

**Equity Considerations in Telehealth Service Access
with a Focus on Rural-Urban Health Inequalities**

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

By

Siyu Wang

Sydney School of Public Health

Faculty of Medicine and Health

The University of Sydney

2026

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.

Siyu Wang

28 February 2026

Acknowledgements

At the completion of this thesis, I would like to express my sincerest gratitude to everyone who has supported and helped me throughout my PhD journey, both academically and personally.

First and foremost, I am deeply grateful to my lead supervisor, Professor Andrew Wilson.

Thank you for offering me the opportunity to pursue a PhD and for enabling me to work towards my academic dream. Your encouragement and trust from start to finish, your thoughtful guidance on my progress, and your care and support as I navigated life and study in a foreign country have given me strength, warmth, and confidence to keep moving forward.

I also extend my heartfelt thanks to my other supervisors, Dr Amy Von Huben, Dr Anagha Killeddar and Associate Professor Sarah Norris. Thank you for your invaluable guidance, constructive feedback, and continued support across research design, thesis writing, and academic development. I am especially grateful to Amy for her generous and detailed support in data analysis and the methods work, which was pivotal to the progress of this research.

I would also like to offer a special thank you to Anagha for her consistently timely and thorough feedback. Your careful attention to detail, and your willingness to respond quickly whenever I needed guidance, made an enormous difference. I have also deeply appreciated your kindness and care, particularly at moments when I felt uncertain or under pressure.

I sincerely appreciate the patience, time, and consistent positive encouragement provided by all my supervisors, which has meant a great deal to me.

In addition, I would like to thank the Leeder Centre for its support during my PhD. I am grateful to everyone at the Centre who has assisted me along the way, and for creating a collegial, professional, and supportive research environment.

My deepest gratitude goes to my family. I thank my parents, Jinguo Wang and Yan Lu, for their unwavering love and wholehearted support. It is because of your dedication and sacrifice that I have been able to pursue opportunities beyond my own horizons. Your love has carried me through one challenge after another and has given me the courage to begin again whenever I needed to.

I also want to thank my boyfriend, Tianqi Ma, for his constant companionship and support. Thank you for being by my side, for helping me through periods of uncertainty, anxiety, and low moments, and for walking with me as I grew and learned to see the world more widely.

Finally, I would like to thank myself for never giving up and for persisting all the way to this point. I would like to close with a quote that has stayed with me and continues to inspire me:

“I am driven by a deep passion and need to make a difference and leave this world a little better than when I arrived. That’s what keeps me going!”.

Authorship attribution statement

This thesis contains material that has previously been published as peer-reviewed journal articles. The relevant articles are listed in Appendix B, together with detailed statements of each co-author's relative contributions.

Additionally, I make the following general statement of acknowledgment:

This thesis is principally the work of Siyu Wang. She is the sole author of the Thesis roadmap and the overarching general introduction in Chapter 1, as well as the integrative discussion and conclusions in Chapter 7. She is the first and corresponding author for the component studies, including both published and unpublished work, presented across Chapters 2 to 6, comprising: (i) evidence synthesis of telehealth and equity-related literature, (ii) synthesis and appraisal of equity frameworks relevant to telehealth and digital health, (iii) a health-equity analysis of Australian telehealth policies and strategies, (iv) a comparative case study applying a nine-dimension telehealth equity framework to Australian telehealth programmes, and (v) a best-worst scaling preference survey examining user priorities for telehealth features.

Siyu Wang was primarily responsible for the overall research design and conduct of the thesis; developing the nine-dimension equity framework; designing and implementing the document review and data extraction processes; designing and administering the preference survey; conducting data cleaning and statistical analyses (including best-worst scaling

models); interpreting findings; and drafting, revising, and finalising all chapters. She prepared all tables, figures, and appendices included in the thesis.

All supervisors listed below provided substantial support for this project, including guidance on conceptualisation and study design, interpretation of findings, and critical review of chapter drafts and manuscripts.

Siyu Wang		Date: 28 February 2026
Professor Andrew Wilson		Date: 28 February 2026
Associate Professor Sarah Norris		Date: 28 February 2026
Dr Amy Von Huben		Date: 28 February 2026
Dr Anagha Killedar		Date: 28 February 2026

Ethical clearance

Ethics approval for the studies in Chapters 5 and 6 was obtained through separate approvals from The University of Sydney Human Research Ethics Committee (HREC No. 2024/HE001354 and HREC No. 2025/HE000929, respectively). Ethical approval letters are provided in Appendix C.

For the study reported in Chapter 5, all participants provided written informed consent prior to participation.

For the survey reported in Chapter 6, informed consent was obtained electronically via the consent statement presented on the first page of the questionnaire before respondents could proceed.

Generative AI statement

The author used ChatGPT (OpenAI) and Claude (Anthropic) for the purposes of text enhancement and limited coding assistance. The use of these generative AI tools included spelling corrections, minor sentence restructuring, clarity enhancement, and support for drafting/debugging analysis code. The author confirms that where content was modified by generative AI, it was reviewed for possible errors, inaccuracies, and bias. The author takes full responsibility for the submitted thesis, confirms the work is their own, and has used generative AI in accordance with University guidelines and policies.

