to support the implementation of the LMUP.

Our finding that more than a third of women with an unintended pregnancy did not receive education about post-partum contraception is new, and a service gap that requires attention. Midwives in our study identified service level issues including a lack of structured care pathways to support women with an unintended pregnancy as a barrier to implementation which could address this gap. This thinking was echoed in the UK study where midwives also expressed the desire to use information gained from the LMUP to inform contraception and preconception care services. (9)

My review also described how prospective measures of pregnancy intention can identify women and their partners who can benefit from preconception care interventions or contraception for those not intending a pregnancy. (12) A large prospective cohort study in the United States (US) showed that pregnancy intention was “highly fluid” for women who were considering pregnancy. (13) This supports the need to have measures of pregnancy intention that are easy for clinicians to use, and acceptable to women. The pilot study of the One Key Question® (OKQ®) tool was to our knowledge, the first study exploring this tool in Australia.

Our finding that women mostly saw the OKQ® as relevant to their general health is aligned with other research exploring acceptability of assessing pregnancy intention. (14) Additionally our finding that clinicians felt the tool was easy to use has been demonstrated internationally. (15, 16) Our study demonstrated there was with a small impact on appointment times with asking the OKQ® which has also been shown in both the primary care and specialist setting. (16). This pilot study was unique in assessing

both consumer and clinician perspectives in the same settings, where other studies have typically only explored the consumer or clinician perspective. (15, 16) This preliminary study needs to be supported by future research that explores how to implement prospective measures of pregnancy intention into routine care and their impact on reproductive health outcomes.

In Chapter 3 I have described how measures of pregnancy intention present an opportunity to identify women and their partners who can benefit from family planning and preconception services. There are different measures that can be applied to assess both prospective and retrospective pregnancy intention. Understanding the perspectives of consumers and clinicians is key to their successful and sustained implementation. Monitoring these measures can identify populations who require targeted care and inform service delivery.

10.3.3 Workforce: primary health care nurses and preconception care.

Collaborative education programs, development of resources, and consideration of financial incentives for primary care practices can enhance the primary health care nurse's (PHCNs) capacity to provide preconception care.

Primary care has been cited as the most appropriate setting to lead the delivery of preconception care, as it is the most likely point of health care contact for people of reproductive age. (17) PHCNs are the largest clinician workforce in the primary care setting in Australia. (18) In Chapter 4 I performed a cross-sectional study to explore the

knowledge, practice and attitudes relating to preconception care among PHCNs in Australia. (19)

In my study I found that 95% of surveyed PHCNs identified at least one barrier to the delivery of preconception care. Time constraints, a lack of knowledge, a lack of structured referral pathways and financial incentives were the most identified barriers. These barriers contribute to the low proportion of PHCN's who routinely discuss preconception health with their clients.

My study also showed that 87% of respondents wanted more education to increase their confidence in delivering preconception care. A desire for further education and training to increase confidence in delivering preconception care has also been reported by PHCNs in South Africa. (20) Respondents in my study wanted more educational resources, with fact sheets and websites the most frequently desired. Online preconception learning modules have been shown to be effective in improving both PHCN's and midwives' knowledge and confidence in delivering preconception care. (21, 22) In my survey only 12% of respondents had completed an available learning module which suggests that support may be needed to encourage nurses to access such resources.

A recent Australian study of midwives' perspectives on preconception care also showed a desire for more online educational resources which can present an opportunity for collaboration to develop these resources. (23) Additional opportunities to

increase knowledge for both PHCNs and midwives involve the inclusion of preconception care into tertiary education curricula. (23, 24) This is yet to be explored in Australia and is an area for future research to improve knowledge and confidence for nurses and midwives in delivering preconception care.

A lack of financial incentives for PHCNs to deliver preconception care was another significant identified barrier described in Chapter 4. In Australia, the healthcare system is both publicly and privately funded. Medicare is Australia's universal (public) insurance scheme, and the Medicare Benefits Schedule (MBS) is a list of services that can be rebated under this scheme. (25) Currently, PHCNs cannot bill for preconception care on the MBS. The availability of an MBS item number for preconception care has been suggested as an enabler to the delivery of preconception care, by PHCN's, midwives and general practitioners. (23, 26, 27)

Given PHCNs are well placed to deliver preconception care, this research into their preconception knowledge, attitudes and practice is both original and important. There is also increasing awareness of the importance of enabling PHCNs to work to their full scope of practice. (28) This can transform access to preconception care services for people though nurse-led models of care or through task-sharing models with GPs. (27, 29, 30) Addressing the identified barriers of education, and funding models can increase the utilisation of the PHCN workforce in the delivery of preconception care and are important areas for future research.

10.3.4 Understandings of preconception health and care.

Women and men in Australia are keen to learn about preconception care and see this as important. Despite this, there is limited understanding of the content of preconception care, and the term “preconception care” is considered medical jargon. Online resources are a preferred source to obtain reproductive health information amongst people of reproductive age.

In Chapter 5, I described the understandings of preconception care for people across Australia. In this study I included people from metropolitan, regional and remote Australia and a balance of people planning and not planning a pregnancy in the next 12 months to align with the potential and public health preconception perspectives. (31) Three key themes emerged from the in-depth interviews, being perceptions of preconception health and then practices and preferences for learning about preconception health.

I found that all participants were keen to learn about preparing for pregnancy and saw this as an important issue. Despite understanding the overall concept, I showed that participants had significant variation in their knowledge of preconception health. This variation is related to the breadth and detail of the content of preconception care and to the populations who need it. Previous Australian research has shown that women see preconception health as important but it is not a priority health action for them. (32) The important relationship between a person’s priorities and health care behaviours has been recognised in other clinical areas. (33, 34) It is reasonable to assume that if

understanding of good preconception health is enhanced, that preconception health may be better prioritised. This supports the idea that efforts to raise awareness and improve understanding of preconception health are important next steps.

While limited knowledge and understanding of preconception health is a consistent finding with other cross-sectional survey studies in women (35-39) and a recent systematic review for men, (40) our interviews offer some more detail into the limitations of their understandings. A key finding I demonstrated in Chapter 5 was that most participants were unfamiliar with the term “preconception care” and that they identified this as medical jargon that impacted access to information. Medical terminology, that is not understood by the public, has been shown to cause confusion that can negatively impact decision making and health behaviours. (41-43) Clear information, expressed in plain language is significantly better understood. (43, 44). The use of the term “preconception care” has previously been shown to not resonate with women of reproductive age. (32) My interviews allowed insight into preferred search terms for preconception information which showed a strong preference for plain language terms such as “how to get ready for pregnancy”.

All participants in my study acknowledged the importance of including partners in preconception care discussions. The benefits for including partners in health and maternity care have been demonstrated previously. (45-47) However preconception care is a unique situation where improving the health status of two separate individuals can contribute to better health outcomes. My finding that participants wanted

educational resources that were relevant to both partners is encouraging and the development and impact of such resources is an area for future research.

I also described practices and preferences for reproductive health information seeking and showed that online sources were preferred as a source of information. The potential for digital health tools to improve reproductive health has been demonstrated in previous research and recently endorsed by the WHO. (48-51) In Chapter 5 I also showed insight into factors that influence engagement with online resources. People want online resources and tools that are endorsed by reputable institutions to increase their trust. I also described that healthcare providers, particularly those who provide pregnancy care, and community members are also trusted resources for preconception information. Participants supported a life course approach to preconception care education, suggesting this commence in school.

My findings from Chapter 5 inform the need for health promotion efforts that include partners and are presented in plain language to educate people of reproductive age about good preconception health. My findings support the use of digital health tools as a medium to do this.

10.3.5 Optimisation of an online self-assessment tool for preconception care

An online self-assessment tool is a valued resource for preconception health information as it can present a breadth of information, in a single convenient location. Such a tool must be intuitive to find and easy to use and communicate health messages effectively.

In chapter 6 I conducted the first study to rigorously investigate consumer perceptions and usability of an online self-assessment tool for preconception care. I involved women and men, planners and non-planners, and people of any relationship status, to fit Hill et al's potential and public health preconception perspectives. (31) The concept of the Healthy Conception Tool (HCT) was well received, with participants valuing the accessibility and convenience of such an expansive range of information within one location. Research on online information searching from reproductive health and other health conditions, shows a need for effective internet search skills to access comprehensive information and that limited search skills can be a barrier to accessing information. (52-54) My qualitative analysis found that participants appreciated the comprehensive suite of information available through the HCT and commented on learning new information that they would not have known to search for.

I also described that participants placed importance on knowing that the tool was supported by reputable academic organisations. This aligns with existing evidence that consumers judge the trustworthiness of online health information by its association with credible organisations. (55-58) Another key finding in Chapter 6 was the importance of users being able to find the online self-assessment tool with ease. Driven by my findings

in Chapter 5, that “preconception care” is medical terminology and not a search term used by people of reproductive age, I explored alternative titles for the self-assessment tool in the interviews and user-experience testing. There is a paucity of peer-reviewed literature on the impact of a title for digital health tools. Nonetheless, there is sound evidence supporting increased uptake and engagement of digital health tools that are easy for consumers to understand and pitched at an appropriate health literacy level. (58-60) My findings from the qualitative interviews informed a name change for the tool, with a draft plain English title of “Healthy You, Healthy Baby” and operational changes to improve the user experience.

From both my in-depth interviews and user-experience testing I described how participants want a tool that was quick and easy to use. This aligns with the findings of other eHealth modalities, where ease of use and simplicity are determinants in user engagement. (61, 62) Similar findings have been shown for reproductive health information where women prefer digital health resources that fit with their already busy lives. (49) I also showed that participants wanted personalised and meaningful results to communicate the health message effectively. Studies on risk communication support the use of personalised information to increase knowledge. (63-65). My findings also showed that participants valued the visual tool of colour-coding to enhance risk communication. While this is recognised as an effective strategy for health communication, (66, 67) some research has shown this is not always positively received and can send mixed messages. (68) This requires monitoring and follow-up to ensure effectiveness of the enhanced self-assessment tool.

In Chapter 6 I described the process taken to optimise an online self-assessment tool for preconception health. The enhanced tool has the potential to improve knowledge about the importance of good preconception health across the potential and public health perspective population. This tool can be adapted for priority populations, including people from culturally and linguistically diverse backgrounds to further improve the delivery of preconception care.

10.3.6 Health promotion for an online preconception self-assessment tool

An image within an advertisement for reproductive health can significantly impact engagement, as can the location in which the advertisement is seen. People of reproductive age are more likely to engage with an advertisement if presented in a healthcare setting compared to a more general media setting such as public advertising on transport.

In chapter 7 I used a discrete choice experiment (DCE) to understand the preferred features of an advertisement for reproductive health amongst people of reproductive age. I specifically explored what features would increase engagement to proceed to the optimised self-assessment tool for preconception care. Participants placed most importance on the image in the advertisement, and the location in which they say the advertisement favouring healthcare settings compared to more general medial locations.

Evidence shows that images can assist the clear and simple communication of health messages in both promotional and education materials. (69, 70) Research has also shown an increase in behaviour change intentions when images are matched to their target population. (71) This has been demonstrated across both demographic and clinical factors. (71, 72) The use of culturally appropriate images to reach diverse population groups is an area of future research to increase the awareness of the Healthy You, Healthy Baby tool with people from diverse backgrounds.

I also showed that the location for where respondents saw the advertisement was a significant factor to drive engagement with the self-assessment tool. Primary health care locations of General Practices or pharmacies were preferred. This presents important opportunities to promote and offer preconception care. The promotion of preconception care has been piloted internationally in primary care waiting rooms. (73) This pilot study showed an increase in the identification and assessment of preconception risk factors and is a promising area for future research.

The DCE further confirmed that the plain English title of “Healthy You, Healthy Baby” was preferred amongst people of reproductive age. These original findings informed the development of health promotion activities targeting consumers and clinicians to increase awareness about the importance of good preconception health. These activities reached over one million people in Australia and generated over eleven thousand actions.

My studies from Chapters 5-7 have synergistically informed the assessment, enhancement and dissemination of an online self-assessment tool. Figure 10.2 shows the relationship of these studies and how they can raise awareness about the importance of preconception health.

Figure 10.2 Relationship of studies in this PhD thesis to raise awareness about the importance of preconception health.

At the time of writing this PhD report, detailed analytics on the reach of the enhanced Healthy You, Healthy Baby tool had not been performed. Preliminary analysis shows an average of 500 visits per month since the launch of the enhanced tool in June 2023. This is a significant increase compared to before the research period, where there were less than an average of 100 visits per month.

10.3.7 Priorities for preconception health and care

Priority areas for preconception care encompass health and social care factors for women and their partners. Strategies to implement these include education, health promotion, policy and health service reforms.

Internationally both the UK and US have developed priorities and strategies for preconception health and care. (74, 75) To date, there has been little work on the cross-sectoral priorities for preconception health and care in Australia. In Chapter 8 of this thesis, I described the priority setting activities for preconception health and care across the health, education and social care sectors in Australia. The importance of cross-sectoral input to health policy has been seen in many health domains. (76-78) Such an approach allows for improved equity and inclusion and improved resource utilisation. (79)

In Chapter 8, I outline the ten identified priority areas for preconception health and care in Australia. This includes partner health which has not traditionally been captured in maternity and preconception care initiatives. Public Heath England acknowledges that preconception care is for all people, however there is limited attention to partner health in their pathways for preconception care. (74) Likewise, a recent maternity care policy in the Australian state of New South Wales, identifies the importance of preconception care information for women yet does not specify to include their partners. (80) This important recognition of, and attention to partner health is an area for future research and efforts to improve preconception care.

In chapter 8 I also described the identification of strategies and underpinning values to facilitate implementation of these preconception priorities. Six key strategies across health promotion, education, policy and health service reform were defined, which were consistent with the preconception strategies from the UK and US. (74, 75) Nine

underpinning values to ensure the effective implementation of preconception care were defined. These values encompass a person-centred, life course approach that considers the social and economic determinants of health. These values aligned with a recent global analysis on determinants of maternal health.(81) An additional consideration from this analysis is recognition of "superdeterminants" and their impact on maternal health. (81) Superdeterminants have been defined as *"the underlying contexts and forces that broadly influence the health and wellbeing of women before, during, and after pregnancy"*. These include factors such as political and environmental factors that can influence the social determinants of health, the physical environment and how health systems operate. The impact of superdeterminants is an area for future exploration in preconception strategy.

In Chapter 8 I mapped the strategies to achieve preconception care priorities to the barriers for preconception care explored in this PhD thesis. This allowed me to strengthen my approach to enhancing the understanding and delivery of preconception care.

10.3.8 Monitoring for preconception health

Seven domains were identified as important to monitor the preconception health and health behaviours for people in Australia. There is limited data available at a state and national level to report on these indicators.

In chapter 9 I described the original and important work to develop a set of core indicators for preconception health in Australia, and to identify data sources that align with the core indicators. Both the UK and US have existing frameworks for monitoring preconception health. (82, 83) The definitions of a preconception health indicator were consistent across these frameworks and applied in Chapter 9. While both the UK and US involved a range of experts in their indicator generation, our study was the only one to use consumer input into indicator generation. There is growing evidence to support the positive impact of consumer input into health policy and evaluation processes and as such consumer involvement is encouraged. (84)

Over three workshops with stakeholders and consumers, we identified seven domains to monitor the preconception health and health behaviours of people in Australia. The seven domains are;

1. Nutrition and clinical activity
2. Clinical indicators
3. Health behaviours
4. Preventive health
5. Mental health
6. Reproductive life planning
7. Social determinants of health.

The defined indicators were similar to those used in both the UK and US which is not surprising given the alignment in strategies and priorities for preconception care. (74, 75)

A point of difference in the monitoring frameworks is the data that is available to match the indicators. In the US population health surveys are used to monitor preconception health and behaviours. (83) In the UK there is a National Maternity Services Dataset that captures and records data on all pregnant women in the country. (85) In Australia, while information to support the selected preconception health indicators may be collected at a local level, there is a lack of uniformity at a state and national level in the way that data is captured and recorded. As such the mapping exercise we performed in Chapter 9 found that only some indicators are currently collected at a state or national level in Australia. Mechanisms, such as statewide changes to the way data are collected, or the use of artificial intelligence to improve analysis of existing data collection methods are areas for exploration to improve the monitoring of preconception health in Australia.

10.4 Strengths and Limitations

10.4.1 Strengths

This PhD has identified a number of ways in which community understanding of preconception health could be enhanced, and how the delivery of preconception care could be better supported. The strengths of each individual study have been discussed within their chapters. The particular strengths of this body of work are:

1. Applied a socioecological model to identify and map the barriers that impact preconception health knowledge and care across individual and population health levels.

The literature review in Chapter 1 of this thesis identified multiple barriers to the delivery of preconception care. This approach, applying a socio-ecological model, from the outset allowed a detailed understanding and visualisation of the complex interplay between these barriers. (86, 87) It has encouraged a holistic appraisal of the barriers and development of solutions that employ a multi-faceted approach that do not operate in their own silos. This can contribute to more effective and sustainable initiatives for preconception care.

2. Successfully led the establishment of a range of national and international research collaborations which produced the systematic review on guidelines and review of pregnancy intention measures

Throughout this thesis, I engaged with key stakeholders both nationally and internationally to deliver comprehensive approaches to the identified barriers of lacking guidelines and the importance of pregnancy intention in preconception care. This ensured both a multidisciplinary approach, and involvement of international experts who could provide critical contextual insights to enhance analysis, interpretation and framing of recommendations. The systematic review in Chapter 2, presents the highest level of evidence for guidelines in preconception care. (88) The international collaboration was also important in the emerging area of measures of pregnancy intention, where there has been limited experience in Australia.

3. Identified ways to promote preconception health by building research around consumer engagement and their recommendations for enhancing and promoting an online self-assessment tool.

Chapters 5-7 of this PhD thesis include a comprehensive series of projects to enhance and promote an online self-assessment tool for preconception care. Within this body of work, I established and sustained the involvement of a consumer advisory group (CAG). The CAG informed all aspects of project design through dissemination of results and health promotion activities. This ensured a person-centred approach and that issues that are important to consumers were targeted in the research questions.(89) In addition the nature of the research projects involved significant consumer input with both in-depth interviews and user experience testing. This has contributed to outputs that are relevant to the Australian population and aligned with their needs.

4. Brought together a range of national stakeholders to identify opportunities in primary health care to expand the delivery of preconception care and to define preconception priorities for Australia.

Multidisciplinary collaborations at the national level were also a strength of work in this PhD thesis. This was seen in projects for primary health care nurses (Chapter 4) and defining preconception care priorities (Chapter 8) where I engaged with people working directly in these fields to understand and apply their perspectives. Another important collaboration was with the Centre for Health Economics and Research Evaluation to apply the methodology of a discrete choice experiment (DCE) to

preconception health promotion (Chapter 7). This enabled the application of an additional methodology in this PhD to explore an identified barrier to the delivery of preconception care.

5. Applied rigorous and varied research methodologies to gain maximum information to addressing the barriers of preconception care.

Preconception care is a broad concept with many components and can therefore be considered a complex intervention. (90) Frameworks have been developed for the evaluation of complex interventions that recommend using a range of tools that ask both narrow and broad question. (91, 92) Furthermore the range of barriers identified in Chapter 1 of this thesis did not lend themselves to a single research question or study methodology. In my PhD I have employed a range of research methodologies, including qualitative, quantitative and review methodologies that have been purposefully matched to the research questions to gain maximum output. All research projects have been performed in accordance with recommended research guidelines including the Preferred Reporting Items for Systematic Review (PRISMA-2020) in Chapter 2, (93) and the Standard for Reporting Qualitative Research (SRQR) in Chapter 6. (94)

10.4.2 Limitations

There were several limitations, many of which were a result of the direct and indirect impacts from the COVID-19 pandemic. Lockdown regulations prohibited face-to-face interactions which impacted research activities. These included research planning meetings, recruitment for studies and workshops, all of which were facilitated online due to the COVID-19 restrictions.