Abstract

Background

Telehealth has been widely promoted as a strategy for overcoming geographic barriers to healthcare, particularly for rural and remote populations who experience poorer health outcomes, reduced workforce availability, and greater travel burdens than metropolitan residents. The COVID-19 pandemic dramatically accelerated telehealth adoption in Australia, with remote consultations rising from less than 2% of general practice encounters in 2019 to over 40% during pandemic peaks. However, substantial uncertainty remains about whether telehealth consistently reduces health inequalities or whether it may in some circumstances exacerbate them. Digital divides in connectivity, device access, digital literacy, cultural appropriateness, and affordability may create new forms of exclusion for populations already experiencing disadvantage. Despite growing policy rhetoric emphasising equity, existing research has not systematically examined how equity considerations are conceptualised, operationalised, and experienced across the multiple levels of telehealth systems, from academic evidence and theoretical frameworks through policy architecture and programme implementation to end-user preferences and priorities.

Objectives

To systematically assess equity considerations in Australian telehealth services addressing rural-urban health inequalities, by: (1) synthesising evidence on how telehealth influences

health equity across multiple access dimensions; (2) critically appraising equity frameworks for their applicability to digital health contexts; (3) examining the extent to which Australian telehealth policies integrate equity considerations; (4) developing and applying a nine-dimension telehealth equity evaluation framework through comparative case studies; (5) quantifying user preferences for equity-relevant telehealth service attributes and exploring preference heterogeneity across geographic populations; and (6) integrating evidence across these layers to identify cross-cutting equity mechanisms, gaps, and actionable implications for policy and service design.

Methods

Chapter 2: A systematic review of reviews (42 reviews, 2012-2023) synthesised evidence on telehealth's impact on equity in non-urban areas, mapping findings to six access dimensions (the 6A framework: accessibility, availability, acceptability, affordability, adequacy, and awareness).

Chapter 3: A systematic review and narrative synthesis identified and appraised health equity frameworks (n=13) relevant to telehealth and digital health.

Chapter 4: A policy analysis of Australian telehealth strategies and policy documents (n=15) assessed how equity considerations were articulated and operationalised, using the 6A framework and structured content analysis.

Chapter 5: Comparative case studies of two Australian telehealth programmes (RPA Virtual

Hospital and VRGS) applied a newly developed nine-dimension equity evaluation framework using a transparent 0-4 scoring rubric, supported by document review and stakeholder validation.

Chapter 6: A cross-sectional online survey of 2,882 adults residing in New South Wales (NSW) administered a Best-Worst Scaling (Case 1) experiment with 24 attributes spanning nine equity-relevant domains. Multinomial logit models tested preference heterogeneity across major city, regional city/large town, and rural/remote area populations, complemented by multivariable regression analyses of structural barriers, digital confidence, and scenario-specific telehealth willingness.

Results

Chapter 2: Across the 42 included reviews, coverage of the six access dimensions was uneven and comprehensive coverage was rare. Poor coverage predominated across covered dimensions, with “poor” indicating that a dimension was only briefly acknowledged rather than examined in substantive detail. Acceptability had the highest proportion of good ratings (10/42 reviews, 23.8%), where “good” indicated comprehensive coverage of a dimension. Awareness was least explored, with 16/42 reviews (38.0%) not addressing it at all.

Chapter 3: Thirteen frameworks were identified, but none consistently covered all equity-relevant dimensions for digital health. Gaps were particularly evident in digital infrastructure assessment, cultural adaptation guidance, and operational equity indicators, informing

development of the nine-dimension framework.

Chapter 4: Policies showed extensive equity rhetoric but weak operational mechanisms.

Accessibility and availability were most frequently addressed, while affordability and awareness received the least substantive attention. Monitoring and evaluation was consistently weak, with few policies specifying dedicated resources or accountability mechanisms tied to equity outcomes.

Chapter 5: Application of the nine-dimension framework revealed distinct equity profiles.

RPA Virtual scored higher on cultural adaptation (4 vs 2) and stakeholder governance (4 vs 3), while VRGS demonstrated stronger economic affordability through lower estimated unit costs (A\$1,047 vs A\$1,753). Both programmes received a score of 3 on five dimensions, indicating structured implementation with some supporting evidence, but not full operationalisation or routine equity-stratified monitoring.

Chapter 6: Age was the most consistent predictor of variation in telehealth willingness across

clinical scenarios. Rural/remote respondents had higher odds of internet access problems than major city respondents (aOR 1.88; 95% CI 1.45–2.44), while geographic differences in digital confidence were largely explained after adjustment for sociodemographic factors such as age, education, and income. Best-Worst Scaling showed that the highest-weighted attributes, as a percentage of overall attribute importance, were perceived clinician quality (12.1%), access to prescriptions/referrals (9.4%), and timely care (7.5%). Six attributes showed statistically significant differences in preference weights for regional city/large town

respondents compared with major city respondents; no statistically significant attribute-level deviations were detected for rural/remote respondents.

Conclusions

This thesis indicates that telehealth has the potential to reduce rural-urban health inequalities in Australia, but that realising this potential is likely to require sustained, multi-level action.

Five cross-cutting findings emerged: (1) awareness is a systematically neglected yet foundational precondition for equitable access; (2) digital divides are structural and multi-dimensional, encompassing infrastructure, capability, and trust; (3) strong equity policy rhetoric is not matched by operational implementation mechanisms; (4) efficiency and cultural safety need not be treated as trade-offs when approached through modular and tiered service design; and (5) preference heterogeneity, driven more strongly by age than geography in end-user willingness and capability, supports flexible, adaptive service models rather than universal standardisation. The nine-dimension telehealth equity evaluation framework may support more systematic equity assessment and improvement activities across programmes, informing recommendations for standards, funding, monitoring, workforce development, and service design.

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Chapter 1 Introduction

1.1 Conceptual Foundations and Context

1.1.1 Clarifying Health Inequality, Inequity, Equity and Disparities

Before examining rural-urban differences in healthcare access, it is important to clarify several related terms that are often used interchangeably but have distinct meanings.

Health inequality refers to observable and measurable differences in health outcomes or healthcare access across individuals or groups (1-4). These differences may be associated with socioeconomic position, geography, education, or other social characteristics (1, 2). The term itself is descriptive. It identifies that differences exist, but does not by itself determine whether those differences are fair or unfair (5).

Health inequity, by contrast, refers to differences that are unfair, avoidable, and socially produced (6-8). It therefore carries an explicit normative dimension. Where inequality identifies variation, inequity highlights injustice and the ethical imperative to address it (5, 8). In this sense, inequity is a subset of inequality: not all inequalities are inequities, but inequities are those inequalities that are judged to be unfair and remediable.

Health disparities is commonly used to describe substantial gaps in health status, healthcare quality, or healthcare access across socially defined groups (9). In practice, the term often signals patterns of disadvantage affecting groups defined by race, ethnicity, socioeconomic

circumstances, geography, age, disability, or other demographic and social characteristics (9-12). Health disparities are closely linked to questions of fairness because they often reflect accumulated structural disadvantage rather than isolated individual differences (10, 12).

Health equity refers to the principle that all people should have a fair and just opportunity to attain their highest possible level of health (10, 13). Achieving health equity does not imply identical treatment or identical allocation of resources. Rather, it may require proportionately greater support for groups facing systematic disadvantage in order to reduce avoidable gaps in health and access to care (14, 15). In this sense, equity is not simply about equal distribution, but about fair distribution according to need and circumstance.

For the purposes of this thesis, the term health inequalities is used as the primary overarching term when describing rural-urban differences in health outcomes and healthcare access. This choice reflects two considerations. First, it allows the thesis to examine measurable patterns of difference without assuming that every observed difference has the same cause or normative status. Second, it remains compatible with the broader aim of improving health equity, which is the normative concern underpinning the study (5, 12, 13, 16). Thus, throughout the thesis, empirical analysis focuses on inequalities, while interpretation remains oriented toward equity.

This distinction is particularly important in the context of telehealth. Telehealth is frequently promoted as a strategy for reducing inequalities in access by overcoming distance and service scarcity (17-19). However, whether telehealth actually advances equity depends on how it is

designed, implemented, governed, and used in practice. A service that improves access for some groups may still widen inequities if it introduces new barriers for others, such as those related to connectivity, affordability, digital capability, trust, language, or cultural appropriateness (19-27). Accordingly, this thesis treats telehealth not as inherently equity-enhancing, but as a service model whose equity effects must be examined systematically.

1.1.2 Rural-Urban Health Inequalities in Australia

Among the many forms of health inequality, rural-urban differences remain especially prominent. In many countries, people living outside major metropolitan centres experience reduced service availability, longer travel distances, fewer health professionals, and poorer health outcomes. These patterns are shaped by the interaction of geography with broader social, economic, and infrastructural determinants of health (6, 15, 16). While such patterns are widely recognised internationally, the focus of this thesis is the Australian context.

Australia provides a particularly important setting in which to examine rural-urban health inequalities. Although Australia has universal Medicare coverage and a comparatively well-resourced health system, people living in rural and remote areas continue to experience poorer health outcomes and more limited access to healthcare services than those living in metropolitan areas (28-31). Around 27% of the population lives in rural or remote areas, and these communities continue to experience shorter life expectancy, higher burdens of chronic

disease and injury, and reduced access to a broad range of health services (30-32). These differences are not explained by geography alone. They are also shaped by transport constraints, limited service capacity, workforce shortages, reduced infrastructure, and the higher costs of delivering care across dispersed populations (30, 32-35).

The distribution of the health workforce is particularly important. Rural and remote communities face persistent shortages of healthcare professionals, especially specialists, which has significant implications for access, continuity, and timeliness of care (30, 32-35).

In remote areas, the number of medical specialists per capita remains substantially lower than in major cities, contributing to delayed treatment, unmet need, and heavier reliance on travel to access care (33, 35). These structural access constraints make Australia a strong case for examining whether telehealth can reduce distance-related barriers in practice.

At the same time, rural-urban inequalities in Australia are not experienced uniformly.

Geographic disadvantage often intersects with other forms of social and structural disadvantage. In particular, the longstanding health disparities between Aboriginal and Torres Strait Islander peoples and non-Indigenous Australians are well documented and have been recognised both nationally and internationally as a matter of profound concern (36).

Throughout this thesis, "Aboriginal and Torres Strait Islander peoples" is used as the primary term when referring to the First Peoples of Australia. The term "Indigenous" is used only where required by direct citation context, in established compound terms such as "Indigenous data sovereignty" and "Indigenous-led research", or where reproduced from published

material. Other equity-relevant factors, including older age, lower educational attainment, lower income, disability, and cultural and linguistic diversity, may further compound barriers to care in rural and remote settings (4, 5, 7, 8, 37, 38). For this reason, rural-urban inequality in this thesis is not treated simply as a matter of place of residence, but as a manifestation of wider structural conditions that shape access to healthcare.

This context makes Australia especially relevant to the present study. The combination of universal health financing, geographically dispersed populations, longstanding rural and remote disadvantage, and rapid telehealth expansion creates a useful setting in which to ask whether digital models of care can mitigate geographic barriers without reproducing or amplifying existing inequalities (17-19, 28, 30, 39-43). The question is not simply whether telehealth increases service reach, but whether it does so in ways that are equitable across different populations and settings.