The RWH-CAG was recruited through virtual meetings, and all CAG meetings were held online. This was not felt to significantly impact engagement or collaboration. Recruitment for the cross-sectional survey was only possible via a study link in the Australian Primary Health Care Nurses' online newsletter. While the response rate for those who clicked on the page displaying the survey was high (82%), the absolute number of respondents (152) was low. This may have been due to recruitment methods and also the workload for PHCNs during the COVID-19 pandemic.

Another impact was that recruitment for qualitative interviews was only performed online. Original plans to place flyers in rural community group locations were not permitted due to both perceived infection risk and the fact the groups were no longer meeting. This led to potential recruitment bias as only those who were able and active to use certain social media platforms would have seen study advertisements. A high proportion of the interview participants had a tertiary qualification which is possibly due to the recruitment process.

Other individual studies did have some limitations which can be addressed in areas of future research. In the systematic review, only guidelines that were freely accessible were included for analysis which may have underestimated the number of guidelines that clinicians use. In Chapter 3, women's perceptions of being asked the LMUP were not explored which is important to understand to further optimise implementation. In the qualitative interviews, only people who could speak and read English were eligible to

take part. While the pre-existing Healthy Conception Tool was only available in English, and hence this eligibility criteria were in place, the perspectives of people with language backgrounds other than English has not been assessed in this work. In Chapter 7 for the DCE only two images were tested as practical in the choice task design. The testing of more images will allow for further nuance in advertisements that may resonate with consumers.

10.5 Implications for practice and directions for future research

Each of my eight key findings have implications for both public health and clinical practice as well as areas for future research. While these have been presented in detail throughout this PhD thesis, a summary of these is below:

1. How can we broaden community understanding of preconception health.

   This PhD thesis has demonstrated that we can increase public awareness and understanding of preconception health and care through digital health tools. Such tools must be consumer informed and of appropriate health literacy. An area requiring future research is the understanding of preconception care for people from different cultural groups. This includes Aboriginal and Torres Strait Islander people and people of culturally and linguistically diverse backgrounds. Different population groups experience different contexts that can influence their health and social needs, and this must be understood to inform the development of interventions and care packages. This includes the co-design and development of public health

campaigns and digital health tools, such as an online self-assessment tool that are culturally appropriate for these populations.

2. How can we promote engagement with the Healthy You, Healthy Baby tool.

The availably of a digital health tool does not translate to its uptake and engagement and as such the impact of the enhanced Healthy You, Healthy Baby Tool is another area of future research. This includes a quantitative assessment using metrics for reach and engagement and qualitative measures to understand the impact on knowledge and behaviour change. In particular the enhanced presentation of results, including the traffic light system colour-coding needs to be assessed for acceptability and impact.

3. How can we better support clinicians to deliver preconception care

This PhD has outlined several mechanisms that can support clinicians to deliver preconception care. These include the development of high-quality evidence-based CPGs, and the development of such guidelines for the Australian setting is an area requiring further research. This requires careful planning and collaboration to ensure relevance to the range of clinicians who can provide preconception care. Guidelines must also include recommendations for partners, be relevant and appropriate for priority populations, and be in a user-friendly format for clinicians. Future research needs to extend beyond just the development of guidelines and include an evaluation of guideline reach, ease of use for clinicians and impact on preconception health behaviours.

Also required are health service reforms to enable non-medical clinicians such as PHCNs to work to their full scope of practice. This includes a review of funding models and educational resources. Changes to funding models require economic evaluation to demonstrate cost-effectiveness. This would include analysis of the direct and indirect costs and outcomes including service reach, service use and impacts on preconception health behaviours.

4. How can we improve collaboration across health and social sectors to deliver preconception care.

This PhD showed the value of collaborations across sectors to enhance the delivery of preconception care. Given the breadth of the preconception population and the range of interventions, a multidisciplinary and collaborative approach is required to drive future research. The Preconception Health Network is an example of a collaboration across the health and social care sectors, research, policy and advocacy domains and is underpinned by strong consumer engagement.

5. How can we best monitor progress in preconception health?

Projects within this PhD have demonstrated the potential for health service reforms to enhance the delivery of preconception care. This includes the use of measures of pregnancy intention to “triage” people to preconception or post-partum family planning services and the subsequent impact on preconception health behaviours or unintended pregnancy rates. It also includes the role of PHCN’s to deliver preconception care. The

adoption of such service delivery solutions, to provide accessible preconception care needs to be monitored for impact on individual and population health outcomes. This can be achieved through targeted research studies and the use of preconception health indicators. Further research is needed in data collection processes to be able to fulfil monitoring and reporting with preconception health indicators. This can include a review of current data capture methods, or the use of artificial intelligence to maximise existing data collection methods.

A final note is that it was not possible to explore all the identified barriers to the delivery of preconception care in this PhD thesis. These remain important areas for future research to enhance the delivery of preconception care.

10.6 Conclusion

The findings from my PhD thesis call for a structured, multi-strategy approach that addresses barriers to the delivery of preconception care across the socioecological spectrum. Such an approach requires significant change to the current public health practice and service delivery of preconception care.

A public health campaign, that encompasses and respects all population groups, is needed to raise awareness about the importance of good preconception health. Such a campaign needs to engage, educate and empower the population to address pregnancy planning and preparation. It must be in language that resonates with and is understood by all people, and one that is free of medical jargon. This needs to be supported by the

availability of accessible, evidence-based health information. An additional approach is required for clinicians to enable them to deliver high quality preconception care. This needs to be supported with high-quality, evidence-based guidelines to facilitate the delivery of preconception care.

Changes to service delivery are also required. This includes enabling workforces such as primary health care nurses and midwives to work to their full scope of practice and supporting their role in the delivery of preconception care. Funding models and adequate referral pathways must be explored to achieve this.

All efforts to enhance the delivery of preconception care must be appraised for feasibility, acceptability, effectiveness and impact. Ongoing research into interventions, and the use of preconception care indicators can help to accomplish this.

The series of projects presented in my PhD thesis present a detailed analysis of nine barriers to the delivery of preconception care. Eight original and important public health findings have been presented that can improve the understanding and delivery of preconception care and as such to improve the health of people in Australia.

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Chapter 11: Appendices

Appendix A

Research

Using a validated instrument to assess pregnancy planning and preconception care at antenatal booking visits: a retrospective cohort study

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The known: Preconception health shapes the wellbeing of future parents and their children in both the short and longer terms.

The new: Preconception health behaviour can be monitored by incorporating the London Measure of Unplanned Pregnancy (LMUP) into the antenatal booking visit. In our study, LMUP scores indicated that 71% of women had planned their pregnancies, but 54% had not undertaken any health-related actions prior to pregnancy. The likelihood of pregnancy planning declined as the number of previous births increased.

The implications: Better postpartum contraception advice could reduce the number of women who have multiple unplanned pregnancies. Broader use of the LMUP could improve the management of preconception health.

Abstract

Objective: To determine the completion rate for the London Measure of Unplanned Pregnancy (LMUP), a psychometrically validated measure of a woman's intention with regard to a current or recent pregnancy, during booking visits at two metropolitan antenatal care clinics; to identify socio-demographic characteristics associated with unplanned pregnancy.

Design, setting, participants: Retrospective cohort study; analysis of LMUP data for women attending antenatal care booking consultations as public patients in the Sydney Local Health District, 31 December 2019 – 30 November 2020.

Main outcome measures: Proportions of women with LMUP scores indicating unplanned (0–9) or planned pregnancies (10–12); associations between planned pregnancy and socio-demographic characteristics, crude and adjusted for age, parity, and socio-economic status (Index of Relative Socioeconomic Disadvantage).

Results: Of 4993 women with antenatal care bookings, the LMUP was completed by 2385 (47.8%; 1142 of 3564 women at the tertiary referral hospital [32.0%], 1118 of 1160 at the secondary hospital [96.3%]). Planned pregnancies were indicated by the total LMUP scores of 1684 women (70.6%); 1290 women (59.1%) reported no health actions in preparation for pregnancy. In multivariable analyses, planned pregnancies were more likely in all age groups than for women aged 24 years or younger (30–34 years: adjusted odds ratio [aOR], 2.54; 95% confidence interval [CI], 1.76–3.66; 35–39 years: aOR, 2.91; 95% CI, 1.95–4.33). The likelihood of planned pregnancy declined with increasing parity (*v* no previous births: three previous births: aOR, 0.25; 95% CI, 0.16–0.40; four or more previous births: aOR, 0.10; 95% CI, 0.05–0.19).

Conclusion: Seven in ten women who completed the LMUP had planned their pregnancies, but fewer than half had undertaken health-related actions prior to conceiving. Higher parity was associated with unplanned pregnancy, indicating the importance of postpartum contraception advice. Overcoming barriers to implementing the LMUP more widely would enhance preconception health monitoring.

The health and health behaviours of both women and men prior to pregnancy are key predictors of pregnancy outcomes.[1-3] Further, parental health around the time of conception shapes the health and wellbeing of the parents and their children in the short and longer term, helps prevent non-communicable diseases, and may benefit overall health for several generations.[2-4] Nevertheless, progress in the provision and monitoring of preconception care has been limited. A recent systematic review identified eleven preconception care guidelines in various countries, only one of which was classified as high quality (the Canadian HIV Pregnancy Planning Guidelines).[5]

In Australia, the Preconception Health Network was established in 2021 to promote best practice in preconception health care by "promoting collaboration and integration on a national level across the domains of research, policy, consumer engagement, health, social care and advocacy."[6] The network has identified priority areas for attention, including optimising health behaviour, understanding and managing general medical needs (including obstetric medical history, chronic disease history, medication use, and genetic information), achieving a healthy weight, optimising reproductive health (including birth spacing and pregnancy planning), and optimising mental health. Taking time to plan a pregnancy and improve health prior to conceiving is vital for achieving goals in these areas.

An instrument for assessing pregnancy planning or intention that takes social, emotional, financial, cultural, and other contextual factors into account can be helpful for monitoring progress in preconception health programs.[7] It can be used to assess patterns of need for contraception and to document preconception readiness and health.[8] Pregnancy intention is not reported in Australian perinatal data reports, although this information is often assessed during antenatal booking visits with a simple question about whether the pregnancy was planned or not.

Since 2019, the London Measure of Unplanned Pregnancy (LMUP) has been included in Sydney Local Health District (LHD) electronic medical records for antenatal booking visits. The LMUP is a psychometrically validated measure of intention with regard to a current or recent pregnancy[8] that has also been validated for use in Australia.[9] The six-item measure assesses behaviour around the time of conception, and can be used to evaluate family planning or preconception care programs; it is recommended for this purpose in the United States[10] and the United Kingdom.[11]

In this article, we report our analysis of twelve months of Sydney LHD LMUP data. We determined the LMUP completion rate during this period, and examined socio-demographic characteristics associated with unplanned pregnancies.

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Methods

We analysed data for women who gave birth in the Sydney LHD during 1 December 2019 – 30 November 2020. About 8% of New South Wales births take place in this LHD.[12] The LHD includes two public maternity services: a tertiary referral hospital and a secondary metropolitan facility. At the start of the study, we provided training at the two sites on the use of the LMUP; we also provided a video describing the purpose and components of the LMUP that was retained on the antenatal clinic computers. About 15% of women are admitted as private patients and receive antenatal care from private obstetricians; as their booking visit details are not included in the LHD database, they were not included in this study.

Demographic and parity information for included women was obtained from the Sydney LHD electronic maternity medical record system, into which routine pregnancy, birth, and postpartum data can be entered by all health care providers. De-identified data were supplied to the investigators for analysis. We defined residential socio-economic status according to the Index of Relative Socioeconomic Disadvantage (IRSD), a national census-based index of measures of area-level disadvantage, such as low educational attainment, low household income, and high unemployment.[13]

Outcome

The primary outcome was the LMUP score recorded at the first antenatal visit, derived from responses to six questions regarding contraception use prior to conception, timing of motherhood, intendedness of the pregnancy, desire for a baby, discussion with the partner about having a child, and actions taken to prepare for pregnancy (eg, folate supplementation, avoidance of alcohol). Two points are allocated to each question, yielding a total score of 0 to 12. Using the original LMUP version, we classified responses as indicating an unplanned (score, 0–9) or a planned pregnancy (10–12).

Statistical analysis

In complete case analyses, crude (univariable) associations between planned pregnancy (LMUP score, 10–12) and socio-demographic characteristics were assessed using logistic regression models; we report odds ratios (ORs) with 95% confidence intervals (CIs). Multivariable analyses were adjusted for age, parity, and socio-economic status (greatest disadvantage: IRSD deciles 1–4; intermediate disadvantage, deciles 5–7; least disadvantage: deciles 8–10); we report adjusted ORs (aORs) with 95% CIs. We determined the LMUP completion rate at each hospital, and assessed in χ^2 tests whether the socio-demographic characteristics of women who completed the LMUP differed from those who did not. For women who completed the LMUP, we also examined whether LMUP findings differed between those for whom age or socio-economic status data were or were not available. Analyses were conducted in SPSS 28 (IBM).

Ethics approval

The Sydney Local Health District Ethics Review Committee (RPAH zone) approved our study (X20-0428; 2020/ETH02453).

Results

During 1 December 2019 – 30 November 2020, 4993 women had antenatal care bookings as public patients at the two Sydney LHD hospitals. The LMUP was completed in 2385 cases (47.8%; 1142 of 3564 women at the tertiary referral hospital [32.0%], 1118 of 1160 women at the secondary hospital [96.3%], and 125 of 269 women for whom the hospital was not specified [46.5%]). At the tertiary hospital, the LMUP was completed by smaller proportions of women born overseas (549 of 1949, 28.2%) than of those born in Australia (593 of 1615, 36.7%), and of women whose preferred language was not English (185 of 753, 24.6%) than of those for whom it was English (957 of 2811, 34.0%). The LMUP completion rate at the tertiary hospital increased with socio-economic status (deciles 1–4: 125 of 463, 26.9%; deciles 5–7: 375 of 1265, 29.6%; deciles 8–10: 571 of 1582, 36.0%). The characteristics of the women at the secondary hospital who did or did not complete the LMUP were similar (data not shown).

The age group including the largest proportion of women who completed the LMUP in the Sydney LHD was that of women aged 30–34 years (842 women; 35.3%); 1405 were born overseas (58.9%), 487 preferred a language other than English (20.4%), 1137 had residential postcodes in the three least socio-economically disadvantaged deciles (47.6%), and for 1171 women it was their first ongoing pregnancy (Box 1).

1 Characteristics of the 2385 women seeking antenatal care in the Sydney Local Health District who completed the London Measure of Unplanned Pregnancy, 1 December 2019 – 30 November 2020

Characteristic	Value
Age (years)	
24 or younger	193 (8.1%)
25–29	596 (25.0%)
30–34	842 (35.3%)
35–39	534 (22.4%)
40 or older	95 (4.0%)
Missing data	125 (5.2%)
Country of birth	
Australia	980 (41.1%)
Other	1405 (58.9%)
Preferred language	
English	1898 (79.6%)
Other	487 (20.4%)
Socio-economic status* (decile)	
1–4 (most disadvantage)	873 (36.6%)
5–7	172 (7.2%)
8–10 (least disadvantage)	1135 (47.6%)
Missing data	205 (8.6%)
Parity	
0	1171 (49.1%)
1	727 (30.5%)
2	317 (13.3%)
3	115 (4.8%)
4 or more	55 (2.3%)

* Index of Relative Socio-economic Disadvantage.[13] ◆

2 Responses of the 2385 women seeking antenatal care in the Sydney Local Health District who completed the London Measure of Unplanned Pregnancy, 1 December 2019 – 30 November 2020

Questions/response options (score)	Number
Contraception	
Always used contraception (0)	86 (3.6%)
Inconsistently used (1)	149 (6.2%)
Not using contraception (2)	2150 (90.1%)
Timing	
Wrong time (0)	51 (2.1%)
OK, but not quite right (1)	378 (15.8%)
Right time (2)	1956 (82.0%)
Intention	
Did not intent to get pregnant (0)	393 (16.5%)
Intentions kept changing (1)	234 (9.8%)
Intended to get pregnant (2)	1758 (73.7%)
Desire	
Did not want a baby (0)	72 (3.0%)
Mixed feelings about having a baby (1)	244 (10.2%)
Wanted a baby (2)	2069 (86.8%)
Partner	
Never discussed getting pregnant (0)	75 (3.1%)
Discussed but no firm agreement (1)	387 (16.2%)
Agreed pregnancy with partner (2)	1923 (80.6%)
Preparations*	
No actions	1290 (54.1%)
Health preparations: one action	548 (23.0%)
Health preparations: two actions	547 (22.9%)
Total London Measure of Unplanned Pregnancy score	
Unintended (0–3)	62 (2.6%)
Ambivalent (4–9)	639 (26.8%)
Planned (10–12)	1684 (70.6%)

*For example: folic acid supplementation, smoking cessation or reduction, alcohol cessation or reduction, seeking medical advice. ◆

Planned pregnancies were indicated by the total LMUP scores of 1684 women (70.6%); 1290 women (59.1%) reported taking no health actions in preparation for pregnancy (Box 2). The proportions of planned pregnancies among women for whom complete socio-demographic data were available (age: 1595 of 2260, 70.6%; socio-economic status, 1540 of 2180, 70.6%) were similar to those among women for whom age (89 of 125, 71.2%; χ^2 test: $P = 0.88$) or socio-economic information were missing (142 of 205, 70.2%; χ^2 test: $P = 0.90$).

In multivariable analyses, planned pregnancies were more likely in all other age groups than for women aged 24 years or younger (30–34 years: aOR, 2.54; 95% CI, 1.76–3.66; 35–39 years: aOR, 2.91; 95% CI, 1.95–4.33). Women living in areas in the three least socio-economically disadvantaged deciles were more likely to plan their pregnancies than women living in the four deciles of greatest disadvantage (aOR, 1.49; 95% CI, 1.12–1.97). The proportions of planned pregnancies declined with increasing parity (*v* no previous births: three previous births: aOR, 0.25; 95% CI, 0.16–0.40; four or more previous births: aOR, 0.10; 95% CI, 0.05–0.19) (Box 3).

Discussion

We report the first study of the integration of the LMUP, a validated measure of the prior pregnancy intention of pregnant women, into antenatal routine data collection in Australia. Completing the measure was not mandatory for women, and was undertaken at about half the antenatal booking visits over a 12-month period, but the completion rate was markedly different at the tertiary and secondary hospitals in this study. In the secondary hospital, in-person booking visits continued during the coronavirus disease 2019 (COVID-19) pandemic, and support from midwives for the measure was strong. In contrast, as booking consultations at the tertiary hospital shifted to telehealth during this period and leadership support was less strong, the completion rate was much lower, particularly among women whose preferred language was not English. Our qualitative study of how midwives experienced the introduction of the LMUP found that many supported its use, but they also noted barriers, including time constraints, the impact of COVID-19, and uncertainty about referral pathways.[14]

We found that, according to LMUP responses, 29% of pregnancies were unplanned, and planned pregnancies were less likely for women aged 24 years or less, living in postcodes of greater socio-economic disadvantage, or pregnant with a third or later child. These findings are consistent with those of our 2010–11 study in the Sydney LHD tertiary hospital, for which women were invited to complete questionnaires during antenatal clinic visits other than the midwifery booking, in which 67.6% of pregnancies were planned (824 of 1218). Unplanned pregnancies were more frequent for women under 25 years of age, but postcode-based socio-economic status did not influence intention; information on parity was not collected.[15] In a validation study in the Netherlands, LMUP responses by 515 women indicated that 84.4% of pregnancies had been planned.[16]

The peri-conception period is critically important for fetal development, and suboptimal maternal health and diet at this time can lead to impaired fetal growth, poorer birth outcomes, and long term effects on the child's cardiovascular and metabolic health.[2] Among the best established preconception interventions is folate supplementation, which reduces the risk of neural tube defects (including spina bifida and anencephaly) by 70%.[17] In our study, only 46% of women who completed the LMUP undertook any health-related precautions prior to pregnancy, including folate supplementation. In a United Kingdom study of women who had used the online Tommy's Pregnancy Planning tool, adherence to preconception recommendations was also generally poor, including recommended vitamin supplementation by women with planned pregnancies (44%); 20% of women reported smoking, 54% alcohol use, and 42% inadequate exercise levels.[18]

In 2021, 51% of Australian mothers were overweight or obese (based on standard body mass index definitions) when they gave birth.[19] Awareness of the implications of unhealthy weight, both during pregnancy (for the mother: gestational diabetes, hypertension in pregnancy, pre-eclampsia, need for caesarean delivery; for the child: prematurity, stillbirth, congenital

3 Socio-demographic characteristics and planned pregnancies (London Measure of Unplanned Pregnancy scores of 10–12) among 2385 women, 1 December 2019 – 30 November 2020: univariable and multivariable analyses

Characteristic	Planned pregnancy	Odds ratio (95% CI)	Adjusted odds ratio (95% CI)*
Age (years)			
24 or younger	113 (58.5%)	1	1
25–29	386 (64.8%)	1.30 (0.94–1.81)	1.60 (1.12–2.30)
30–34	628 (74.6%)	2.08 (1.50–2.88)	2.54 (1.76–3.66)
35–39	408 (76.4%)	2.29 (1.62–3.25)	2.91 (1.94–4.33)
40 or older	60 (63.2%)	1.21 (0.73–2.01)	2.07 (1.16–3.69)
Missing data	89	—	—
Country of birth			
Australia	699 (71.3%)	1	NA
Other	985 (70.1%)	0.94 (0.79-1.13)	
Preferred language			
English	1343 (70.8%)	1	NA
Other	341 (70.0%)	0.96 (0.77–1.20)	
Socio-economic status (decile)†			
1–4 (most disadvantage)	616 (62.1%)	1	1
5–7	424 (73.9%)	1.69 (1.35–2.12)	1.16 (0.89–1.51)
8–10 (least disadvantage)	500 (80.4%)	2.45 (1.93–3.10)	1.49 (1.12–1.97)
Missing data	144		
Parity			
0	888 (75.8%)	1	1
1	558 (76.8%)	1.05 (0.85–1.31)	1.01 (0.80–1.29)
2	168 (53.0%)	0.36 (0.28–0.47)	0.33 (0.25–0.39)
3	55 (47.8%)	0.29 (0.20–0.43)	0.25 (0.16–0.40)
4 or more	15 (27.3%)	0.12 (0.07–0.22)	0.10 (0.05–0.19)

CI = confidence interval; NA = not applicable (not statistically significant in univariate analysis). * Adjusted for age, parity, and socio-economic status. Data for 2070 women were included in the final analysis † Index of Relative Socio-economic Disadvantage.[13] ◆

anomalies, macrosomia)[20] and longer term (for the child: overweight, cardiovascular and metabolic disease)[2] should be improved by public health campaigns.

Of the variables that influence pregnancy planning, parity perhaps warrants the most attention. Many women return to health services with successive unplanned pregnancies, suggesting that postpartum advice regarding contraception could be improved. A comprehensive postpartum contraception service is not generally provided by Australian hospitals, as it is expected that contraception will be discussed at the routine six-week postpartum general practice consultation. In the United States, however, about 50% of women do not attend such appointments.[21] In an Australian study, women reported receiving inconsistent information about the time and details of the postnatal general practice visit, and general practitioners commented that they lacked the resources to advise women about postpartum care.[22] Comprehensive postpartum care guidelines could reduce these problems, as well as ensuring that contraception is more accessible and affordable, as recommended by a recent Senate enquiry into sexual, maternity, and reproductive health care.[23]

Increasing the uptake of preconception care can be challenging. International leaders in this field have recently described an evidence-based model of preconception care, including contraception advice. They specifically recommend that public education about preconception health should begin in schools and include social media and other national campaigns, as well as recommending that training and system-level support for health care professionals to implement the care model.[24]

Limitations

Our study was limited to public patients in a single New South Wales LHD over twelve months and coincided with the first year of the COVID-19 pandemic in Sydney. Further, only half the eligible women completed the LMUP. Less than one-third of the women attending the tertiary site completed the LMUP, and differences in completion rates by country of birth, preferred language, and socio-economic status were noted; only socio-economic status influenced the likelihood of pregnancy planning. The generalisability of our findings is consequently uncertain.

We modified the final LMUP question to broadly assess the number of behaviour changes, but we did not assess the specific actions women undertook. In 2020, the LMUP question about the mother's partner was modified in the United Kingdom to reflect changes in family composition over the preceding two decades

(eg, same sex relationships, co-parenting, pregnancy without a partner).[25] The new wording would also be appropriate in Australia, but its use would not have affected our overall findings.

Conclusion

We document the first twelve months of the integration of the LMUP into routine antenatal bookings visit at two Sydney hospitals. Higher parity was the factor most closely associated with unplanned pregnancies, and improved access to postpartum contraception could help reduce the likelihood of unplanned pregnancies after a previous birth. If Australia is to develop preconception health indicators, as in the United Kingdom,[26] overcoming service barriers to implementing the LMUP will be important. Specifically, public awareness of the importance of pregnancy planning should be raised, and senior midwifery leaders should be educated about the purpose of the LMUP, including its facilitation of personalised care and early consideration of postnatal contraception.

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Appendix B

Original research

Introduction of the London Measure of Unplanned Pregnancy at the booking visit and the midwives' perspective

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ABSTRACT

Background Pregnancy planning and preconception care benefit women, their children, and future generations. The London Measure of Unplanned Pregnancy (LMUP) is a tool that can be used in antenatal care to identify women with unintended pregnancies who require improved access to such services. This tool was recently implemented into routine antenatal care in two maternity centres in New South Wales, Australia. This study explores midwives' attitudes to the LMUP 12 months after it was introduced into the booking visit and their understanding of its application to their scope of practice.

Methods This is a qualitative study using in-depth semi-structured interviews with midwives from two maternity care centres in Australia. All midwives performing antenatal booking visits were eligible to take part. Interviews were transcribed, analysed, and coded to define key themes. Recruitment ceased when thematic saturation was reached.

Results Ten midwives from two maternity centres were interviewed. Midwives support the inclusion of the LMUP into the booking visit and felt it was in their scope of practice to be using the tool. Time constraints, the impact of COVID-19 and the lack of structured referral pathways were identified as barriers to the implementation of the LMUP in routine care.

Conclusions Midwives support the inclusion of the LMUP into the antenatal booking visit and see that it falls within their scope of practice. Service barriers were identified at the individual, organisational and external context levels. These need to be addressed to enhance the potential of this tool.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Pregnancy planning and preconception care benefit women, their children, and future generations; assessing and understanding this can inform service provision to improve outcomes for potential parents and their children.

WHAT THIS STUDY ADDS

⇒ This study explores the introduction of the London Measure of Unplanned Pregnancy in routine antenatal care. This tool has the support of midwives who perceive it as relevant to their scope of practice; however, they identified service barriers at the individual, organisational and external context levels. These need to be addressed to enhance the potential of this tool.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The use of the London Measure of Unplanned Pregnancy should be included in the routine antenatal booking-in visit. National surveillance of pregnancy planning is the first step toward improving preconception care and will aid allocation of resources and support the First 2000 Days initiative.

INTRODUCTION

Estimating pregnancy intention is deemed an important public health measure to evaluate both family planning and preconception care programmes. Unintended pregnancy affects 40% of Australian women during their reproductive lifetime, which is consistent with rates of unintended pregnancy globally.[1 2] Planned pregnancies fare better in terms of the health and social perinatal outcomes compared with unplanned conceptions.[3]

Planned pregnancies are associated with maternal health behaviours that can decrease risks for the developing fetus, including earlier antenatal booking, lower rates of smoking, better glycaemic control in women with diabetes, and decreased or no alcohol intake.[4] It is well within a midwife's scope of practice to assess pregnancy intention, and to provide advice for pregnancy planning across an individual's or couple's pregnancy journey.[5 6]

In the Australian maternity practice setting, pregnancy intention is not consistently reported nationally, although maternity databases collect some information at the antenatal booking visit. Usually, this enquiry consists of a single question, with a dichotomous outcome, about whether the pregnancy was planned or not, with midwives the responsible professional for asking this question.

The London Measure of Unplanned Pregnancy (LMUP) is a psychometrically validated measure of the degree of intention of a current or recent pregnancy.[7] This measure has been validated for use in the Australian population.[8] The measure is a six-item scale that captures behaviour and intention around the time of conception. The LMUP can be used to evaluate family planning or preconception care programmes. It is increasingly useful to understand whether or how women are preparing for pregnancy, especially with the rising rates of complexity, which means pregnancy planning might be more important.[2]

Within maternity care centres in New South Wales, Australia, the following question about pregnancy intention has been asked historically: 'Was this pregnancy planned?' with possible responses including 'planned, unplanned/happy, not known or other'. In 2019 after a review, a change to the electronic medical record system that collects maternity data enabled the LMUP to be included in the booking visit in two maternity centres in New South Wales.

In this study we investigate midwives' attitudes to using the LMUP and their understanding of its application to their scope of practice 12 months following its introduction.

METHODS

Study design

This was a qualitative study design using in-depth semi-structured interviews to explore midwives' experiences of using the LMUP and their understanding of its application.

Setting and participants

This study was performed across two maternity centres in a local health district (LHD) in New South Wales, Australia. The district has over 7000 births, under public and private models of care, each year with a larger tertiary referral facility (site 1, level 6) and a district facility (site 2, level 4). Maternity care service levels are explained in online supplemental file 1.[9] This LHD is characterised by socioeconomic diversity, with pockets of both extreme advantage and extreme disadvantage; almost half the maternity population speak languages other than English at home. All midwives, who conduct antenatal booking visits for women having public maternity care within the LHD, were invited to take part. Those who had used the LMUP as a component of their antenatal care (at the booking visits) in the first 12 months after its introduction (1 December 2019 to 31 December 2020) were eligible to participate. We excluded those who had not used the LMUP as they were unable to provide their perspective on using the tool.

Recruitment

We used a convenience sampling approach in which all midwives received an email sent via a staff email distribution list, inviting them to express interest in participating in the study. Study information flyers were placed in staff communal areas including tea rooms and the antenatal clinic desk. Participants who expressed interest were contacted by a member of the research team. Recruitment opened in February 2021 and was completed in April 2021 when we reached thematic saturation as determined by the researchers through iterative data analysis[10] (online supplemental file 2). We are aware that data saturation may not always be an appropriate goal in inductive research, where the focus is on identifying themes emerging from the data. In this narrow study 'information power' supported our sample size along with no new themes emerging.[11] Informed consent was obtained before commencing interviews, and participants were assigned a unique study identification number. The research team used open ended questions without interruption to facilitate full participant responses.

Changes to antenatal care during the recruitment period focused on minimising contact in an effort to reduce transmission of COVID-19.[12] At the larger site a move to telehealth occurred for all booking visits, except some considered higher risk. The other site maintained usual face to face visits, though mostly with the exclusion of a support person/partner.

Data collection and analysis

Interviews were performed face-to-face, via telephone or Zoom at the participants preference. Interviews were recorded, and later transcribed verbatim (by KC) and subsequently checked (by ED). Transcriptions were analysed after each interview using inductive thematic analysis[13] by two researchers (ED, KC) who have backgrounds in midwifery, obstetrics, and public health. The main findings were identified and coded, and in-depth discussions elicited the key themes. Iterative modifications were made to the interview guide, where required. Key themes emerged early. Representative quotes were extracted to highlight these themes. Basic demographic data of midwives were not

collected due to the very possible risk of identification of the participant midwives.

RESULTS

Ten midwives were recruited, five from each site, and interviewed for this study. Due to staffing fluctuations during the COVID-19 pandemic we estimate 18 midwives were conducting booking visits each month across each site. The LMUP was not a mandatory question at the booking visit and as such we did not have information on who did or did not use the tool at this time point. All midwives who expressed interest participated. They ranged from senior staff to new graduates in their experience. Our analysis identified key challenges in the implementation of the LMUP which were identified at an individual, organisational and population level. A detailed insight into the midwives' understanding of the application of the LMUP to their practice was revealed (online supplemental file 3).

Individual-level challenges

Respondents identified challenges at the level of the midwife–client interaction, commenting on the sensitive nature of questions within the LMUP and providing their perception on the individual woman's reactions. These challenges were consistently reported by midwives of all experience levels. Midwives reported concern at the women's reaction to the questions: *'Some women think it's quite funny and some women are sort of like "why are you asking this when I'm already 20 weeks?" '* (participant 4, site 1); one respondent concluded: *'I don't know how to ask it at all'* (participant 1, site 1).

Several respondents also acknowledged women's social and demographic factors limiting the implementation of the LMUP. As almost half of the antenatal women within the LHD have a language other than English as their primary language, this posed challenges for the delivery and the understanding of the questions. *'…women that don't speak English as a first language it said that it is a difficult group of questions to ask verbatim if you're using an interpreter'* (participant 3, site 2);

'…so if there is a non-English speaking woman I don't think they understand the questions' (participant 4, site 1).

Others expressed a concern for vulnerable groups and how they would receive the questions: *'I was a bit worried that certain vulnerable groups in the community might find it a bit intrusive…'* (participant 2, site 1).

Organisational-level challenges

At the organisational (facility) level, respondents noted three key domains that challenged the implementation of the LMUP.

Time

All respondents raised the issue of time constraints in the antenatal booking visit: *'…time is everything in a booking visit. It's a big visit and we don't have enough time. I might prioritise other aspects to focus on, like mental health'* (participant 4, site 1). However, respondents did report the ease of use increased over time and hence the LMUP was not as time consuming: *'It is very easy once you know'* (participant 1, site 1).

Education and professional support

Not all participants had a clear understanding for the implementation of the LMUP: *'I would have liked to understand why it was included and how it relates to our care'* (participant 9, site 2). Several respondents wanted more: *' do think it helps to have some specific training….if people understand why we are doing it you're more likely to get compliance'* (participant 3, site 2).

Those who had received some education or more support from managers found it easier to apply: *'…but then there's the presentation on it and why it was being done and I think that sort of solidified the usefulness of the tool, it just became part of the booking visit'* (participant 3, site 2).

The importance of education and training was also recognised as an enabler to overcoming the challenges of asking sensitive questions: *'I think we need an in-service about the questions and how to ask the questions'* (participant 7, site 1).

Participants had their own approach when asking the LMUP questions, with some reading the question as phrased within the e-MR and others paraphrasing to the suit the consultation: *'… when we first started using it was a bit clunky…. It became a conversation and I think people now have a conversation with women around the points'* (participant 3, site 2).

Lack of structured referral pathways

Many respondents identified that there was no linked pathway between the LMUP outcome score and direction for action regarding postpartum contraception: *'It would be great if we had a referral pathway… I hear about how we can organise post-natal contraception, but I don't know how'* (participant 7, site 1). This was directly linked to not always asking the LMUP: *'I don't feel like I want to ask if I can't do anything about it you know.'*

Several respondents expressed a desire to be involved in this ongoing care and referral: *'If I was doing continuity of care then contraception is an easier discussion'* (participant 4, site 1).

Broader/external challenges

Due to the COVID-19 pandemic, changes to booking visit procedures occurred including restrictions on face-to-face appointments and holding the booking visit over two appointments. Many participants acknowledged the limitations this had on conducting their booking: *'This happened just before COVID-19. That changed everything. We had to do the booking*

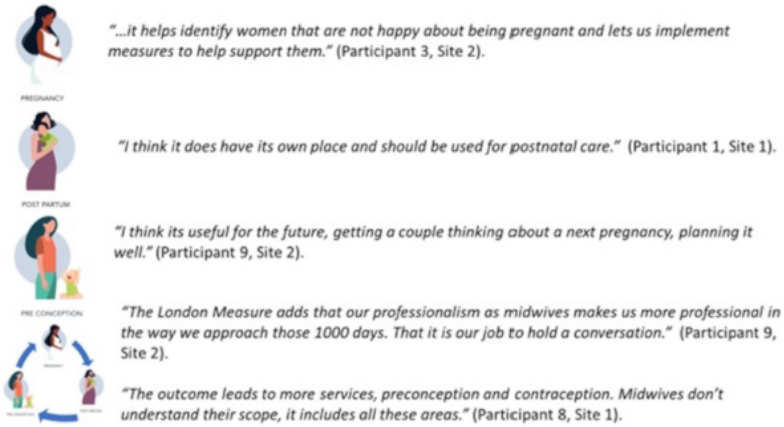

Figure 1 Midwives' understanding of the applications of the London Measure of Unplanned Pregnancy.

visit over the phone and follow-up at a later time.... Without COVID-19 it might have been easier' (participant 7, site 1). Respondents also acknowledged that COVID-19 restrictions affected the roll-out of education and support for using the LMUP.

Midwives understanding of its applications

Most respondents saw that it was within their scope of practice to use the LMUP, and could see the benefits for the current pregnancy, post-partum contraception and longer-term health implications (figure 1).

DISCUSSION

Our research explored the perspective of midwives using the newly introduced LMUP at the booking visit, and their understanding of its application to their practice. Overall, midwives supported the inclusion of the LMUP in the antenatal booking visit; however, challenges to the implementation of the tool across individual, organisational and broader contextual factors were identified. They saw the LMUP as another means to achieving holistic care which was identified as being within their scope of practice.

Eleven of the 12 months of the LUMP introduction period occurred during the COVID-19 pandemic, throughout which changes were made to the delivery of booking visits. At site 1 (level 6 facility) visits were via telehealth predominantly, while site 2 continued face-to-face visits but without a support person. Many participants acknowledged the limitations this had on booking visits, particularly not seeing women face-to-face, and the time restrictions and fragmented nature of booking visits (sometimes conducted in two parts). This change in practice was identified as a barrier, because asking these types of questions requires judgement, sensitivity and a private space. The impact of COVID-19 on maternity care has been well reported.[13–16] We know women are willing to have comprehensive screening[17] and be asked about risk factors; however, this process is time-consuming and some complexity arises with some consultations.

Another major barrier identified to the implementation of the LMUP was time. We heard that the ease of use of the LMUP increased with practice, and thus consumed less time as confidence grew. Midwives raised a concern that if they did spend time using the LMUP then there was no structured referral pathway for action regarding postpartum contraception. This is a familiar issue identified with the use of the other tools such as for mental health screening, oral health and domestic violence screening.[18–22] Supporting such consultation and referral are the Australian National Midwifery Guidelines for Consultation and Referral.[23] These guidelines aim to provide guidance for frameworks for consultation but also for referral, which is a potential partner for progress in this field. Using the principles stated in these guidelines will encourage and support midwives with the introduction of the evidence found in our work and clinical practice.