1.1.3 Telehealth and Digital Health Technologies: Definitions and Scope

Telehealth is discussed in this thesis within the broader field of digital health, but the two terms are not identical. Digital health is a broad umbrella concept referring to the use of digital technologies to support health system functions, health information exchange, service delivery, and patient care (28, 38, 44, 45). It includes, for example, electronic health records, health information systems, mobile health applications, remote monitoring technologies, and

telehealth services (21, 38, 44, 45). Digital health has increasingly been positioned as a strategic priority in health system strengthening, both internationally and in Australia (28, 38, 44, 45).

Telehealth, by contrast, refers more specifically to the delivery of healthcare and related activities through communication technologies across distance (46-49). Although telehealth became much more visible during the COVID-19 pandemic, it should not be understood as a purely pandemic-era development. Telehealth has a longer history and has been used for decades in different forms, including telephone-based consultations, video consultations, remote specialist input, store-and-forward approaches, and digitally supported monitoring and follow-up (18, 46-49). What the pandemic did was not create telehealth, but rather accelerate its uptake, expand its policy prominence, and normalise it more rapidly within mainstream care delivery (17, 18, 40-43, 46, 47).

For the purposes of this thesis, telehealth is defined as digitally enabled healthcare involving direct interaction between patients and healthcare providers, together with the surrounding infrastructure, governance, policy, and operational arrangements that make such care possible (46-49). This scope includes telephone- and video-based consultations, digitally supported referral and follow-up processes, and selected forms of supported remote care (46-49). It does not attempt to cover every domain of digital health. Rather, the focus is on telehealth as a service model through which questions of access, implementation, and equity can be examined empirically.

This definitional narrowing is deliberate. The thesis is concerned less with digital transformation in the broadest sense than with how specific telehealth services are conceptualised, designed, implemented, and experienced in ways that may either reduce or reinforce rural-urban health inequalities in Australia (17-21, 28). Telehealth is therefore treated not merely as a technology category, but as a form of service delivery embedded within wider social, policy, and organisational conditions.

In Australia, telehealth has become increasingly prominent as part of broader digital health development. Over time, digital health infrastructure has expanded through initiatives such as practice management systems, electronic prescribing, My Health Record, and national digital health strategies (39, 50-54). During the COVID-19 pandemic, telehealth in particular became a highly visible component of service continuity, with remote consultations used widely to reduce disruption to care and support ongoing access to primary and specialist services (40-43). However, the existence of telehealth services does not in itself guarantee equitable access. As later sections show, the relationship between telehealth and equity is more contingent and requires closer analysis.

1.1.4 Rural-Urban Health Inequalities in Australia and the Role of Telehealth

Telehealth is frequently described as a promising strategy for improving access to care, particularly where in-person services are scarce or travel burdens are high (17-19, 41-43). In

Australia, telehealth has been used to extend specialist input, reduce delays, support continuity of care, and improve convenience for people in rural and remote areas (18, 19, 40-43). It therefore has clear relevance to longstanding concerns about uneven service distribution and the health impacts of distance.

The potential advantages of telehealth are substantial. Telehealth may enable redistribution of healthcare resources across regions, support timely specialist input from metropolitan centres, reduce the need for travel, and offer greater flexibility in how care is delivered (14, 18, 42, 43, 55). In some contexts, it may also improve convenience for patients and families, support continuity of follow-up, and make better use of limited workforce capacity (14, 42, 43, 55).

These potential benefits explain why telehealth has often been framed as an important strategy for improving rural access.

However, the equity implications of telehealth are not straightforward. The same service model that reduces distance-related barriers may also create new obstacles related to connectivity, device access, affordability, digital literacy, privacy, trust, or cultural appropriateness (19-27). For some groups, telehealth may improve convenience without necessarily improving equitable access. For others, it may actually deepen exclusion if digital participation itself becomes a prerequisite for receiving timely care.

This tension is especially relevant in rural and remote Australia. Despite major investments in digital infrastructure, connectivity remains uneven and reliable access to internet services is still lower in many rural and remote locations than in metropolitan areas (56). Emerging

technologies such as low earth orbit satellite services may improve connectivity for some users, but affordability and equipment costs may remain limiting factors for disadvantaged households (57, 58). In addition to infrastructure constraints, effective use of telehealth often requires access to suitable devices, confidence in using digital platforms, the ability to interpret health information online, and trust in remote care processes (24-27). These requirements may disproportionately disadvantage older adults, people with lower educational attainment, some culturally and linguistically diverse populations, and others with lower levels of digital access or support (25-27).

Accordingly, telehealth should not be treated as inherently equitable simply because it is remote. Whether it improves equity depends on the interaction between service design and the broader social and system conditions in which it is implemented. In Australia, these conditions include the quality of digital infrastructure, the affordability of internet and devices, health workforce availability, service integration, service awareness, and the extent to which users can engage confidently and safely with digital care (19, 22-28, 30, 33-35, 39, 56-59).

This tension is central to the thesis. The study does not begin from the assumption that telehealth either improves or worsens equity in a universal way. Instead, it examines how telehealth interacts with existing structural conditions and whether, in practice, telehealth services are more likely to mitigate, reproduce, or reconfigure rural-urban health inequalities. Doing so requires an analytical approach that can capture both access outcomes and the

broader implementation conditions that shape those outcomes.

1.1.5 Theoretical and Conceptual Framework

This thesis is informed by two complementary strands of scholarship: (i) health equity and the social determinants of health, and (ii) healthcare access theory, particularly the 6A framework derived from Penchansky and Thomas and extended by Saurman (10, 13, 15, 16, 60, 61).