Australian midwives are routinely involved in postpartum contraception care, yet antenatal care is also a time for midwives to identify women at risk of further unintended pregnancy. Understanding how planned or intended a pregnancy is offers opportunities for midwives to fulfil their scope of practice to routinely include discussions about birth spacing and subsequent preconception health. The midwives in our study told us that they want to work to the full scope of their practice and provide holistic care.[24] National and international studies have found women want midwives to offer expert care across their pregnancy journey.[25 26] Postpartum contraception advice from midwives, for example, was well received by women in a UK study in which women cited trust and continuity of care as contributing factors.[25] Dutch midwives are already providing unstructured preconception counselling.[27] Midwives provide high quality care, and the emerging

scope of practice of midwives in Australia incorporates contemporary issues, such as pregnancy planning and pre- and inter-conception care.

Strength and limitations

This is the first research into the use of the LMUP in Australian maternity care. Data collection took place 1 year following its introduction, which was timely to capture the midwives' perspectives on the tool accurately. We recognise that the introduction was ultimately less than ideal due to the COVID-19 pandemic, and as such occurred under tight financial, social and time constraints in response, which may have affected recruitment numbers. It would have been ideal to hear the voices of the women to whom the LMUP was applied; however, this was not possible in this study.

CONCLUSION

Midwives in this study were interested in and supported the inclusion of the LMUP into the antenatal booking visit as a more nuanced method of asking about pregnancy intention. However, they emphasised barriers such as competing time constraints, the need for ongoing education and in-services, and structured referral pathways. The findings suggest that the inclusion of the LMUP into the antenatal booking visit is supported although issues such as training, time constraints and referral pathways must be addressed.

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Appendix C

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Australian Journal of Primary Health

Acceptability and usability of 'One Key Question'® in Australian primary health care

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ABSTRACT

Background. Around one-third of pregnancies in women attending antenatal care are unintended. This means a substantial number of women enter pregnancy without optimising their health prior to conception. Primary care practitioners are uniquely placed to counsel women about how to plan for pregnancy and about how to avoid unintended conception. The One Key Question® (OKQ®) tool facilitates a discussion of pregnancy intention and opens up subsequent discussions regarding preconception or contraception care. This study aimed to assess the acceptability and usability of the OKQ® tool in the Australian primary care setting. **Methods.** We undertook a pilot study consisting of quantitative and qualitative components across two general practice settings in Sydney, New South Wales, Australia. We documented women's responses to being asked the OKQ® as part of their consultation. We collected data on the characteristics of the participating GPs and their experience of using the OKQ® tool and conducted semi-structured interviews with all participating GPs. **Results.** Fifty-six patients were asked the OKQ®, with the majority stating they were happy to be asked about their reproductive choices and felt it was relevant to their general health. The 10 participating GPs felt the OKQ® was easy to use and although 62.5% reported it extended the consultation time, the medium time taken was 2 min. GPs felt framing the OKQ® helped introduce pregnancy intention discussions into a consultation. **Conclusions.** The OKQ® is acceptable to patients and easy for GPs to use. This tool facilitates a proactive and routine discussion to enhance the delivery of preconception care and contraceptive counselling.

Keywords: communication, general practice, One Key Question®, preconception, pregnancy intention, pre-pregnancy, primary care, screening.

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Introduction

A recent report investigating the impact of unintended conceptions in Australia found that 40% of pregnancies are unintended (Organon and HTAnalysts 2022). As a result, many are entering pregnancy without the benefits of behavioural or lifestyle changes that can improve maternal and neonatal outcomes. Preconception care consists of interventions that aim to identify and modify the biomedical, behavioural and social risks to a woman's health prior to conception (Moore *et al.* 2017). Such interventions include the use of folate supplementation to prevent neural tube defects (De-Regil *et al.* 2010) and the tight control of blood sugar levels in women with diabetes around the time of conception to reduce the risk of fetal congenital abnormalities (Fraser and Lawlor 2014; Genuis and Genuis 2016). Of increasing importance is the optimisation of pre-pregnancy maternal weight to improve the general health and wellbeing of the mother and to decrease the risk of an adverse pregnancy outcome, including miscarriage, stillbirth and fetal abnormality (Schummers *et al.* 2015). Important too are the longer-term impacts on the child's health and obesity (Drake and Reynolds 2010), leading the World Health Organization to name preconception care as one of the six strategies to reduce childhood obesity (World Health Organization 2016).

Due to these potential health benefits of preconception care for mothers and babies, the Royal Australian College of General Practitioners (RACGP) has recommended preconception care as an important preventive care healthcare strategy (RACGP 2016). Indeed, primary care is uniquely placed to reduce unintended pregnancies by improving use of contraception in women not wanting to conceive and by counselling women about preconception care should they wish to receive it. Interventions such as the use of folic acid supplementation prior to conception will have a positive benefit on fetal development (Wilson *et al.* 2015). However, numerous barriers to implementation of preconception care have been identified in this setting, including time constraints, a lack of women being identified as actively planning for pregnancy, and a lack of resources for assisting in the delivery of preconception care guidelines (Mazza *et al.* 2013). Several enablers have been suggested to enhance the delivery of preconception care, including clinical practice guidelines and checklists.

One tool, developed by the Oregon Foundation for Reproductive Health (Bellanca and Hunter 2013; Allen *et al.* 2017), the 'One Key Question®' (OKQ®) facilitates pregnancy intention screening in the non-pregnant population. The OKQ® simplifies the process for practitioners by encouraging them to routinely ask women of reproductive age 'Would you like to become pregnant in the next year?'. The clinician documents one of four responses: Yes; I'm OK either way; I'm not sure; or No; and depending on this answer, the clinician then follows up with information and advice around preconception care or contraceptive methods (see Fig. 1). The OKQ® thus offers the opportunity to embed a discussion on reproductive planning into primary care consultations and potentially overcome the barrier of women not presenting for preconception care. This tool has been evaluated in several studies in the United States (Ferketa *et al.* 2022; Stulberg *et al.* 2019) that have explored

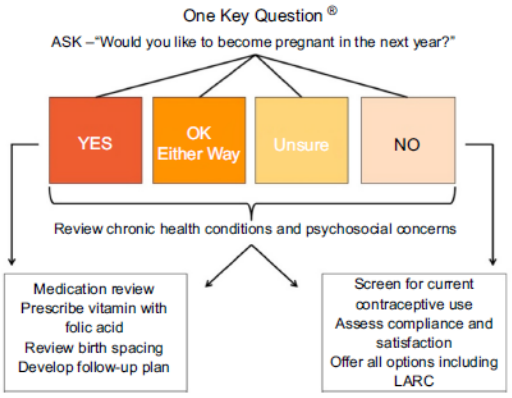

Fig. 1. One Key Question®. LARC, Long Active Reversible Contraceptive.

clinician and patient perspectives, but the OKQ® has never been tested in the Australian context. The aim of this study was to assess the acceptability and usability of the OKQ® implemented in an Australian general practice setting from the perspective of women and the general practitioner (GP).

Methods

Study design

We undertook a pilot study consisting of quantitative and qualitative components that explored the acceptability and usability of the OKQ® among patients and GPs in primary care in Australia. A survey-based quantitative approach was used in this pilot study to maximise patient encounters and subsequently the strength of any conclusions drawn about patient and GP perspectives regarding the acceptability and usability of the OKQ®. Qualitative interviews with all participating GPs were conducted after the completion of the quantitative component of the study to gain overall insights of how GPs found using the OKQ®. This is compared to the case-by-case analysis of a specific patient interaction, which is what the quantitative GP survey provided. GPs' thoughts on the delivery of preconception care was also asked to provide context to the space in which the OKQ® would be used.

The OKQ® tool, developed by the Oregon Foundation for Reproductive Health, is now registered as a product by Power to Decide (Power to Decide 2022) who provide training in the use and application of the tool. Although the clinicians in this study did not undergo the certified training that is recommended prior to use, the leadership team at Power to Decide granted permission for the authors to use the tool for the purposes of this pilot study.

Setting and participants

This study took place in two primary care general practices in urban Sydney between September 2019 and December 2019. One site was a mixed billing practice (private and public) in the inner-city where some patients (those on low income or government benefits) were charged only the amount of the government rebate, and others were charged above this and had out-of-pocket expenses. The other site in Sydney's south-east only charged patients the cost of the government rebate ('bulk-billing') so there were no additional costs to the patients.

General practitioner participants

All GPs working at the two study sites were eligible to participate. GP participants at both sites who provided informed consent were educated on the recruitment process (Fig. 2). Any woman aged 18–40 years who presented for a consultation (regardless of the reason for presentation) and

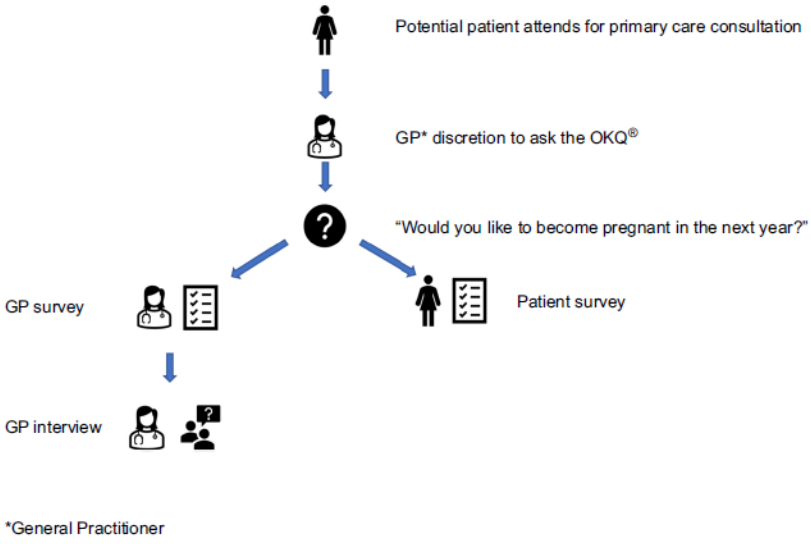

Fig. 2. Study process.

who had sufficient English-language skills could be asked the OKQ® at the discretion of the clinician. Following the consultations, GPs were asked about how they felt about asking the OKQ®, how it was received, its ease of use and whether it led to a change in medication. Their responses were recorded on a paper-based survey after each patient consultation (Appendix 1).

Patient participants

All female patients aged between 18 and 40 years, presenting for a consultation at either site, were eligible for inclusion. The population from which the patients were drawn were inner-city with a higher socioeconomic status (SES) for the mixed billing practice, and suburban with a lower SES for the bulk-billing practice. Patients who had insufficient English-language skills to understand the written study information were excluded from the study. Patients were not informed about the trial implementation of the tool as it was deemed an important part of routine health care.

After their consultation with the GP, patients were informed that the study investigator (JF) was on site to discuss the study. Patients were asked whether they would be willing to allow their consultation to be included in the research. All patients were provided with a participant information sheet and consent form, which permitted inclusion of the appointment interaction, and they were also requested to complete a short survey. All 56 patients who were asked the OKQ® by their GP agreed to meet with the study investigator and subsequently provided informed consent to participate in the study. The patients proceeded with the paper-based patient survey of their experience of the OKQ® (see Appendix 2). The survey asked whether they had been previously asked about their pregnancy intentions, whether they were happy to discuss their reproductive plans and whether they considered it relevant to the current consultation or to their health in general. Their feelings about a pregnancy in the next 12 months were also recorded. Patients were informed that they were free to opt out of the study and not have their consultation included.

Descriptive statistics of median and percentages were used describe the usability and acceptability of the OKQ® tool by patients and GPs.

At the end of the recruitment period, all of the participating GPs took part in face-to-face semi-structured interviews with JF (see Appendix 3). In these interviews, GPs were asked, among a range of questions, to describe some of the challenges in delivering preconception care, to identify the patient factors or other factors that prompt them to discuss pregnancy planning with patients, whether they felt patients were aware of preconception care, whether the OKQ® will be a useful tool and how they perceived patients' reactions to be being asked the OKQ®. The interviews ranged in length from 8 min and 20 s, to 16 min and 35 s.

Qualitative analysis

After the recordings were de-identified, they were transcribed by an external provider. The interview transcript data were extracted by JF using descriptive coding, and coded transcripts were reviewed independently by two team members

(JF and ED). Both researchers used Braun and Clarke's (2006) reflexive thematic analysis to organise and agree on the codes into themes. The initial themes were reviewed and subsequently defined by the research team.

Reflexivity

I, the study investigator (JF), was a General Practice registrar during the data collection period. Since finishing data collection, I have completed General Practice training and am a clinical and academic GP with an interest in women's health. I conducted all the interviews. Although some GPs were previously known to me prior to the study, as they were experienced practitioners, I felt they could choose whether to provide consent to participate in the study freely.

As a doctor who strongly believes in the importance of women's health and preconception care, I was aware throughout the interviews that my context influenced my interviewing technique and the GPs' perceptions. I knew that many GPs were committed to the delivery of preconception care, but that there were likely barriers that separated the 'ideal' from the 'real world' practice. The most challenging aspect of reflective practice was to allow the GPs to describe their experiences using the OKQ® without exaggeration for my benefit. To help mitigate my influence, I would re-read the semi-structured interview schedule prior to each interview and facilitate the GP participant to do most of the talking.

Ethics approval

Ethical approval was granted by the University of Sydney Human Research Ethics Committee, Number 2019/402. Research was undertaken with appropriate informed consent of participants.

Results

Quantitative results

In total, 56 patients and 10 GPs were recruited across the two sites. As all patients were female aged between 18 and 40 years, no additional demographics were collected to maintain confidentiality in this pilot study. More patients (70%) were recruited from the bulk-billing site. Six of the 10 GPs were female, with five GPs recruited from each study site (Table 1).

Of the 56 patient participants when asked the OKQ® 'Would you like to become pregnant in the next year?', 19 (33.9%) said 'yes', 22 (39.3%) said 'no', nine (16.1%) said 'not sure' and six (10.7%) said 'I'm ok either way'.

Half (n = 28; 50%) of the patient participants reported being asked previously of their pregnancy plans prior to the research consultation with the clinician (Table 2).

Table 1. Participant demographics.

Participant demographics	n
Patients	
Site	
Mixed billing practice	16
Bulk-billing practice	40
General practitioners	
Gender	
Female	6
Male	4
Age (years)	
20–39	6
40–69	3
≥70	1
Site	
Mixed billing practice	5
Bulk-billing practice	5

Regarding being asked in the study consultation, almost all participants
(55, 98.2%) reported being happy to discuss their pregnancy intentions and regarded it as relevant to their general health.

The survey of the GPs demonstrated that over three-quarters (n = 44; 78.4%) felt comfortable or somewhat comfortable asking the OKQ® and almost (n = 40; 70%) as many regarded the OKQ® as very easy or easy to use (Table 3). GPs reported that asking the OKQ® increased the length of consultation time in two-thirds of consults, but of these consults, the median time that was added to the consult was only 2 min, with the maximum being 20 min and the minimum being 1 min.

Qualitative results

The aim of this study was to assess the acceptability and usability of the OKQ® implemented in an Australian general practice setting from the perspective of patients and GPs. The following results explore the perspectives of the GPs and their perceptions of their patients' perspectives through the constructed themes. (Table 3).

The OKQ® was easy to use

Broaching the issue of reproductive life planning was experienced as less challenging than the practitioners anticipated. Indeed, using the OKQ® was generally found to be easy and did not arouse practitioner discomfort.

> I actually found it pretty straightforward. I haven't come across any major barriers or complications or awkward impact or anything like that. (GP6, female, aged 30–39 years)

Table 2. Participant patient responses.

Question	Response	Number (%)
Have you been asked about your pregnancy plans before?	Yes	28 (50)
	No	28 (50)
Were you happy to discuss your thoughts regarding your reproductive choices today?	Yes	55 (98.2)
	No	1(1.8)
Did you feel it was relevant to this consultation?	Yes	39 (69.6)
	No	17 (30.4)
Do you think it is relevant to your general health?	Yes	55 (98.2)
	No	1 (1.8))
Were you surprised to be asked about it?	Yes	9 (16.1)
	No	47 (83.9)
How would you feel if you became pregnant in the next year?	Very happy	10 (17.8)
	Happy	9 (16.1)
	Neutral	6 (10.7)
	Unhappy	8 (14.2)
	Very unhappy	14 (2.8)
	Not sure	9 (1.5)

Table 3. General practitioner responses.

Question	Response	Number (%)
How did you feel asking the OKQ®?	Comfortable	25 (44.6)
	Somewhat comfortable	16 (28.6)
	Neutral	10 (17.8)
	Somewhat uncomfortable	5 (8.9)
	Uncomfortable	0
How did you feel the patient felt being asked it?	Comfortable	22 (39.2)
	Somewhat comfortable	22 (39.2)
	Neutral	6 (10.7)
	Somewhat uncomfortable	4 (7.1)
	Uncomfortable	2 (1.8)
How easy was the OKQ® to use?	Very easy	20 (35.7)
	Easy	21 (37.5)
	Neither easy nor difficult	15 (26.8)
	Difficult	0
	Very difficult	0
Were any medications or supplements started or ceased?	Yes, folate	4 (7.1)
	Yes, other	3 (5.4)
	No	49 (87.5)
Did the OKQ® extend the length of the consultation?	Yes	35 (62.5)
	No	21 (37.5)

I found it really easy. (GP4, female, aged 40–49 years)

Asking the OKQ® often required an introduction and was deemed easier to pose in consultations where there was a clear link between the reason for presentation, like contraceptive discussions or cervical screening tests, or in general health checks.

> I probably would use it more so when they come in for a preventative health reason like for their pap smear or 'Hey I'm just coming in for a general health check.' . . . if they're coming in for preventative health, it's a good place to use it. (GP10, Female, aged 30–39 years)

In other consults, GPs often found framing the OKQ® a useful way to introduce preconception care discussions into the consult without seeming too jarring. Framing was frequently discussed by GPs and was seen to increase the OKQ®'s ease of use. Framing methods were varied, but often included a brief spiel about how the GP was asking all relevant patients the OKQ® or explained some of the rationale behind the OKQ®.

> So, in general, if it was framed in an appropriate way, it was fairly routine and unobtrusive. (GP2, Male, aged 20–29 years)

> I think I said, 'I'm also just asking all patients . . . around your age this sort of question as a preventative health screening. Are you planning on having children in the next 12 months?' (GP10, Female, aged 30–39 years)

Perceived patient acceptability

A second theme constructed was that GPs felt that patient acceptability of being asked the OKQ® was higher than anticipated. There was caution among some of the GPs prior to commencing the study that patients may feel awkward being asked the OKQ®, or that even in a worst-case scenario, it may negatively affect the ongoing patient–doctor relationship. All GPs felt that patients were open to being asked the OKQ®, even if it was not directly relevant to their presenting problem.

> I don't think they had any problem with me asking them. (GP4, Female, aged 40–49 years)

> Women in general seem to respond reasonably even [if] asked out of the blue. (GP2, Male, aged 20–29 years)

> I think most of them accept the fact that doctors were all asking [OKQ®] and they are quite happy about giving the information . . . I don't think anybody actually gets upset. Most of them seem to be quite tolerant and able to discuss the issues. (GP5, Male, aged 80–89 years)

This sense that the OKQ® was generally well received and, indeed, more acceptable than GPs had anticipated meant that they were encouraged to use the question going forward.

> I must admit, before I did this, I thought that it was a little bit uncomfortable... it was surprisingly quite comfortable and people very open about it. And so I think now I've actually changed my view of it, I think that I will use it. (GP9, Female, aged 30–39 years)

Barriers to using the OKQ®

The third key theme was the identification of common barriers to using the OKQ®, and more generally to delivering preconception care. Time constraints were acknowledged as an important issue in asking the OKQ® because its use would often require follow-on questions. Additionally, it was felt that the discussion may be regarded as inappropriate in the patient's presenting circumstances.