The health equity perspective emphasises that all people should have a fair opportunity to attain the highest possible level of health, and that achieving this requires attention to structural barriers and socially patterned disadvantage (10, 12, 13, 15). The social determinants of health perspective reinforces this by highlighting the role of income, education, employment, housing, geography, and other social conditions in shaping both health outcomes and healthcare access (6, 15, 16, 29). In the context of rural-urban health inequalities in Australia, these determinants are especially relevant because geographic remoteness interacts with service capacity, infrastructure, economic opportunity, and social disadvantage to shape both healthcare access and health outcomes (29-35).

To examine access more specifically, this thesis uses the 6A framework of healthcare access as an interpretive lens in Chapters 2 to 4: accessibility, availability, acceptability, affordability, adequacy, and awareness (60, 61). This framework provides a useful basis for

identifying which aspects of access are being addressed and which remain under-recognised in telehealth evidence and policy. It is particularly useful for structuring analysis of healthcare access outcomes across different types of literature and policy material.

However, telehealth also raises equity-relevant issues that are not fully captured by conventional access concepts alone. These include digital infrastructure and device access, digital capability, privacy and cybersecurity, governance and stakeholder participation, sustainability of enabling supports, and integration with the broader health system (21-28, 39, 44, 45, 56-59). For this reason, later chapters develop and apply a nine-dimension telehealth equity evaluation framework. Because that framework is an output of the thesis rather than a starting assumption, it is introduced here only as a forward signpost rather than as a fully established model. The role of this introductory chapter is to explain why such a framework becomes necessary, not to present its full development in advance.

Based on this theoretical and conceptual foundation, the broad logic of the thesis can be summarised as follows (Figure 1.1):



Figure 1.1 Theoretical logic

Figure 1.1 provides a simplified conceptual guide to the overall thesis logic. It is intended to show the broad relationship between social determinants, healthcare access, health outcomes, and health equity, rather than to represent the full complexity of causal pathways. Its purpose is heuristic: to orient the reader to the conceptual structure of the thesis.

To evaluate how telehealth may influence equity in healthcare access, this thesis uses the “6A” dimensions as an interpretive lens for access outcomes and maps these dimensions to telehealth service contexts (see Table 1.1).

Table 1.1 Access dimensions and their operationalisation in telehealth contexts

Dimension	Original Definition	Application in Telehealth
Accessibility	Location	Ease of digitally or physically accessing telehealth services, including addressing geographic and digital divides.
Availability	Supply and demand	Availability of telehealth providers, telecommunication infrastructure, and necessary equipment (internet, devices).
Acceptability	Consumer perception	Patient satisfaction, cultural appropriateness, privacy/security concerns, and quality of patient-provider interactions within telehealth consultations.
Affordability	Financial and incidental costs	Cost implications of telehealth services, including internet access, device acquisition, fees for consultations, and indirect savings from reduced travel.
Adequacy	Organization	Flexibility and user-friendliness of telehealth platforms, ease of scheduling appointments, responsiveness to patient digital literacy.

Dimension	Original Definition	Application in Telehealth
Awareness	Communication and information	Patients' awareness of telehealth services, including service availability, eligibility criteria, how to access, and potential health benefits.

While the 6A framework provides a robust foundation for analysing healthcare access, telehealth introduces additional determinants that are not fully captured by traditional access concepts alone. These include digital infrastructure and device access, user capability and support, privacy and trust, governance and participation, sustainability of enabling resources, and integration with the broader health system. As a preliminary roadmap for the reader, shows how the 6A access dimensions relate conceptually to the telehealth-specific dimensions that are developed more fully later in Chapter 5.

Table 1.2 shows how the 6A access dimensions relate conceptually to the telehealth-specific dimensions that are developed more fully later in Chapter 5.

Table 1.2 Conceptual mapping between the 6A access framework and the nine-dimension telehealth equity evaluation framework

6A Dimension	Nine-Dimension Component	Relationship
<i>Core dimensions (direct determinants of individual access and benefit)</i>		
Accessibility	Digital Infrastructure and Access	Direct extension: geographic accessibility expanded to encompass network coverage, device availability, and internet reliability

6A Dimension	Nine-Dimension Component	Relationship
Affordability	Economic Affordability	Direct extension: traditional healthcare costs expanded to include devices, data, and connectivity costs for patients and system-level costs for providers
Awareness	User Digital Literacy and Capacity	Broadened: from awareness of service existence to skills, confidence, and support mechanisms required to engage with digital platforms
Acceptability	Cultural Adaptation and Social Inclusion	Broadened: from cultural appropriateness of care to linguistic diversity, culturally responsive platform design, and community engagement
Adequacy	Service Quality and Clinical Outcomes	Refocused: from organisational fit to measurable clinical effectiveness, safety, and patient-centred care delivery via telehealth
<i>Supporting dimensions (structural conditions for sustained equitable services)</i>		
Availability	Healthcare System Integration	Restructured: from provider supply and demand to coordination between telehealth and face-to-face services, interoperability, and care pathways
—	Data Security and Privacy Protection	New dimension: addresses technical safeguards, user trust, and cybersecurity concerns specific to digital health delivery (identified as a gap in Ch 2-3)
—	Stakeholder Engagement and Collaborative Governance	New dimension: evaluates inclusion of diverse voices (patients, communities, providers) in programme design and implementation (identified as a key theme in Ch 4)
—	Sustainability and Policy Support	New dimension: assesses funding stability, policy continuity, and long-term operational viability (identified as systemic constraint in Ch 4-5)

Note: The 6A framework (Penchansky & Thomas, 1981; Saurman, 2016) is used as the interpretive lens in Chapters 2-4. The nine-dimension framework, developed in Chapter 5, extends and operationalises these access concepts for telehealth-specific equity evaluation. “—” indicates no direct 6A antecedent; these dimensions were identified through the iterative evidence synthesis across Chapters 2-5.