> I mean there's just so many things to talk about and this is, I guess, another one of those things we probably should bring up on a regular basis but just don't. (GP3, Male, aged 40–49 years)

> You can't rush them. Once you put the question in, you've got to give them enough time. And if you are not prepared to give them enough time and you're rushing to see your next patient, you better not ask them. (GP5, Male, aged 80–89 years)

The perceived acuity of the patient's presenting complaint, and the presence of a more emergent issue deterred GPs from asking the OKQ®. GPs used their judgement to decide if the patient would feel comfortable with the question during that particular consultation interaction, and also whether there was time to discuss the issues that emerged from the conversation.

> I see a lot of [people with] mental health [issues] and so I'm very conscious with some of the people that I see where there are lots of issues which are going on that sometimes it's about what they can handle in terms of distress management and that was not going to be on that priority list at that time. (GP8, Female, aged 40–49 years)

The constructed themes support the quantitative data; that is, the OKQ® is easy for GPs to use and is deemed acceptable by both GPs and patients.

Discussion

This pilot study revealed that patient participants generally found the screening tool to be acceptable and that it was applicable to their general health. The minority were surprised to be asked this, and indeed, half the sample reported a previous conversation with their GP about their plans for pregnancy. Clinicians were mostly comfortable using the tool, and the mean time it added to the consultation was 2 min. In the qualitative data, clinicians revealed the ways in which they framed the question in order for it to seem more routine and increase the perceived acceptability of asking the OKQ® to their patients. The clinicians found using the OKQ® easy, informative and were planning on continuing its use.

Our study is unique in exploring both provider and patient perspectives. Previous studies from the United States have focussed on either the patient experience or clinician-identified facilitators and barriers to the OKQ® implementation (Song *et al.* 2021; Ferketa *et al.* 2022). In a recent study, patient satisfaction before and after the OKQ® implementation was reported to increase (Song *et al.* 2021). In a study across an obstetrics and gynaecology clinic and a family medicine clinic, clinicians identified the simplicity of the tool and its alignment with the clinic goals to be facilitators of the OKQ® implementation, but raised concerns about the impact on clinic workflow (Ferketa *et al.* 2022). A further study sought to assess the impact the integration of the OKQ® into the Electronic Medical Record (EMR) of an urban community health centre had on rates of contraceptive and preconception counselling. The researchers found that the rates of contraceptive counselling and long-acting reversible contraceptive (LARC) recommendations increased, but the rates of preconception counselling did not (Stulberg *et al.* 2019).

All of the GPs in the study acknowledged the opportunistic nature of preconception care and spoke of the difficulties providing preconception care to patients who were not aware of the importance and recommendation of pre-pregnancy interventions. A number of the GPs felt that having an evidence-based tool, like the OKQ®, had the potential to promote the delivery of preconception care to their patients. This promotion would also be furthered by endorsement and backing from the two colleges responsible for overseeing general practice in Australia – the Royal Australian College of General Practitioners and the Australian College of Rural and Remote Medicine.

Other studies have examined the use of tools to enhance reproductive life planning. One study involved a randomised controlled trial comparing the use of the 'Family Planning quotient', another method of measuring desired fertility, to the OKQ®, finding that both tools were equally reported as being useful by two-thirds of women for communicating reproductive goals to healthcare providers. The healthcare providers reported less utility, with a half or less stating the tools helped to focus their counselling (Baldwin *et al.* 2018). The authors point out that an individual's reproductive life goals are much more complicated than the responses elicited at one point in time. Further, it remains unknown if

tools such as the OKQ® have the potential to lead to behaviour change and impact on population health outcomes, such as unplanned pregnancy and interconception care and birth spacing.

In this study, we provided GPs with the OKQ® without the formal training recommended by the Power to Decide (Power to Decide 2022). The organisation that has trademarked the OKQ® offers a 4- to 6-h online certification training course that teaches providers to initiate the conversation about pregnancy desires. However, when we devised this study, we were unaware of this requirement. Fortunately, the team at Power to Decide still permitted us to pilot the tool. Another limitation is that we did not record the extent to which the clinician applied the tool in detail, such as follow up with those not wanting to get pregnant with a discussion around contraception.

This study thus provides encouraging preliminary data about the acceptability and usability of the OKQ® without training in an Australian general practice setting. Future research could further explore how best to implement the OKQ® into Australian clinical practice. It would be important to assess the impact of the OKQ® on preconception care and contraception counselling and uptake.

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Data availability. The data that support this study will be shared upon reasonable request to the corresponding author.

Conflicts of interest. The authors declare no conflicts of interest.

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Appendix 1

Survey questions for GPs

1. Did you ask the OKQ® today?
2. How did you feel asking it?
3. How did you feel the patient felt being asked it?
4. How easy was the OKQ® to use?
5. Were any medications or supplements started or ceased?
6. Did the OKQ® extend the length of the consultation?
   If yes, then approximately how many minutes?

Appendix 2

Survey questions for patients

1. Were you asked 'Would you like to become pregnant in the next year?' today by your GP?
2. Have you been asked about your pregnancy plans before?
3. Were you happy to discuss your thoughts regarding your reproductive choices today?
4. Did you feel it was relevant to this consultation?
5. Do you think it is relevant to your general health?
6. Were you surprised to be asked about it?
7. How would you feel if you became pregnant in the next year?

Appendix 3

Interview questions for GPs

1. What are some challenges in delivering preconception care?
2. What patient factors or other factors prompt you to discuss pregnancy planning with women?
3. How do you think the OKQ® could be best used?
4. Do you think you will use the OKQ® in the future? Why or why not?
5. How did you find using the OKQ® during the study?
6. How did you perceive patients felt being asked the OKQ®?
7. How do you think the OKQ® influenced the patient–doctor relationship?
8. What factors do you think patients are unaware of regarding preconception care?
9. Are you aware of any preconception care hospital services that you could refer women to?
10. What sort of women would you consider referring to a preconception care service?
11. Do you have any other opinions or thoughts on this study?

Given the semi-structured basis of these interviews, related themes arising from participant interviews may form the basis of questions for subsequent interviews.

Appendix D

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Setting Preconception Care Priorities in Australia Using a Delphi Technique

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Abstract

Preconception health affects fertility, pregnancy, and future health outcomes but public awareness of this is low. Our aims were to rank priorities for preconception care (PCC), develop strategies to address these priorities, and establish values to guide future work in preconception healthcare in Australia. A Delphi technique involved two rounds of online voting and mid-round workshops. Inputs were a scoping review of PCC guidelines, a priority setting framework and existing networks that focus on health. During July and August, 2021, 23 multidisciplinary experts in PCC or social care, including a consumer advocate, completed the Delphi technique. Ten priority areas were identified, with health behaviors, medical history, weight, and reproductive health ranked most highly. Six strategies were identified. Underpinning values encompassed engagement with stakeholders, a life course view of preconception health, an integrated multi-sectorial approach and a need for large scale collaboration to implement interventions that deliver impact across health care, social care, policy and population health. Priority populations were considered within the social determinants of health. Health behaviors, medical history, weight, and reproductive health were ranked highly as PCC priorities. Key strategies to address priorities should be implemented with consideration of values that improve the preconception health of all Australians.

Keywords

- preconception care
- primary care
- health care
- consensus

Issue Theme Preconception (Part 1); Guest Editors, Kirsten I. Black, MBBS, MMed, FRANZCOG, PhD, FFSRH, DDU and Jacqueline A. Boyle, MBBS, FRANZCOG, MPH&TM, PhD

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Background

Preconception Health

Preconception health impacts fertility,[1,2] pregnancy outcomes,[3] infant health[4,5] and the future health and wellbeing of parents and their children.[1,2,5,6] Preconception health traditionally refers to the critical weeks before conception and the period when someone is actively planning to become pregnant.[7,8] A life course view of preconception health includes the years and even decades before a pregnancy, when wellbeing and health behaviors have the potential to impact on pregnancy outcomes.[7] Preconception health is adversely impacted by a plethora of non-modifiable and modifiable risks. Non-modifiable risks include, but are not limited to, genetics, age, and pre-existing health conditions such as type 1 diabetes and endometriosis.[9–11] Modifiable risks are often related to health behaviors such as poor diet, substance use and exposure to toxins.[12] Evidence suggests many people are unaware of the degree to which their preconception health can affect fertility, pregnancy, and future health outcomes.[11] Preconception health is relevant to all people because of its positive impact on an individual's short- and long-term health regardless of pregnancies.

Preconception Care (PCC)

Preconception care (PCC) is the provision of biomedical, behavioral and social health interventions to optimize the preconception health of potential parents.[13,14] The scope of PCC is broad, with the Centers for Disease Control Work Group on Preconception Health and Health Care reviewing over 80 potential components.[15] Traditionally, there has been a highly gendered approach to interventions that increase awareness of preconception health and PCC, with most interventions targeting women,[16] rather than being inclusive of all people, all genders and all sexual orientations. Among all people, community awareness of PCC is low[17,18] and many people only seek PCC if they experience difficulties when trying to become pregnant.[19] Regardless of whether health risks are modifiable or not, PCC may help to mitigate many of the risks related to preconception health. Importantly, PCC should be accessible to all and provided with consideration of the social and economic determinants of health, including education, access to health care and employment that impact on health and health behaviors, particularly for priority populations.[20]

Where does PCC Fit in the Australian Health System?

Primary care is viewed as a person's or couple's first point of contact with PCC.[13,17] Primary care is delivered by a range of health professionals including doctors, nurses, midwives, pharmacists and allied health professionals. The Royal Australian College of General Practitioners' guidance for PCC provides general recommendations[13] and the Royal Australian and New Zealand College of Obstetricians and Gynaecologists have a statement (currently under review) with four consensus-based recommendations to guide health professionals as they counsel women prior to pregnancy[21]; however, no national and cross-sectorial PCC recommendations exist in Australia. Interestingly, there is no Medicare Benefits Schedule item number (healthcare funding scheme in Australia) to bill PCC appointments in primary care[22] which would take longer than a routine primary care visit. Health professionals in Australia have reported both the lack of guidelines and financial incentives as barriers to the provision of PCC.[23,24]

Access to PCC is important in other settings including tertiary health care, social care and education settings, particularly those serving priority populations. Rates of preconception health risks such as sexually transmitted infections (STIs), family violence and suboptimal nutrition tend to be higher in groups that experience health inequity and/or encounter barriers to accessing heath care such as geographical isolation and racism.[25–27] Therefore, other sectors such as social care and education have a crucial role in increasing people's access to preconception health knowledge and support. These sectors have been recognized internationally as universal opportunities to implement PCC.[28] Currently there is minimal integration of PCC services across these sectors in Australia.

The Preconception Health Network (the Network) was established in 2021 through collaboration between the National Health and Medical Research Council Centre of Research Excellence Health in Preconception and Pregnancy, Monash University and the University of Sydney. The Network is building a national cross-sectorial network that aims to promote best practice in preconception health promotion and care and empowers people to optimize their reproductive health and wellbeing across the life course. Objectives of the Network include to i) identify and prioritize gaps in preconception health promotion, PCC and research, ii) foster collaboration across health care, iii) foster collaboration across sectors, iv) advocate for systems and legislation that promote preconception health, and v) promote research translation and the development of evidence-based resources. Initial Network discussions focused on selecting and planning initiatives to achieve its objectives. The Network agreed that future work should target areas where the most significant gains in preconception health could be achieved.

One of the Network's first tasks was to undertake priority setting for PCC in Australia. This research documents how the Network: i) identified and ranked priorities for PCC, ii) developed key strategies for addressing the priorities; and iii) established a set of underpinning values to guide future work undertaken in preconception health in Australia. This priority setting will guide the future activities of the Network and provide all sectors involved in preconception health promotion, including research, health care, education, social care, and government, with a clearer picture of what is required to make significant gains in preconception health for the general population and priority groups.

Methods

The Network used a Delphi technique to achieve the study aims. A Delphi technique is a process of gathering expert opinion to arrive at a consensus.[29] This process has been

applied in health care in a range of ways, including to prioritize lifestyle and medical factors for the achievement of optimal weight management for preconception[30] and pregnancy.[31] A Delphi technique may take many forms but a key feature is that it involves rounds of opinion sharing, reflection and reconsideration of opinion until a consensus is reached.[29,32] Our Delphi technique involved two rounds of online voting and mid-round online workshops involving participants with expertise in the field of preconception health and a consumer advocate (recruited via a women's health organization). Ethics approval was granted by Monash Human Research Ethics Committee (Ref: 29304).

Participants and Setting

The Network launch invited via email consumer advocates and people with expertise in preconception health, working in a range of sectors including health care, social care, public health and health policy, many of whom were leaders of relevant organisations. Due to COVID-19 restrictions in Victoria and New South Wales, the launch was an online event.

Recruitment and Consent

The aims and process of the Delphi technique were explained by a Network leader (JB), as well as the framework for the priority setting task. The Australian Policy Prioritisation Framework was the basis for the priority setting task, as it has been previously adapted for priority setting in maternal obesity prevention.[30,31] The framework asked participants to consider several factors in relation to sub-optimal preconception health. These were: i) the health burden, ii) potential of prevention, iii) whether location or access to services plays a role, iv) provision of services, v) potential to improve health outcomes or services, vi) collaboration, vii) policy, viii) alignment with the vision of the Network, ix) collaborative action and the development of improved health outcomes.[30,31] Potential participants were given an opportunity to ask questions before breaking into smaller groups to discuss the overall vision and aims of the Network.

Two days after the Network launch, an email was sent to all attendees and an additional four experts in preconception health who could not attend the launch. This email included an invitation to participate in the Delphi technique, an Explanatory Statement, the priority-setting framework and a link to the round one online questionnaire. Participants confirmed their consent to participate in the introductory questions of the round one online questionnaire.

Data Collection

The structure and content of the Delphi technique was set by members of the Network (KB, JB, ED, RW) after a range of preliminary activities and a series of consultations. The Delphi technique was divided into three sections: i) PCC priority setting, ii) key strategies for addressing the priorities, and iii) underpinning values (►**Table 1**). A scoping review[33] of preconception guidelines in Australia informed the PCC priority setting section and the underpinning values section. For this review, a working party of Network members (JB, KB, KC, ED, KH, RW) reviewed national and state-based preconception guidelines available in Australia and New Zealand.[33] Delphi participants were asked to rank the health care priorities for PCC identified in this review, from most important to least important. Participants were then asked to draw on their expertise to identify key strategies for addressing the health care priorities for PCC in Australia. Underpinning values drawn from the scoping review and the Australian Health Research Alliance Women's Health, Research Translation Network and the National Women's Health Strategy were listed and participants were asked to rank their importance (1 being extremely important, 5 being

Table 1 The Delphi technique, with details of round one and round two online questionnaires

Sections	Round one online questionnaire ($n = 23$)	Workshops ($n = 16$)	Round two online questionnaire ($n = 23$)
PCC priority setting	• Participants ranked 19 health care priorities in the provision of PCC. • Participants added missing health care priorities in the provision of PCC.	• Results from round one were discussed. • Priorities were grouped.	• Participants ranked 10 health care priorities in the provision of PCC. • No additional priorities could be added. • Participants responded to whether weight should be its own priority or grouped with health behaviors. • Participants identified priorities with the the greatest opportunity for improvement.
Strategies	• Participants identified key strategies to address priority areas.	• Key strategies were grouped. • Wording was refined. • Scope of each strategy clarified.	• Participants suggested final modifications for wording and scope.
Values	• Participants ranked the importance of nine underpinning values identified.	• All values were deemed as important. • Wording was refined. • Scope of each value was clarified.	• Participants suggested final modifications for wording and scope.

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not important). Participants could add suggested priorities, strategies and values.

In round one, participants completed an online questionnaire. The online questionnaire was open for two weeks, with a reminder email sent after one week. Results from round one were collated and a summary was sent to participants who were able to participate in one of two online workshops. The online workshops gave participants an opportunity to debate the results and provide more in-depth feedback. Questions asked in the workshops were: i) Can any priorities be merged together? ii) Should any priorities be removed? iii) Should any priorities be added to the next ranking process? and iv) How do we word and define the key strategies and underpinning values? Combined results from round one voting and the online workshops were sent out to all participants with a link to the round two online questionnaire. Participants who were unable to attend either of the online workshops were asked to complete the round two online questionnaire. Again, the round two questionnaire was open for two weeks, with a reminder email sent after one week. A final Executive Summary was sent to all participants and participants could raise any questions or concerns via the Network email.

Qualtrics was used for round one and round two data collection. Online workshops were conducted via Zoom and audio-taped with a Dictaphone so that notes taken could be checked afterwards.

Data Analysis

A Nominal Group Technique was used for the priority setting section of the Delphi. A Nominal Group Technique requires participants to prioritize issues, ideas, or suggestions, to generate priorities for action or appropriate and targeted research questions.[34] In round one, the highest priority received a rank of one and the lowest priority received a rank of 19. Mean ranks were calculated and presented with their range (as opposed to standard deviation) in the mid-round and final summaries. After round one voting, key strategies were collated, with those suggested most often being identified in the workshops. Similar or related strategies were also grouped together (e.g., sugar taxes and increasing the price of tobacco were grouped with government policy). Mean scores for underpinning values were also calculated in round one. In round two, the Nominal Group Technique was used again to rank 10 preconception priorities. Participants were asked to provide feedback regarding the wording of the strategies and underpinning values.

Results

Of the 24 attendees with expertise in preconception health and two consumer advocates at the Network launch, 19 participated in the Delphi technique, one of these being a consumer advocate. An additional four experts who could not attend the launch also participated, giving a total of 23 participants in round one and round two voting. Sixteen participants including the consumer advocate were available to attend one of the two mid-round online workshops (►**Tables 1** and **2**).

Table 2 Delphi participants, profession and state

	n = 23 (%)
Profession*	
Obstetrician/gynaecologist	7 (30.4)
Midwife	4 (17.4)
Public Health	3 (13.1)
Nursing (including primary care)	2 (8.7)
Bioethics	1 (4.0)
Community Advisor	1 (4.0)
Dietitian	1 (4.0)
Education	1 (4.0)
Geneticist	1 (4.0)
Epidemiology	1 (4.0)
Social Care	1 (4.0)
State	
Victoria	15 (65.2)
New South Wales	6 (26.1)
South Australia	1 (4.0)
Tasmania	1 (4.0)

* Many of our experts are also working in research, governance and academia.

Round One

In the preconception priority setting section, 'medical history and optimization of pre-existing medical conditions' was ranked as the highest priority with a mean score (minimum, maximum) of 5.74 (1, 16). 'Sexually transmitted infection screening' was ranked as the lowest priority with a mean score (minimum, maximum) of 14.83 (5, 19). There was considerable variation in expert opinion, with most priorities ranked as the highest priority (ranked as 1), or as one of the lowest priority (ranked > 14), by at least one participant (►**Table 3**). Participants suggested adding 'history of childhood trauma', 'available support networks', 'partner health', and 'isolation' as additional priorities. The predominant participant feedback was that ranking the priorities was difficult because all priorities were deemed important, and many were interconnected. Several participants suggested that priorities should be grouped (e.g., combine physical activity, nutrition, prenatal supplementation and weight into 'Health behaviors').

In the key strategies for the preconception health section, 64 suggestions were made. Some suggestions were the same but worded differently. Some suggestions could be grouped (e.g., 'sugar taxes' and 'increase floor price of alcohol and tobacco' were grouped into health policy). Suggestions were grouped into nine categories by the authors (KB, JB, ED, RW). The four groups with the most suggestions were: i) raising

Table 3 Results of PCC priority setting task (round one, workshops, round two)

ROUND ONE ONLINE QUESTIONNARE			WORKSHOPS	ROUND TWO ONLINE QUESTIONNAIRE		
Rank	**PCC priority**	**Mean score (min, max)**	**Grouping of PCC priorities**	**Rank**	**PCC priority**	**Mean score (min, max)**
1	Medical history and optimisation of pre-existing medical conditions	5.65 (1,16)	**Medical history:** medical history and optimisation of pre-existing medical conditions + obstetric history + medications + genetic history	1	**Health behaviors:** nutrition + physical activity + prenatal supplementation	2.52 (1, 6)
2	Weight	5.74 (1,19)	**Healthy weight**	2	**Medical history:** medical history and optimisation of pre-existing medical conditions + obstetric history + medications + genetic history	3.74 (1, 10)
3	Reproductive life planning	6.04 (1,19)	**Reproductive health:** reproductive life planning + contraception	3	**Healthy weight**	4.04 (1, 8)
4	Alcohol	7.57 (1,14)	**Health behaviors:** nutrition + physical activity + prenatal supplementation	4	**Reproductive health:** reproductive life planning + contraception	4.13 (1, 10)
5	Mental health	7.26 (1,16)	**Mental health:** mental health + available support networks + isolation	5	**Mental health:** mental health + available support networks + isolation	5.17 (1, 8)
6	Smoking	8.26 (1,18)	**History of trauma or family violence**	6	**Substance use, smoking, alcohol**	5.74 (2, 10)
7	Nutrition	8.39 (2,17)	**Substance use, smoking, alcohol**	7	**History of trauma or family violence**	6.30 (1, 10)
8	Physical activity	8.65 (2,18)	**Partner health**	8	**Exposures:** environmental exposures	7.70 (2, 10)
9	Prenatal supplementation	8.91 (1,18)	**Screening:** sexually transmitted infection screening + cervical screening + genetic screening	9	**Partner health**	7.83 (3, 10)
10	Domestic violence	10.30 (1,17)	**Exposures:** environmental exposures	10	**Screening:** sexually transmitted infection screening + cervical screening + genetic screening	7.82 (5, 10)
11	Medications	10.43 (3,17)				
12	Genetic history	11.35 (1,19)				
13	Obstetric history	11.43 (3,19)				
14	Contraception	11.48 (1,19)				
15	Substance use	11.87 (2,18)				
16	Vaccinations	13.61 (5,19)				
17	Environmental exposures	13.87 (3,19)				
18	Cervical screening	14.35 (9,19)				
19	Sexually transmitted infection screening	14.83 (5,19)				
To add	Available support networks, isolation, history of childhood trauma, partner health					

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community awareness/health promotion/education, ii) Medicare and health service reform, iii) development of guidelines/national guidelines, and iv) health professional education (►**Table 4**).

All underpinning values were ranked as being important or highly important (►**Table 5**).

Online Workshops

The focus of workshop discussions was ordering, and where relevant, grouping together the preconception priorities for round two. Suggested new priorities were added and no priorities were removed. In the end, ten areas were agreed priorities (►**Table 3**). The main difference in opinion was whether weight should be grouped with health behaviors or not.

Participants then worked together to refine the wording of the key strategies and clearly define the scope of each one. Two of the key strategies, 'culturally tailored solutions' and 'collective strategies across sectors' were deemed to be underpinning values and therefore, moved to that section

Table 4 Results of key strategies to address PCC priorities (round one, workshops, round two)

ROUND ONE ONLINE QUESTIONNARE	WORKSHOPS	ROUND TWO ONLINE QUESTIONNAIRE
Most often raised	**Distinction between most and least often raised removed**	
Raising community awareness/health promotion/education	Public health campaigns: schools, workplaces, community, men, women	Public health and social care campaigns: schools, workplaces, community, men, women
Medicare and health service reform	Service reforms: Medicare item number, alternate funding models, nurses (including practice nurses, midwives, maternal and child health), access to care, resources available, improving health care safety and access	Health service reforms: Medicare item number, alternate funding models, nurses (including practice nurses, midwives, maternal and child health), access to care, resources available, improving health care safety and access
Existence of guidelines/national guidelines	Preconception guidelines	Preconception guidelines, health professional and social care education
Health professional education	Health professional education	
Less often raised	Recognition by government: health policy such as sugar taxes, increase floor price of alcohol and cigarettes	Shaping health policy
Collective strategies across sectors (key stakeholders, multi-College, integration of health and social care)	Digital technology – cross cutting	Digital technology as a platform for education, health promotion and health care
Recognition of the importance for public health by government, policies such as increased floor price on smoking and alcohol, sugar tax, include as part of women's health strategy	Education for the community and improving health literacy	Education for the community and improving health literacy
More digital technology		
Less traditional methods of delivery		
Culturally tailored solutions (communication barriers, early support for groups at risk, special consideration for First Nations)		
Improve equity of access to care with special consideration for Aboriginal and Torres Strait Islander peoples and their preconception health care needs is required to improve overall health outcomes	Note: Culturally tailored solutions (communication barriers, early support for groups at risk, special consideration for First Nations) AND Collective strategies across sectors (key stakeholders, multi-College, integration of health and social care) should be underpinning values. Explicit inclusion of practice nurses and midwives.	

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Table 5 Results of underpinning values task (round one, workshops, round two)

ROUND ONE ONLINE QUESTIONNARE			WORKSHOPS	ROUND TWO ONLINE QUESTIONNAIRE
Rank	**Underpinning value**	**Mean score (minimum, maximum)**	**Re-wording of underpinning values (education for population and health professionals were moved to key strategies)**	**Re-wording of underpinning values**
1	Community engagement (consumers and stakeholders) and co-design	**1.22 (1,2)**	Community engagement (consumers and stakeholders) and co-design	Community engagement (consumers and stakeholders) and co-design
2	A life course approach to health research that encompasses the social and economic determinants of health	**1.26 (1,3)**	A life course approach to sexual and reproductive health, recognizing it as a state of physical, emotional, mental and social well-being	A life course approach to sexual and reproductive health, recognizing it as a state of physical, emotional, mental and social well-being
3	Informing advocacy and policy	**1.39 (1,3)**	An integrated multi-sectorial approach	An integrated multi-sectorial approach
4	Education for population	**1.39 (1,5)**	Leveraging and strengthening large scale national collaboration	Leveraging and strengthening large scale national collaboration
5	Leveraging and strengthening large scale national collaborative effort to improve preconception health	**1.39 (1,2)**	Health equity and tailored solutions that incorporate diversity	Health equity and tailored solutions that incorporate diversity
6	Health equity between people across priority populations	**1.52 (1,3)**	Aboriginal and Torres Strait Islander health equity	Aboriginal and Torres Strait Islander health
7	Delivering research, translation and impact in agreed priority areas	**1.52 (1,3)**	Real world impact that encompasses clinical, policy and population (including improved measurable outcomes)	Real world impact that encompasses clinical, policy and population (including improved measurable outcomes)
8	Education for health professionals	**1.61 (1,4)**	Research capacity building	Research capacity building
9	Building capacity in researchers across priority groups and diverse disciplines	**1.91 (1,4)**	Recognize the importance of the social and economic determinants of health	Recognize the importance of the social and economic determinants of health

(►**Table 4**). The rest of the time in the workshops was spent on refining the wording of the underpinning values, defining them to ensure that they would meet the needs of the priority populations. 'Education for health professionals' and 'education for population' were deemed key strategies and therefore, moved to that section (►**Table 5**).

Round Two

Combining priorities resulted in one main change in the PCC priority setting. 'Health behaviors' incorporating physical activity, nutrition and prenatal supplements was ranked highest. All other priorities were ranked similarly to round one, with only small changes due to the combining and addition of priorities (►**Table 3**). When asked whether weight should be on its own as a priority, 12 (52.2%) selected 'No'.

When asked what priorities have the greatest opportunity for improvement, 'reproductive life planning' was identified by nine participants. 'Health behaviors' was often paired with 'healthy weight', with one or both being identified seven times. 'Partner health' was identified five times, 'mental health' four times, 'trauma and family violence' was identified twice, and 'environmental exposures' was identified once. One participant responded with, "I think there are gaps in all areas that can be worked on." Another participant acknowledged that some priorities may be more difficult to address in some groups than others with, "I think it depends on the groups we are working with. For example, whilst smoking and alcohol are not universally a problem, they are in particular groups." This participant also highlighted that, "[reproductive life planning] is more broadly relevant to all."

Two changes in the wording of key strategies were being explicit about the inclusion of 'social care', and the combination of 'preconception guidelines' with 'health professional and social care education' (►**Table 4**). Minimal changes were suggested for underpinning values (►**Table 5**).

When asked how the Network can work together to address the preconception priorities, a range of suggestions

that could be categorised into key strategies and underpinning values were listed (►**Supplementary Table S1**).

Discussion

This Delphi technique to identify and rank health care priorities for PCC in Australia can be used to direct key stakeholders including research, health care, education, social care, and government in their efforts to improve preconception health and pregnancy outcomes. The technique was based on peer-reviewed evidence from existing preconception guidelines[33] and expert opinion across a range of sectors. After ranking activities, discussion, and debate, ten priority areas were identified, with health behaviors (nutrition, physical activity, prenatal supplementation), medical history (including optimization of pre-existing medical conditions, obstetric history, medications, genetic history), and reproductive health (reproductive life planning, contraception) ranked most highly. Six key strategies were identified to address the priorities. Future work in PCC should be guided by underpinning values that promote engagement with key stakeholders, a life course view of preconception health, an integrated multi-sectorial approach and strengthening large scale collaboration. Priority populations should be considered within the social determinants of health when planning and implementing interventions that deliver real world impact across health care, social care, policy, and population health.

Preconception Priorities

There was broad agreement that the 19 preconception priorities identified in the scoping review should be grouped to reflect their interconnectedness and simplify messaging to key stakeholders. Grouping the priorities occurred via robust workshop discussions with very little disagreement. In round two, health behaviors were ranked as the highest priority, above medical history that was ranked as the highest priority in round one.

Australia's national pregnancy care guidelines[35] provide recommendations regarding a range of pre-existing medical conditions during pregnancy (not PCC), and over the counter and prescription medicines that may be teratogenic. In addition, increasing proportions of women in Australia are starting pregnancy with pre-existing medical conditions such as obesity[3] and type 2 diabetes.[36,37] Rates of overweight, obesity and type 2 diabetes are also increasing in men.[38] This substantiates the high priority placed on medical history in the priority setting task. One reason why health behaviors were ultimately ranked higher than medical conditions is that many pre-existing medical conditions can be prevented by optimizing health behaviors, including nutrition and physical activity in the preconception period. Another reason was that optimizing health behaviors is relevant to all people, regardless of their pregnancy intentions.

Prenatal supplementation was grouped into health behaviors because it was considered a crucial aspect of preconception nutrition. In addition to the public health measure of mandatory folic acid fortification of wheat flour for bread making in Australia,[39] folic acid supplementation (400ug/day in most cases) is recommended in the month before pregnancy and throughout the first trimester to prevent neural tube defects[40]; however, in a national study of women in Australia[41] ($n = 857$) only 27% reported taking folic acid as recommended. Many of the women in this study were unaware of the correct folic acid dose and received inconsistent, incorrect or no advice from health professionals.[41] A higher dose of folic acid supplementation (5-mg/day) is indicated for women with obesity, diabetes, risk of malabsorption, women taking anticonvulsant medications, or a history of neural tube defects.[42] Iodine supplementation (150ug/day) is also recommended throughout pregnancy and lactation for the synthesis of thyroid hormones and fetal neurodevelopment[43]; however, many women in Australia experience at least a mild deficiency due to inadequate supplementation.[44] Again, women's and health professionals' limited knowledge of iodine supplementation requirements in Australia contributes to this issue.[41,44,45] Prenatal supplementation is an acceptable, safe, and low-cost public health strategy to prevent a range of serious adverse offspring outcomes, yet uptake in Australia is far from universal.[44]

The only disagreement in the priority setting activity was whether weight should be a stand-alone priority or be grouped together with nutrition, prenatal supplementation, and physical activity in health behaviors. An argument for grouping weight in health behaviors was that addressing suboptimal weight (underweight, overweight, obesity) will always involve lifestyle modification, with or without a biomedical approach. An argument for keeping weight as a separate priority was that there are many causes for suboptimal weight and, among women with obesity, it is not simply a matter of poor nutrition or physical inactivity. For example, women with polycystic ovary syndrome[46] or depression,[47] people who experience food insecurity[48] and people who have experienced childhood trauma[49] are more likely to have a body mass index in overweight or obese categories. These issues can be interrelated and are not necessarily addressed with nutrition and physical activity alone. In the end, there was no consensus regarding whether weight should be its own priority. The extensive discussions highlight that suboptimal weight cannot be treated in isolation from the cause.

Reproductive health, including reproductive life planning and contraception was ranked after weight. Reproductive life planning engages individuals or couples in conversations around their personal goals regarding if and when to have children, based on their priorities[50] and is another acceptable, safe and low-cost approach to improve preconception health. Health professionals ask a series of questions, starting with, 'Do you plan to have any (more) children?'[51] Depending on the answer, people are guided into conversations around contraception, intervals between pregnancies and a range of other topics including all the preconception priorities identified (►**Table 3**). Lifestyle and advanced maternal age have driven the increase of the proportion of women becoming

pregnant with pre-existing medical conditions such as type 2 diabetes and obesity.[36] Many women are unaware of the impact of their or their partner's age on fertility, or other contributing health factors that may impact pregnancy outcomes.[52,53] Reproductive life planning conversations create opportunities to raise awareness of reproductive health choices, to learn about the importance of health when planning a pregnancy, and for decision-making to be supported.[54] It is important that health professionals facilitate conversations that are culturally appropriate and consider health literacy needs.

'Mental health', 'substance use, smoking and alcohol', 'history of trauma or family violence', and 'partner health' were ranked fourth, fifth, sixth, seventh and ninth, respectively, highlighting the necessary involvement of other sectors including social care in the provision of PCC. Environmental exposures and screening for STIs, cervical screening and genetic screening were also acknowledged as being important.[55]

Key Strategies

The mid-round workshops facilitated discussion that consolidated a long list of suggested strategies to address the preconception priorities identified. These strategies were agreed upon in round two and were not ranked. Social care was explicitly added to the strategies (e.g., public health and social care campaigns; health professionals and social care education) acknowledging the important role of social care in reaching priority populations including those who have experienced trauma, disadvantage or both.

The scoping review[33] that informed this Delphi technique revealed gaps in the scope, content, presentation, and availability of PCC guidelines in Australia and New Zealand. Comprehensive PCC guidelines that target a range of health and social care professions, and are developed with input from key stakeholders and community advisors are needed.[33] A subsequent systematic review of international PCC guidelines conducted by members of the Network will further guide work in this area.

Preconception care is primarily perceived to be the role of general practitioners in primary care.[23] Current funding models only support general practitioner-led care and some nurse practitioners, despite it also being provided by primary care health nurses including community health nurses, midwives, maternal and child health nurses, women's health nurses and Aboriginal and Torres Strait Islander health workers. Another issue with the focus on general-practitioner led care is that there is no Medicare item number to bill for PCC consultations.[19,22] An appointment where an individual presents for PCC is likely to be billed with item number 23 (professional attendance to which no other item applies, $39.10, less than 20 minutes)[56] or item number 36 (professional attendance to which no other item applies, $75.75, longer than 20 minutes).[57] Comprehensive PCC that covers all preconception priorities is not possible in a consultation that is less than 20 minutes, particularly for those with complex histories. Gap fees may apply for longer consultations, creating further disadvantage for those who rely on bulk-billed consultations. A potential solution may be a designated item number for PCC, thus increasing the profile and accessibility of this type of care.[19] Another option may be to support broadening the scope of primary health care nurses to provide PCC.[19,58] This predominantly female workforce represents a significant opportunity to improve access and timeliness of high quality preconception care, particularly for women. More work is required to explore the issues and possibilities in the complex area of heath service funding.

Strategies to address the priorities were interrelated. For example, education for the community and improving health literacy are likely to involve digital technology; and digital technology can also be used in the provision of PCC. Shaping health policy is likely to impact on all strategies, with advocacy required for health policy that prioritizes population level preconception health and priority populations.

Underpinning Values

The wording and scope of the underpinning values were clarified in the mid-round workshops. These values were agreed upon in round two and not ranked. Despite the values not being ranked, notable discussion was had around recognizing a life course approach to sexual and reproductive health, the social and economic determinants that impact on preconception health, and priority populations.

Health equity and tailored solutions that incorporate diversity cautions against 'one-size-fits-all' thinking and strategies that meet the needs of the majority while overlooking priority populations or individuals with complex needs. It was agreed that Aboriginal and Torres Strait Islander health should be a value in itself because of the significant and persistent disparities in preconception health and pregnancy outcomes, compared with other Australians.[59] Gibson-Helm et al[60] also engaged with key stakeholders to identify practice gaps in Aboriginal and Torres Strait Islander maternal health care, barriers and enablers of care, and strategies to address priorities. Similar to our research, Gibson-Helm et al[60] reported health behaviors such as nutrition, substance use and psychological wellbeing as priorities. Our research documented general strategies to address identified priorities across populations while the strategies identified by Gibson-Helm et al[60] very were specific to Aboriginal and Torres Strait Islander peoples. For example, culturally appropriate health service reforms including systems that promote continuity of care, workforce capacity building with Aboriginal and Torres Strait Islander workers, and culturally appropriate resources were identified as strategies. Accessibility to food and housing were also acknowledge, highlighting the importance of considering the specific needs of particular groups, as well as the broader population.

Community engagement with consumers and stakeholders and co-design should underpin all work moving forward. This can be applied to all key strategies identified. For example, the National Health and Medical Research Council clearly outlines the requirements relating to community engagement in that development of clinical practice

guidelines.[61] Another example is in health service reforms. Formative work with women and health professionals confirming the acceptability of primary health care nurses providing PCC has been conducted[19]; however, further work with key stakeholders in primary care, social care, policy and the community is required to co-design PCC that is accessible and that meets people's needs and expectations.[62]

Increasing research capacity, particularly among those from diverse backgrounds, was considered an important component of developing and evaluating PCC with real world impacts across clinical work, social care, policy and populations. An integrated multi-sectorial approach and leveraging and strengthening large scale collaborations would mitigate siloed approaches within dynamic and interconnected health and social care systems.

The interconnectedness of the values (e.g., 'Research capacity building' and 'Real world impact that encompasses clinical, policy and population - including improved measurable outcomes'; 'Health equity and tailored solutions that incorporate diversity' and 'Aboriginal and Torres Strait Islander health') and applicability of the values to the key strategies ('A life course approach to sexual and reproductive health, recognizing it as a state of physical, emotional, mental and social well-being' and 'Education for the community and improving health literacy') suggests that these values are appropriate and will guide the Network and key stakeholders as they work together to improve PCC in Australia.

Strengths and Limitations

The Network developed this Delphi technique to guide the future provision of PCC in Australia. An advantage of a Delphi technique in health care is that experts and community advisors can draw on a range of resources, expertise, and experiences to inform their input and develop a consensus.[32] The selection of PCC priorities and underpinning values was based on peer-reviewed evidence from existing preconception guidelines.[33] The priorities and values were ranked by participants with expertise in preconception health from range of sectors and Australian states and a community advisor. Multiple opportunities for engagement, including face-to-face discussions via videoconference, facilitated robust discussion regarding the priorities, key strategies and values and all Delphi participants had time to consider and then re-consider their views.