Accordingly, a central methodological contribution of this thesis is the later development and application of a practical, policy-relevant telehealth equity evaluation framework that integrates telehealth-specific determinants with established access concepts. In the structure of the thesis, Chapters 2 to 4 use the 6A lens to examine access-related evidence, frameworks, and policy; Chapter 5 develops and applies the nine-dimension framework to comparative case studies; Chapter 6 provides user-level evidence through stated preferences and willingness; and Chapter 7 integrates these strands to identify cross-cutting mechanisms, implications, and practical directions for more equitable telehealth.

1.2 Research Question and Objectives

1.2.1 Research Question:

How can health equity considerations be systematically assessed and enhanced in telehealth programmes, particularly those addressing rural-urban health inequalities in Australia?

1.2.2 Research Objectives:

To address this overarching research question, the thesis pursues six interlinked objectives aligned to the empirical chapters. These objectives are presented here as a roadmap for the thesis. References to the nine-dimension telehealth equity evaluation framework at this stage

are intentionally brief, because the framework itself is developed and justified later in Chapter 5. This section is therefore intended to orient the reader to the structure and logic of the thesis, rather than to present the framework as already fully established.

1. To systematically synthesise evidence on how telehealth influences health equity, with a focus on rural-urban differences in access and outcomes (Chapter 2).
2. To critically appraise and compare equity frameworks used in telehealth and digital health research, identifying common dimensions, gaps, and implications for evaluative practice (Chapter 3).
3. To examine Australian telehealth policies and strategies to assess the extent to which equity considerations are articulated, operationalised, and monitored (Chapter 4).
4. To conduct comparative case studies of Australian telehealth programmes to assess how equity is addressed in programme design and implementation, and to identify determinants that facilitate or hinder equitable access (Chapter 5).
5. To develop and apply a nine-dimension telehealth equity evaluation framework with a transparent scoring rubric to support systematic assessment across policy and programme contexts (Chapter 5).
6. To quantify public preferences for equity-relevant telehealth service attributes and explore heterogeneity across geography and digital capacity using a Best-Worst Scaling (Case 1) stated-preference experiment (Chapter 6), and to synthesise insights across all components to generate actionable recommendations (Chapter 7).

To provide an overview of how these objectives are addressed across the thesis, Table 1.3 maps each research objective to its corresponding chapter, study design, data source, and key output. The thesis follows a sequential, multi-level logic: synthesising existing evidence and frameworks (Chapters 2-3), examining how equity is embedded in policy and programme contexts (Chapters 4-5), quantifying end-user preferences (Chapter 6), and integrating findings into actionable recommendations (Chapter 7).

Table 1.3 Thesis roadmap: mapping research objectives to chapters, methods, and key outputs

Research Objective	Chapter	Study Design	Data Source	Key Output
RO1. Synthesise evidence on telehealth and health equity across access dimensions	Ch 2	Systematic review of reviews	42 reviews (2012-2023)	Equity coverage mapped to 6A framework; identification of under-examined dimensions
RO2. Appraise equity frameworks for digital health applicability	Ch 3	Systematic review and narrative synthesis	13 equity frameworks	Three-level integrated framework; gaps informing nine-dimension framework development
RO3. Assess equity integration in Australian telehealth policies	Ch 4	Policy review with structured content analysis	15 national and state/territory policy documents (2019-2024)	Equity scoring matrix (0-4) across five thematic domains; gap analysis with actionable recommendations
RO4. Compare equity in telehealth programme design and implementation	Ch 5	Comparative case study	RPA Virtual Hospital (metropolitan) and VRGS (rural)	Distinct equity profiles; system-level constraints identified via nine-dimension framework

Research Objective	Chapter	Study Design	Data Source	Key Output
RO5. Develop and apply nine-dimension telehealth equity evaluation framework	Ch 5	Framework development with transparent scoring rubric	Literature synthesis (Ch 2-3), policy analysis (Ch 4), case study application (Ch 5)	Nine-dimension framework with 0-4 scoring rubric; demonstrated through comparative application
RO6. Quantify user preferences for equity-relevant telehealth attributes	Ch 6	Cross-sectional survey; Best-Worst Scaling (Case 1)	2,882 adults in NSW, Australia	Attribute-level preference hierarchy across 24 telehealth service features; geographic and demographic heterogeneity in priorities
Integration and synthesis	Ch 7	Integrative discussion	Findings from Ch 2-6	Five cross-cutting findings; framework refinement and implications; policy recommendations; future research agenda

Note: RO = Research Objective; Ch = Chapter; VRGS = Virtual Rural Generalist Service; RPA = Royal Prince Alfred; BWS = Best-Worst Scaling; NSW = New South Wales.

1.3 Conclusion

This introductory chapter has established the conceptual and empirical foundation for examining equity considerations in Australian telehealth services. It has clarified the distinction between health inequality, inequity, disparities, and equity, and situated the thesis within the Australian context of persistent rural-urban health inequalities despite universal health system financing and substantial telehealth expansion. It has also outlined why telehealth should not be assumed to be inherently equity-enhancing, but instead should be assessed in relation to the wider social, infrastructural, service, and governance conditions in

which it is implemented.

The chapter has positioned this research within broader debates on health equity, digital health transformation, and rural health service delivery. It has presented the central research question and six linked objectives that guide the thesis. It has also introduced the conceptual logic of the thesis: the 6A framework is used as the initial interpretive lens for examining access-related evidence, frameworks, and policy, while a telehealth-specific nine-dimension evaluation framework is developed later in the thesis to examine implementation and programme-level equity considerations more systematically.

Australia provides a particularly useful setting for this work because it combines universal Medicare financing, geographically dispersed populations, longstanding rural and remote disadvantage, and rapid telehealth expansion. Together, these features create an important context for examining both the opportunities and the risks of telehealth as a strategy for addressing health inequalities. The evidence generated through this thesis, spanning systematic reviews, policy analysis, comparative case studies, and a stated-preference experiment, is intended to inform more equitable telehealth design, implementation, and evaluation in Australia and in comparable health systems.

The following chapters present this evidence in sequence. Chapter 2 examines how existing telehealth literature addresses equity across multiple access dimensions. Chapter 3 evaluates equity frameworks for their relevance to digital health contexts. Chapter 4 examines Australian telehealth policies and strategies through an equity lens. Chapter 5 develops and

applies the nine-dimension framework to two Australian telehealth programmes. Chapter 6 examines geographic and demographic variation in telehealth willingness and user preferences through a Best-Worst Scaling study. Chapter 7 then integrates the findings across these components to identify cross-cutting mechanisms, implications, and future directions for advancing telehealth equity in practice.

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Chapter 2 Addressing Health Service Equity through Telehealth: A Systematic Review of Reviews

The material in this chapter has been published as:

Wang S, Von Huben A, Sivaprakash PP, Saurman E, Norris S, Wilson A. Addressing health service equity through telehealth: A systematic review of reviews. *Digital Health*. 2025;11. doi:10.1177/20552076251326233.

A statement of the specific contribution of the co-authors can be found in Appendix B.

Purpose of chapter

To synthesize evidence on whether and how telehealth influences health service equity, a systematic review of reviews was undertaken. This chapter summarizes findings on telehealth's impacts on disparities in healthcare access and related outcomes, with particular attention to rural-urban inequalities and other groups experiencing barriers to care. The results establish an evidence base that informs the equity framework development and the subsequent empirical studies presented in later chapters of this thesis.

2.1 Abstract

Objective: To synthesize existing reviews on the impact of telehealth programmes on health service equity in non-urban areas, focusing on six dimensions of access: accessibility, availability, acceptability, affordability, adequacy, and awareness.

Methods: We included systematic and non-systematic reviews published from 2012 to 2023 on telehealth interventions in rural or remote settings. Content was mapped to the six dimensions, and coverage within each dimension was rated based on predefined criteria.

Results: A total of 42 reviews (43% systematic) were identified. Most reviews (90.5%) addressed at least one dimension, yet comprehensive coverage was rare. Acceptability had the highest number of “good” ratings (23.8%), while awareness was the least explored. Gaps included digital literacy, infrastructure challenges, and cultural barriers, factors critical to equitable telehealth access. Cost-effectiveness analyses were also limited, leaving affordability underexamined.

Conclusion: Telehealth shows promise for improving healthcare access in non-urban regions. However, existing reviews often provide incomplete assessments across the six dimensions. This suggests a need for clearer, more robust evaluation frameworks to ensure more comprehensive reporting of equity impacts in telehealth research.

2.2 Introduction

Although the quality and accessibility of healthcare has improved significantly over recent decades, there are still considerable regional differences in the utilisation and outcomes of medical services (1). These discrepancies are particularly pronounced in non-urban areas (2). Residents in these areas often face many challenges in accessing high-quality medical services, including scarcity of medical facilities, lack of professional medical personnel, and heavier travel burden (3). As a result, their health outcomes are often poorer than residents in urban areas.

Telehealth provides a promising avenue for enhancing equity of access to healthcare services, especially for people living in non-urban settings. Ideally, telehealth utilizes cutting-edge information and communication technologies to provide cross-regional healthcare services, enabling patients to receive medical consultations and services in their location from remote experienced healthcare professionals (4). Telehealth covers various forms, including teleconsultations, teleradiology, telepathology, and remote health education (5). With the advent of smartphones and high-speed internet, telehealth can further raise awareness of available healthcare options and accessibility of services for people in non-urban regions (6, 7).

However, while the potential of telehealth is widely recognized, current research indicates mixed results on its actual impact and effectiveness (8). Some studies have found that telehealth can significantly improve patients' health outcomes and access to medical services

(9-12), for example in chronic disease management or mental health support (11, 13-15).

Others, however, report limited or inconsistent effects (16-19). This discrepancy may be due to multiple factors, such as programme design, patient demographics, digital literacy, technology infrastructure, cost and reimbursement policies, as well as cultural acceptance and privacy concerns—all of which may influence whether telehealth programs can be successfully implemented in real-world non-urban contexts.

Given these complexities, we focus on the multi-dimensional concept of healthcare access, which encompasses at least six interrelated dimensions: accessibility, availability, acceptability, affordability, adequacy, and awareness (20, 21). Originally proposed by Penchansky and Thomas (1981) (22), and later extended by Saurman (2016) (20), these dimensions provide a framework for examining why telehealth may or may not address the healthcare challenges faced by non-urban populations. For example, digital literacy directly affects the “awareness” dimension, since a lack of familiarity with technology can hinder patients from even attempting telehealth consultations (23). Similarly, insufficient broadband infrastructure is related to “accessibility” (24), while inadequate reimbursement mechanisms and technology maintenance costs are related to the “affordability” dimension (4). Moreover, cultural acceptance of telehealth, especially in communities with strong religious or traditional beliefs, falls under “acceptability” (25).