Those currently working in other Australian states and territories (Western Australia, the Northern Territory and Queensland) were not represented in our group; however, many participants worked within national organizations or collaborated nationally. The COVID-19 pandemic hindered opportunities to meet face to face, but this was mitigated with the use of videoconferencing. As shown in ►**Table 2**, we had participant representation across health and social care. However, a large proportion of participants had a background in obstetrics and gynecology or midwifery, therefore responses may have been weighted more from the perspective of these professionals.

Conclusion

Participants with expertise in preconception health across a range of sectors with a community advisor identified ten priority areas for PCC in Australia in this Delphi technique. Health behaviors, medical history, weight, and reproductive health were ranked most highly. Six key strategies were identified to address the priorities and future work should be guided by underpinning values that promote engagement with key stakeholders, a life course view of preconception health, an integrated multi-sectorial approach and strengthening large scale collaboration. Priority populations should be considered in all aspects of PCC, strategies and values and in planning and implementing interventions that deliver real world impact across health care, social care, policy, and population health.

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Conflict of Interest

None declared

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Appendix E

Public Health Research & Practice

What are the preconception health and social care needs of Australians? Recommendations for action across research, policy and practice

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What are the preconception health and social care needs of people in Australia? Recommendations for action across research, policy and practice

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Abstract

Objectives: To develop a national framework of indicators to guide preconception research, health and social care and monitoring.

Type of program or service: Co-development of a set of national preconception health core indicators

Methods: Through a series of three workshops, attended by consumers, researchers, clinicians and policy experts we identified that health equity and the social determinants of health should guide framework design and implementation. Other essential strategies included a lifecourse approach, transdisciplinary collaboration and funding reorientation.

Results: Six key domains were identified for informing preconception health and care: (1) reproductive life planning; (2) healthcare; (3) indicators with clinical relevance; (4) nutrition and physical activity; (5) mental and emotional health, safety, quality of life and wellbeing; and (6) prevention.

Lessons learnt: We recommend that the next step to optimising preconception health for people in Australia includes bringing together, and investigating, disparate data sources to enable

monitoring and evaluation of equitable preconception health and care and measure its impact on policy.

Key Points

- A national framework of indicators to guide preconception health, health and social care in Australia has been developed.
- Health equity and the social determinants of health should guide decisions on preconception health, health and social care.
- Taking a lifecourse approach, collaborating across and within sectors, and reorienting funding are required to optimising preconception health, health and social care.
- Our framework can help guide next steps to monitor and evaluate health, care and policy outcomes.

The preconception period is a critical time for interventions to improve people's health, and the health of future children[1]. Preconception care is an umbrella term for a range of biomedical, behavioural and/or social interventions prior to conception (before first pregnancy and between pregnancies)[2]. Access to preconception care can enhance continuity of care and manage risks more effectively to reduce maternal and child morbidity and mortality.[3] The World Health Organization Commission on Ending Childhood Obesity 2016 sees intervention during the preconception period as having the potential to break the cycle of non-communicable disease[1,4]. However, available evidence points to suboptimal PCH in Australia (see Box 1), which is not helped by the lack of relevant guidance and resources for clinicians, health policy makers and administrators, and about men and priority populations.[5]

- **40%** of pregnancies in Australia are unplanned[6]
- Amongst women who plan their pregnancies, less than half (46%) take action to prepare for pregnancy[7]
- Approximately 91% of women in Australia do not meet fruit and vegetable intake guidelines[8]
- Almost half of women in Australia are above the healthy weight BMI category when they enter pregnancy[9]
- **One in 10** Australian women smoke in pregnancy, with disproportionately higher rates in First nations women 42%[10]

Box 1. Evidence of suboptimal preconception health in Australia

The Preconception Health Network Australia (PCHN) was established in 2021 from the Centre of Research Excellence in Health in Preconception and Pregnancy (CRE HiPP). The Network comprises clinicians and health professionals from professional societies and colleges (e.g., Royal Australian and New Zealand College of Obstetricians and Gynaecologists), non-government organisations (e.g., Australian Women's Health Network), consumers and researchers.

In 2022, the PCHN recognised the lack of monitoring and reporting of preconception health behaviour and care. The Network considered it a priority to assess the impact of preconception policy, research and care; and to identify and prioritise indicators that can be used to inform future planning, informed by similar work in the UK and US[11,12]. The PCHN's first step was to develop core indicators for the Australian context incorporating, for the first time, community and social care perspectives, in addition to traditional healthcare[13]. Using these indicators and supporting principles, the Network sought to drive the development of a robust framework for monitoring preconception health, care, and prevention efforts in Australia. This paper describes the development of this framework.

Identifying indicators to monitor preconception health and care

Preconception health indicators are defined as "medical, behavioural and social risk factors or exposures as well as wider determinants of health that may impact potential future pregnancies among all women and men of reproductive age"[14]. These include factors such as chronic conditions, pregnancy intentions/wantedness, financial status, and education.

Methods

Researchers, clinicians, policy experts and consumer/community representatives came together over three workshops, using a modified Delphi approach, to attempt to identify a set of core indicators suitable for monitoring preconception health and care in Australia. Ethics approval was obtained from the Monash University Human Research Ethics Committee (35273).

In Workshop 1 (1.5 hours via Zoom), 19 attendees collaboratively generated a conceptual framework to inform future thinking and decision-making about what matters in relation to measuring and monitoring preconception health. The framework (Figure 1) incorporated a lifecourse approach, promoting inclusion of all genders, cultures, and socioeconomic backgrounds, regardless of pregnancy intentions. It also captured factors across the socioecological spectrum (individual, environmental) that influence preconception health.

Prior to workshop 2, participants were asked to view and rank potential indicators individually and in themed groups, referred to as 'domains'. Indicators were drawn from: (1) A scoping review of Australian and international guideline and policy documents relevant to PCH[11]; (2) the 66 national population-level indicators for PCH identified for the UK[5]; (3) the 45 core PCH

and PCC indicators identified by the National Preconception Health and Health Care (PCHHC) Initiative in the US[12]; (4) the HiPPP Global Alliance PC priorities[13]; and (5) World Health Organization Preconception Care areas (see Supplementary File 1 for full list of indicators).[14] Participants (n = 21) in Workshop 2 (full day in person; included consumer representation from a men's organisation) used the conceptual framework (Figure 2) and earlier ranking survey results to consider what is important to measure (e.g., healthcare, social determinants of health, family planning, mental health). In particular, they were asked to consider what matters to policy makers, to health and social care practitioners. The discussion determined that two overarching principles were vital – *equity* and *social determinants of health*. The domains were reclassified into six key domains: reproductive life planning; healthcare; indicators with clinical relevance; nutrition and physical activity; mental and emotional health, safety, quality of life and wellbeing; and prevention (Figure 2). Finally, it was agreed that all domains and indicators would be important depending on timing and context making further Delphi ranking rounds redundant. Instead, group discussions were undertaken to consider what indicators might be more important for (i) policy makers and (ii) health and social care providers and what reporting would facilitate their work. Commonalities across policy and health/social care included prevention with adequate investment; thinking across the lifecourse and spectrum of society (beyond women and healthcare); and reducing silos both within (e.g., nursing, pharmacy, social care) and across (e.g., healthcare, education) sectors.

Workshop 3 (1.5 hours via Zoom; n = 5 who were all members of the CRE HiPP Consumer Advisory Group) had the express aim of capturing the perspectives of those with relevant lived experience. To frame the workshop, a summary of progress to date and Workshop 2 discussions was provided. Participants then offered advice on effectively promoting preconception health to care providers or other services, government, family, and individuals.

These discussions further described preconception health outside traditional, clinical confines and promoted reproductive justice, which pursues the physical, mental, spiritual, political, social, and economic wellbeing of women and girls, based on the full achievement and protection of women's human rights.[15] Broad areas identified as relevant for improved preconception health included: i) Social and emotional wellbeing for individuals; ii) Intimate partner relationships; iii) Family and friendship support; and iv) Environmental support (eg. workplace, social groups). Specific areas for consideration included clinical guidance for people who are "between the cracks" (i.e., existing resources are not suitable); job security; improving people's understanding of fertility (in the context of family planning); and the availability of reliable and relevant health information. After the workshops, feedback on all outputs were sought from participants via email; with no significant changes suggested.

Lessons learnt

We have a clear framework and indicators to guide preconception health monitoring in Australia, with an accompanying set of implications for care and prevention that have been co-produced by researchers, clinicians, policy makers, and consumers. We advocate for indicators to be integrated into routine monitoring to:

- Monitor the uptake/provision of recommended preconception healthcare/health behaviour
- Identify what is done well and what needs to be done better
- Monitor equity in health care and health outcomes
- Assess the impact of policy or research implementation on preconception healthcare and health behaviours in addressing preconception health recommendations.

To achieve these goals, further work is required to understand the availability, accessibility and utility of preconception indicator data in Australia.

We identified that equity and social determinants of health should be guiding principles for preconception health in Australia, and that indicators for monitoring preconception health should cover domains including reproductive life planning; healthcare; indicators with clinical relevance; nutrition and physical activity; mental and emotional health, safety, quality of life and wellbeing; and prevention. Furthermore, clinicians, policy makers and consumers identified factors such as a lifecourse approach; reducing sector silos, especially across health and social care; and funding reorientation, as essential to improving preconception health. We recommend that next steps establish existing and required preconception indicator data in Australia to guide monitoring and evaluation of preconception health and healthcare, equity in outcomes, and the impact of policies. Doing so will ensure we can work towards optimising preconception health, healthcare, and social care for Australians.

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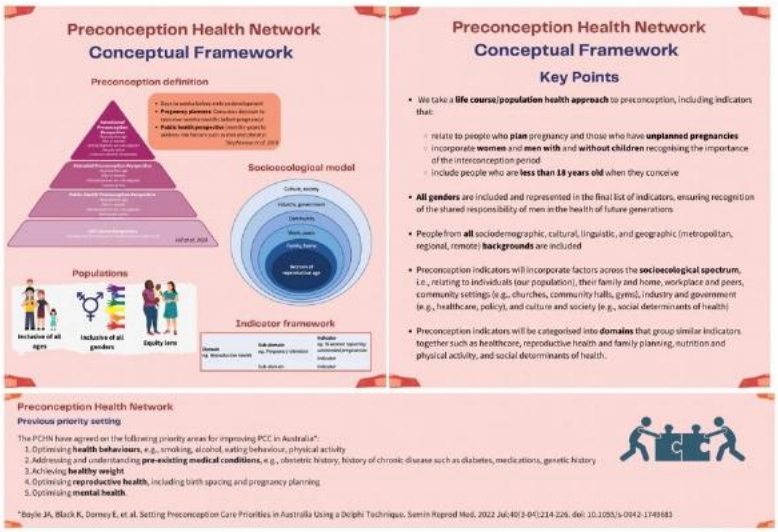

Figure 1. Framework informing development of preconception health core indicators

232x158mm (96 x 96 DPI)

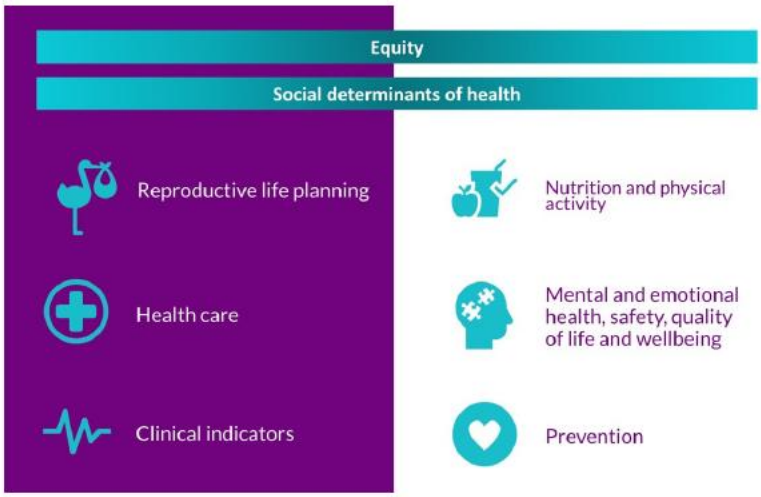

Figure 2. Preconception health domains

127x80mm (220 x 220 DPI)

Core Indicators Summary of Consumer Workshop

Presence in the Zoom

The workshop was attended by 5 consumers from the CRE HiPP (CRE in Health in Preconception and Pregnancy) Consumer Advisory Group.

Discussions

The group were asked what language (terminology) they prefer when thinking about preconception health. They developed a word cloud, with planning featuring heavily, as well as readiness (for pregnancy), health and wellbeing, and support and family. These align well with the key indicator domains and overarching themes developed in the full day workshop - reproductive life planning, modifiable health behaviours and health/social issues, and social determinants of health.

- Modifiable health behaviours - i.e., items within individual control
- Reproductive life planning - including contraceptive use, age, pregnancy planning, etc.
- Preexisting health and social issues - including psychosocial, spiritual, emotional, coordinated care, dental issues
- Social determinants of health - including food security, personal safety, poverty, education, ethnicity, and rurality

What do we need to have good preconception health?

Participants were asked to offer priorities to promote preconception health, thinking about healthcare providers or other services, government, family and individuals. Key themes or topics discussed included:

- Mental wellbeing
- Psychological capability to plan for and have children
- Being in a stable intimate relationship
- Having supportive family and friendship groups (including those in a similar life stage) and environments (workpace, social groups, supermarket)

- Targeting sexual and reproductive health approaches from adolescence (early in life)

Other points raised included:

- Reproductive life planning includes: social factors and is not just about clinical markers; appropriate conversations with healthcare provider; involves both partners
- Taking a more holistic understanding of health that captures people's social circumstances as well as barriers to achieving "normative" health indicators
- Reproductive justice
- Clinical guidance on how to identify and follow-up with patients when resources/information are not the best resource for that person
- Job security
- Improving understanding of fertility (to assist with planning)
- Having reliability and relevant health information

Next steps

The key outcomes from the preconception priorities discussion will be triangulated with those discussed by the healthcare, social care, researcher and policy workshop. The overall findings will be written up as a publication and will be used to support and advocate for improvements in monitoring of preconception health in Australia.

Appendix F

Aust N Z J Obstet Gynaecol 2024; 1–5

ANZJOG

DOI: 10.1111/ajo.13815

SHORT COMMUNICATION

Assessing preconception health in Australia to support better outcomes in the first 2000 days – A critical need for building a core indicator framework

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Abstract

In 2021, the Preconception Health Network Australia co-developed preconception health core indicators identified as critical to ensuring optimal maternal and child outcomes following conception. We conducted an audit of perinatal databases across each state and territory to identify whether preconception core indicator data were available. Seven health domains co-developed by the Preconception Health Network were mapped against the data collected in the perinatal databases. Indicator data were lacking across all seven health domains, with data missing for social determinants of health indicators. Better data linkage and developing a national evidence-based framework would allow ongoing monitoring of women's preconception health nationally.

KEYWORDS

attitudes, health knowledge, intention, maternal health, practice, preconception care, pregnancy, prevention & control, public health, social determinants of health, women's health

INTRODUCTION

Health, behaviours and wellbeing prior to pregnancy, and between pregnancies, can impact on the quality of one's pregnancy and the future health of women and their offspring.[1,2] The importance of optimising preconception health is highlighted in clinical guidelines and policies published nationally and internationally.[3] A preconception population is variably defined, but most frameworks include a life-course approach, a public health approach for those of reproductive age and an individual approach for those actively intending pregnancy or the health of those prior to a current pregnancy, the latter of which we are using in this paper.[1,4] In order to understand the status of Australia's preconception health, there is a need to identify, develop and monitor indicators of preconception health.[2]

The Preconception Health Network Australia (PCHN), auspiced by the Centre of Research Excellence in Health in Preconception and Pregnancy (CRE HiPP) identified data and monitoring of preconception health and care as one of the critical priority areas for attention in Australia.[5] As such, the PCHN has co-developed a set of core indicators suitable to monitor preconception health and care in Australia.[5,6] This was achieved by bringing together researchers, clinicians, policy experts, and community representatives to identify a set of core indicators across seven health domains[6] using a modified Delphi and Nominal Group Technique approach (Fig. 1). These

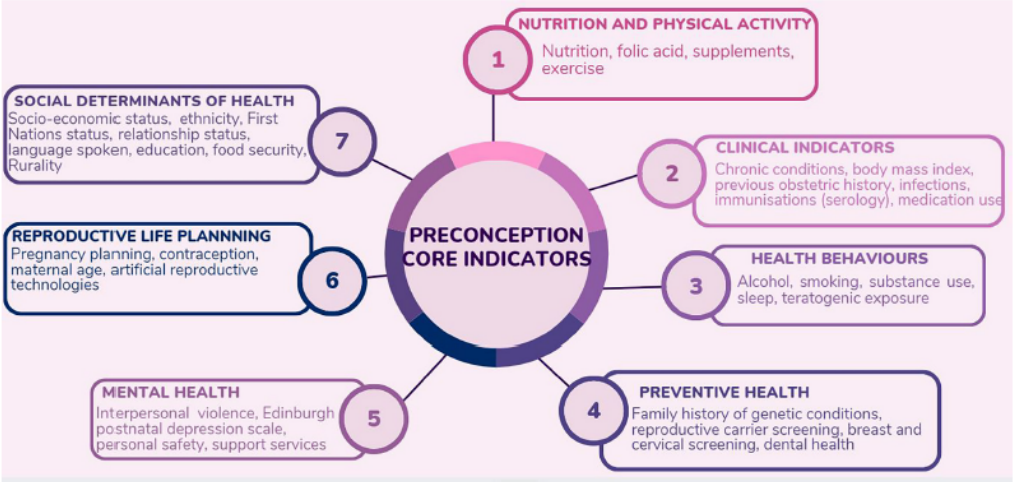

FIGURE 1 Preconception health core indicators developed across seven health domains.

domains demonstrate the complex interactions of biomedical, behavioural, social determinants of health, and emotional wellbeing factors as key components of preconception heath and care.

Monitoring readily accessible pregnancy data enables the evaluation of disparities in preconception health, demonstrated by research from the UK.[2] In order to plan for a similar process in Australia, we therefore aimed to assess national and state-based pregnancy data sets in Australia and to map the data to the core indicators established by the PCHN.

MATERIALS AND METHODS

Using these core indicators, we conducted an audit of all the Australian state and territory-based perinatal databases, and the Maternity Information Matrix (MIM) (a national database derived from the state databases) to assess to what extent the indicators were captured in routinely collected data. We sent our list of preconception health core indicators to data custodians for each perinatal database to check whether the data were available. Data custodians provided Yes/No responses, against each of the core indicators on our list for the perinatal databases from the Australian Capital Territory, New South Wales, South Australia and Western Australia. We were directed to consult the data variable dictionaries available for the perinatal databases for Victoria, Northern Territory, Tasmania and Queensland. These databases were reviewed in the absence of dedicated preconception health databases. Data custodians also provided availability from other data sources such as population health surveys for reference, but these datasets were not linked to perinatal databases.

RESULTS

Data presented are from state and territory based perinatal databases as data custodians from the MIM informed us that perinatal databases for each jurisdiction have the most current data dictionaries. Information regarding chronic conditions, physical health, previous obstetric history, alcohol and smoking, screening for interpersonal violence, age, and ethnic background were mostly available across all states. However, data were not complete for some screening variables. For example, data were collected on whether or not a screening for interpersonal violence was conducted, but the result of that screening was not collected. Additionally, data were lacking nationwide for diet and supplements and missing for exercise, sleep, reproductive life planning, and the entire preventive health domain (Table 1). Importantly, no state data were available for a family history of genetic conditions, or previous pregnancy genetic conditions, reproductive carrier screening, cervical/breast screening, dental health, contraception use, language spoken, personal safety, employment or education level.

DISCUSSION

These findings highlight that while some indicators of preconception health are being collected in state and national perinatal data, some important gaps remain across all seven domains. There are differences between how preconception indicator data are collected by states and territories, such as body mass index and ethnicity, and for some other key indicators (eg social determinants of health) no data are collected. Mapping preconception health indicators using the perinatal databases

TABLE 1 Availability of preconception health core indicator data across state and territory-based perinatal databases

	State/territory							
Health domain	**Victoria**	**NSW**	**ACT**	**Tas**	**WA**	**QLD**	**NT**	**SA**
Nutrition and physical activity								
Fruit and veg			O					
Folic acid			O	O				
Anaemia			O					
Supplements			O	O				
Clinical indicators								
Hypertension	O	O	O	O	O			O
Diabetes	O	O	O	O	O			O
Epilepsy			O	O				O
Asthma			O					O
Polycystic ovarian syndrome			O					O
Cancer			O					O
Autoimmune disease			O					
Physical health								
Body mass index	O	O	O	O	O	O		O
Previous obstetric history	O							
Parity	O	O	O		O		O	O
Preterm birth			O					
Gestational diabetes	O							O
Pre-eclampsia								O
Caesarean section	O		O	O	O	O		O
Abortions	O		O	O	O	O		O
Preterm labour	O		O	O	O	O		O
Infections								
Sexually transmitted infections	O							
Immunisations	O			O	O	O		O
Health behaviours								
Alcohol	O			O	O	O	O	O
Smoking and vaping	O			O	O	O	O	O
Substance use				O	O	O		O
Sleep								
Environmental exposures								
Preventive health								
Genetics, family history, carrier screening, cervical/breast screening, dental								
Mental and emotional health								
Mental health	O			O				
Edinburgh postnatal depression scale score	O				O	O		
Interpersonal violence/family violence screening status	O			O	O	O		
Personal safety		O						
Supports								
Reproductive life planning								
Pregnancy planning, contraception								

(Continues)

TABLE 1 (Continued)

Health domain	State/territory							
	Victoria	NSW	ACT	Tas	WA	QLD	NT	SA
Maternal age	O	O	O	O	O		O	O
Assisted reproductive technology								
Gestational age at booking	O	O		O	O		O	O
Social determinants of health								
Food security								
Poverty								
Education								
Ethnicity		O			O			
Rurality/postcode	O	O		O		O	O	O
Housing								
Coordination of all care with primary care								
Country of birth		O	O					
Language spoken								
First Nations status	O	O		O		O	O	O

'O' depicts data being available in a state/territory perinatal dataset.
ACT, Australian Capital Territory; NSW, New South Wales; SA, South Australia; WA, Western Australia; VIC, Victoria; NT Northern Territory; TAS, Tasmania; QLD, Queensland.

is therefore currently not possible. Yet it is critical that we understand the impacts of preconception policy, health and social care and research on pregnancy outcomes.

The PCHN has recommended that Australia builds a national evidence-based framework to capture and report preconception health and care indicator data to enable longitudinal monitoring of equity, health behaviours, healthcare and health outcomes and to enable benchmarking against preconception health frameworks internationally.[2] This would require a multi-pronged approach. Firstly, based on clinical experience, relevant data for a number of these indicators such as rubella serology, medication and supplement use preconception, need for an interpreter, are collected in many hospital pregnancy records but are not transferred to the state or national perinatal databases. The reasons for this are varied but include a focus on collecting specified pregnancy indicators and that current practice is to send only pre-formatted/pre-determined data extracts from hospital records to state databases. We could potentially conduct an audit of existing maternity databases for content, and identify which fields are pre-formatted, and which fields are mandatory and map to our indicators. Additionally, for the free text we could employ large language models to read these data as there is potential to develop a map that can be applied across different electronic medical records platforms that would assist in collecting data on preconception health indicators. There are a number of approaches to standardisation of the structure and content of data from disparate health systems that could potentially enable data collection and efficient and reliable analyses. Given the different systems used in pregnancy care in hospitals across Australia, a comprehensive national system would take time to develop. However, piloting and testing these mechanisms and collaboratively generating evidence that promotes better health decisions and better care can enable robust monitoring of future preconception health. Finally, national preconception health surveys could be developed and administered to capture missing data on critical preconception health core indicators. These recommendations are aligned with the Preconception Health Network's recommendations for the Senate Inquiry into universal access to sexual and reproductive health.[7]

Producing the first national report card for the state of preconception health for women in Australia has the potential to identify priority preconception health indicators for ongoing monitoring at a national level and targeting interventions with the aim of reducing adverse pregnancy outcomes for women across Australia, particularly those from priority groups at greatest risk of poor outcomes.

ACKNOWLEDGEMENTS

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Appendix G: Supplementary documents from research studies

Chapter 2: Guidelines for preconception care

A systematic review of international clinical guidance for preconception care.

Search Strategy

1. **Health literature databases**

Ovid MEDLINE(R) ALL <1946 to June 04, 2021> EBM Reviews complete: Cochrane DSR, ACP Journal Club, DARE, CCTR, CLEED, CLCMR, & CLHTA via OvidSP	
1	Preconception care
2	Preconception OR preconcept* OR prepregnancy
3	Preconception OR pre-concept* OR pre-pregnancy
4	(Before OR prior OR try* OR prepare OR preparing OR preparation OR plan*) adj (pregnan* OR conceiv* OR conception OR family)
5	((Becom* or get) adj pregnant)
6	(Try* adj baby OR conceive)
7	(Start* adj family)
8	1 or 2 or 3 or 4 or 5 or 6 or 7
9	Guideline* OR practice guideline OR guidance OR committee opinion OR polic* OR consensus OR statement
10	8 AND 9
11	Limit 10 to humans

Embase	
1	Prepregnancy care
2	Preconception OR preconcept* OR prepregnancy
3	Preconception OR pre-concept* OR pre-pregnancy
4	(Before OR prior OR try* OR prepare OR preparing OR preparation) adj (pregnan* OR conceiv* OR conception)
5	((Becom* or get) adj pregnant)

6	(Try* adj baby OR conceive)
7	(Start* adj family)
8	1 or 2 or 3 or 4 or 5 or 6 or 7
9	Guideline* OR practice guideline OR guidance OR committee opinion OR polic* OR consensus OR statement
10	8 AND 9
11	Limit 10 to humans

Cinahl	
1	Prepregnancy care
2	Practice guideline
3	S1 AND S2

2. Prospero & Guideline Registers

Database/Website name	Search terms
PROSPERO https://www.crd.york.ac.uk/prospero/#searchadvanced	• Before pregnancy guideline • Pre-conception guideline • Preconception guideline • Pre-pregnancy guideline • Prepregnancy guideline
National Institute of Clinical Excellence (NICE) Guidelines https://www.nice.org.uk/	• preconception • pre-conception • pre-pregnancy • prepregnancy • before pregnancy *Terms searched separately* LIMIT: all NICE guidelines; 2010 – present
Scottish Intercollegiate Guideline Network (SIGN) https://www.sign.ac.uk/	Preconception OR preconcept$ OR prepregnancy OR pre-concept$ OR pre-pregnancy OR (before pregnancy)

	LIMIT 2010 – Present
National Guideline Clearinghouse (Agency for healthcare and research quality) https://www.ahrq.gov/prevention/guidelines/index.html/	Preconception OR preconcept$ OR prepregnancy OR pre-concept$ OR pre-pregnancy OR (before pregnancy) LIMIT: 2010 – Present LIMIT: results with PDF File Screen on website
NHMRC Guidelines Portal https://www.clinicalguidelines.gov.au/	• preconception • pre-conception • pre-pregnancy • prepregnancy • before pregnancy *Terms searched separately* LIMIT: 2010 – Present
International Guidelines Registry (GIN) https://g-i-n.net/ • International Guidelines Library https://g-i-n.net/international-guidelines-library/ • https://guidelines.ebmportal.com/	Preconception OR preconcept$ OR prepregnancy OR pre-concept$ OR pre-pregnancy OR (before pregnancy) LIMIT: Guidelines, 2010 – Present
World Health Organization https://www.who.int/publications/who-guidelines/	Preconception OR preconcept$ OR prepregnancy OR pre-concept$ OR pre-pregnancy OR (before pregnancy) LIMIT: select "guidelines" from 'Content type' LIMIT: 2010 – Present
International Practice Guideline Registry Platform http://www.guidelines-registry.org/	Preconception OR preconcept$ OR prepregnancy OR pre-concept$ OR pre-pregnancy OR (before pregnancy) LIMIT 2010 – Present
Geneva Foundation for Medical Education and Research https://www.gfmer.ch/000_Homepage_En.htm	• preconception • pre-conception • pre-pregnancy • prepregnancy • before pregnancy *Terms searched separately*

	LIMIT: Guidelines, 2010 – Present

3. Relevant professional organisations

Organisation Name	Search terms
Centre for Disease Control and Prevention CDC https://www.cdc.gov/	Preconception OR preconcept$ OR prepregnancy OR pre-concept$ OR pre-pregnancy OR (before pregnancy) AND guideline OR guid$ LIMIT 2010 – Present
National Academy of Medicine https://nam.edu/	• Before pregnancy guideline • Pre-conception guideline • Preconception guideline • Pre-pregnancy guideline • Prepregnancy guideline *Terms searched separately* LIMIT 2010 – Present
American College of Obstetricians and gynaecologists ACOG https://www.acog.org/	Preconception OR preconcept$ OR prepregnancy OR pre-concept$ OR pre-pregnancy OR (before pregnancy) LIMIT: "Committee Opinion" OR "Obstetric care consensus" LIMIT 2010 – Present
American Academy of Family Physicians https://www.aafp.org/home.html	Preconception OR preconcept$ OR prepregnancy OR pre-concept$ OR pre-pregnancy OR (before pregnancy) LIMIT 2010 – Present
Royal College of Obstetricians and Gynaecologists United Kingdom RCOG https://www.rcog.org.uk/	Preconception OR preconcept$ OR prepregnancy OR pre-concept$ OR pre-pregnancy OR (before pregnancy) Filter by type: Guidelines LIMIT 2010 – Present
Faculty of Sexual and Reproductive Health UK https://www.fsrh.org/	Preconception OR preconcept$ OR prepregnancy OR pre-concept$ OR pre-pregnancy OR (before pregnancy)

	LIMIT: select "Standards and Guidance" from 'Content type' LIMIT 2010 – Present
College of Family Physicians of Canada https://www.cfpc.ca/en/home	• preconception • pre-conception • pre-pregnancy • prepregnancy • before pregnancy *Terms searched separately* LIMIT: "resources" LMIT: Audience to "clinicians" LIMIT: 2010 – Present
Royal Australian & New Zealand College of Obstetricians and Gynaecologists (RANZCOG) https://ranzcog.edu.au/	• preconception • pre-conception • pre-pregnancy • prepregnancy • before pregnancy *Terms searched separately* LIMIT: "statements and guidelines" LIMIT: 2010 – Present
Royal Australian College of General Practitioners (RACGP) https://www.racgp.org.au/	• preconception • pre-conception • pre-pregnancy • prepregnancy • before pregnancy *Terms searched separately* LIMIT: Clinical Resources → Clinical Guidelines LIMIT: 2010 – Present
Federation of Obstetric and Gynaecologic Societies of India https://www.fogsi.org	• preconception • pre-conception • pre-pregnancy • prepregnancy • before pregnancy *Terms searched separately* LIMIT: 2010 – Present

Survey of Australian Primary Health Care Nurses' attitudes and practice to preconception care.

Introduction/Welcome page

Thank you for your interest in our study.

SPHERE is a Centre of Research Excellence that aims to improve the quality, safety, and capacity of primary health care services to achieve better outcomes in women's sexual and reproductive health. SPHERE is partnering with APNA to learn if and under what circumstances primary health care nurses talk to their clients about preconception health, and what resources might help them start a conversation.

To help us understand how SPHERE and APNA can support Primary Health Care Nurses you are invited to complete a brief, anonymous, online survey about your attitudes and practice relating to preconception care. It will take approximately 10 minutes to complete the survey. On completion, you will have the option to provide your email address to go into a draw to win an iPad or one of five $30 Coles-Myer gift vouchers. Your email will not be linked to your survey responses.

The study has been approved by the Sydney University Human Research Ethics Committee (Project Number 2020/430) . Please read the full participant information attached. Submitting you completed survey is in an indication of your consent to participate in the study.

If you have any questions you can email Dr Edwina Dorney who is responsible for the study (edwina.dorney@sydney.edu.au)

If you're ready to begin the survey, please click "Next" below.

Survey Eligibility Questions

Do you have current registration with AHPRA?

Yes

No

Do you see women and/or men aged 16-45 in your daily practice?

Yes

No

***** If either question is answered "No" the survey terminates*****

Section 1 Questions about you

1 Your gender

1 Female

2 Male

3 Transgender

4 Other

5 Prefer not to say

2 Your age

1 Less than 35 years

2 35-44 years

3 45-54 years

4 55-64 years

5 65 years or older

3 What are your current professional qualification/s?

1 Registered Nurse (hospital trained)

2 Registered Nurse (tertiary trained)

3 Enrolled Nurse

4 Midwife

5 Nurse Practitioner

6 Postgraduate Qualifications (Free Text)

4 What is the postcode of your primary place of work?

Free Text response

5 In what setting/s do you mainly work? Tick all that apply

1 Community Health
2 Child and Family Health
3 General Practice
4 Domiciliary setting (custodial/detention, boarding houses)
5 Educational setting
6 Occupational setting
7 Management / Education
8 Other

Section 2 Knowledge of preconception health

6 How would you rate your knowledge about the importance of the mother's health in the preconception period?

1 Excellent

2 Above average

3 Average

4 Below average

5 Poor

7 How would you rate your knowledge about the importance of the father's health in the preconception period?

1 Excellent

2 Above average

3 Average

4 Below average

5 Poor

Section 3: Questions about preconception health promotion

8 In your daily practice, do you ever discuss preconception health with your clients?

1 No, never

2 Yes, occasionally

3 Yes, sometimes

4 Yes, routinely

** If answers "No" directed to Question 13, If answers "Yes" directed to Questions 10*

9 With whom do you initiate a discussion about preconception health? You can select more than one option

1 Women of reproductive age

2 Men of reproductive age

3 Women at risk of subfertility or adverse pregnancy outcomes e.g. obesity, diabetes, chronic conditions, advanced maternal age

4 All people of reproductive age

5 None of the above, I wait until the discussion is initiated by the client

6 None of the above preconception health is not a topic I discuss with my patients

10 Many clinicians are involved in the care of women and men of reproductive age. In your opinion who is best placed to deliver preconception care?

Please select up to three and number in importance of 1 to 3 (1 = best, 2 = next best etc)

	For women	For men
Primary Health Care Nurses		
Midwives		
GPs		
Community Health services		

Family Planning Services		
Obstetricians		
Fertility Specialists		
Other		

11 In your opinion, what are the barriers to discussing preconception health with clients? (You can choose more than one)

1 Time constraints

2 Lack of knowledge

3 Difficult subject to bring up unless asked

4 I do not feel comfortable starting the discussion of preconception health

4 Not part of the Primary Health Care Nurses' role

5 There is no financial incentive for my practice to support Primary Health Care Nurses in providing preconception health advice

6. I do not have the knowledge or training about where to refer to k, or what to do next

6 Other (allow free text response)

12 Would more information / education make you more confident to talk to clients about preconception health when appropriate?

1 Yes

2 No

3 Don't know

13 What resources would help you talk to clients about preconception health?

1 Webinar (a live internet-based information session where you can ask questions)

2 Podcast for health professionals

3 Face to face learning such as a course or conference session

4 Fact sheets to give to patients

5 Trustworthy websites to refer patients to

6 Other (text response)

14 Have you completed the APNA online learning module on "Preconception Health Promotion in Primary Care"?

1 Yes

2 No

Further Research

15

We would value the chance to talk with you about this further and to hear your ideas on how we can best support Primary Health Care Nurses to deliver preconception care. Would you be happy to be contacted with information about taking part in a short interview?

1 Yes

2 No

If yes, redirected to another page to provide email details.

If yes, please provide your email here. This will NOT be linked to your survey responses.

16

Would you like your email address to be included in the draw to win an iPad or one of five $30 Coles/Myer vouchers?

1 Yes

2 No

If yes, redirected to another page to provide email details.

If yes, please provide your email here. This will NOT be linked to your survey responses.

THANK YOU!

Understandings of preconception care and perspectives of online self-assessment tools to improve preconception health

Interview Guide

Obtain consent (written or verbal)
Proceed with interview questions below.

Participant background

Can you tell me a little about yourself? (Then prompt for below as needed)

- Age
- Where do you live?
- ATSI
- Highest level of education?
- Do you have a regular GP?
- Previous pregnancies and outcomes?
- Partner status

Are you currently pregnant or planning to become pregnant in the next year?

Can you tell me how and where you find most of your health information?

Preconception views

Have you heard of the term preconception care?

What does this term preconception mean to you?

What types of people would benefit from preconception care?

Do you think it is acceptable to talk to women/men about planning for pregnancy?

Preconception Information & Services

What would you do if you were thinking of becoming pregnant?

For women or men who have been pregnant/fathered a pregnancy:
What did you do before your previous pregnancy(ies)?
If you had used the HCT how would this have changed things for you?

Views on the Healthy Conception Tool

Overall, how would you describe your experience of using the HCT?

- What did you like about it?
- What did you not like about it?

Do you think this tool would be acceptable to all people?
Are there certain groups you do not think it would be acceptable for?

Title and finding it

What do you think about the title?

Would you have found this online?

Content

What did you think about the topics the tool covered?

What did you think about the **number** of topics covered?
Which topics did you not consider important or relevant?
Did any question/language not make sense?
Were there any other topics you think should have been asked?

- Diet
- Mental Health
- Vaccinations
- Cervical Screen

Visual Appeal

What device(s) did you use the tool on?

What did you think about how the tool looks?

- What did you like about it?
- What did you not like about it?

Can you tell me what you thought about the use of graphics in the tool?

Duration

What did you think about the length of the tool?

How long did it take you to complete it?

Engagement

Did you find the tool engaging?

Would you have completed it if it was not for this research?

If no – where would you have stopped on the tool?

How would you improve the HCT?

Results

What did you think about how you receive the results?
How can this be improved?
Would you be keen to receive more information from the tool?

Impact

When you completed the HCT;
What did you learn that was new?
What will you do with this knowledge?
How has the HCT changed what you will do before a pregnancy?

Interview Closing

If you could fix only one/two parts of the HCT what would you fix?

We've now reached the end of the questions! Is there anything else you think we have missed that you would like to discuss?

Thank you for your time with us today. Your contribution to our research is really valuable. Can we please confirm how to send your VISA gift card?
Via email
Via Post

Fieldnotes template

Participant ID	
Interview set-up • Process of recruitment (brief) • Expectations/ concerns expressed about participating	
Interview setting • Location/surroundings: • The interview atmosphere: • Any interruptions: • Changes in interview dynamic across the interview • Impressions as to the participant's state in leaving the interview	
Method • What questions/ lines of discussion worked well, what did not: • Any adjustments during the interview:	
Synthesis of key ideas	
Issues/ideas raised other than those in the interview guide	
Follow-up actions required	
Suggestions for additions to the topic guide	
Ideas for sampling	