We selected these six dimensions for their relevance to telehealth, as they collectively address both systemic barriers (e.g., infrastructure, service capacity) and patient-centred challenges

(e.g., affordability, cultural acceptability). We acknowledge, however, that these dimensions are neither perfectly mutually exclusive nor collectively exhaustive. For instance, both Availability and Adequacy may address service volume and operating hours. Moreover, supply- versus demand-side factors (providers vs. patients) are not uniformly separated within each dimension. Despite these overlaps, the 6A model remains widely recognized in health services research for systematically examining healthcare interventions. To minimize confusion and ensure a comprehensive but flexible analysis, we refined each dimension's definition (see Table 2.1) to emphasize its primary focus. For example, in our overview Availability focuses on whether sufficient services/resources exist to meet anticipated demand, whereas Adequacy emphasizes how services are organized and structured (e.g., appointment systems, after-hours care) to effectively meet clinical needs.

We recognize that further refinements could involve explicitly distinguishing supply-side (e.g., technical infrastructure, provider capacity) from demand-side (e.g., patient resources, acceptance) within each dimension. Indeed, additional dimensions—such as sustainability or cultural competency—could be considered as stand-alone dimensions in future frameworks. For now, we maintain that the 6A structure offers a pragmatic, well-established lens for identifying critical gaps and guiding policy and practice in telehealth access. By framing our analysis through these six dimensions, we aim to provide a more structured and nuanced perspective on telehealth's potential and limitations.

Table 2.1 Refined definitions and examples of the six dimensions of access

Dimension of access	Definition	Core Focus	Typical Supply-Side Factors	Typical Demand-Side Factors	Examples
Accessibility ^a	Location	Spatial & logistical proximity	<ul style="list-style-type: none"> • Geographic location of services • Adequate roads/telecom infrastructure to reach users 	<ul style="list-style-type: none"> • Patient travel time/cost • Patient capacity to use telehealth platforms (e.g., internet access, basic tech literacy) 	<ul style="list-style-type: none"> • “Is there a clinic or telehealth hub within reasonable travel time?” • “Are broadband speeds sufficient for video consultation at the patient’s home?”
Availability ^a	Supply and demand	Adequate capacity	<ul style="list-style-type: none"> • Enough health professionals • Sufficient equipment or technology for telehealth • Service volume meets community needs 	<ul style="list-style-type: none"> • Demand level for specific health services (e.g., specialized care, chronic disease management) • Timing of demand (peak vs. off-peak) 	<ul style="list-style-type: none"> • “Does the telehealth service have enough professionals or equipment to handle the number of potential users?” • “Are consult slots available at needed times?”

Dimension of access	Definition	Core Focus	Typical Supply-Side Factors	Typical Demand-Side Factors	Examples
Acceptability ^a	Consumer perception	Cultural & social fit	<ul style="list-style-type: none"> • Provider willingness to offer telehealth • Provider attitudes toward cultural/religious practices 	<ul style="list-style-type: none"> • Patient cultural/religious beliefs • Personal preferences or comfort with technology or care mode 	<ul style="list-style-type: none"> • “Do patients feel comfortable receiving care via telehealth given their cultural or religious practices?” • “Do providers trust telehealth’s clinical effectiveness?”
Affordability ^a	Financial and incidental costs	Economic feasibility	<ul style="list-style-type: none"> • Costs for providers to implement/maintain telehealth • Insurance coverage/reimbursement models 	<ul style="list-style-type: none"> • Out-of-pocket costs for patients • Hidden costs (e.g., internet data plans, equipment) 	<ul style="list-style-type: none"> • “Can low-income households afford the broadband or devices needed for telehealth?” • “Are telehealth services reimbursed at parity with in-person visits?”
Adequacy ^a	Organization	Service design & organization	<ul style="list-style-type: none"> • Operational workflows (referral, after-hours, appointment systems) • Facility readiness (e.g., telehealth equipment) 	<ul style="list-style-type: none"> • Patient ability to navigate appointments and schedules • Suitability of the service for diverse clinical needs 	<ul style="list-style-type: none"> • “Are after-hours telehealth services available for urgent consultations?”

Dimension of access	Definition	Core Focus	Typical Supply-Side Factors	Typical Demand-Side Factors	Examples
					<ul style="list-style-type: none"> • “Do patients with complex conditions receive adequate follow-up via telehealth?”
Awareness ^b	Communication and information	Knowledge & information exchange	<ul style="list-style-type: none"> • Provider outreach efforts • Public health campaigns • Clear communication channels to reach communities 	<ul style="list-style-type: none"> • Patient familiarity with telehealth • Community education about benefits/limitations 	<ul style="list-style-type: none"> • “Do patients know telehealth options exist in their region?” • “Do healthcare professionals understand cultural factors that might influence patient uptake?”
<p>^a The five dimensions of access identified by Penchansky and Thomas (1981).</p> <p>^b A sixth dimension added by Saurman (2016) to emphasise the role of communication and information.</p>					

Objectives

This study aims to provide a comprehensive synthesis of existing reviews on the impact of telehealth programmes on health service access in non-urban areas. By examining the multiple dimensions of access, our objective is to fully understand how telehealth can shape healthcare in non-urban areas and how the design and evaluation of telehealth services might be optimized to fully realise the potential of these approaches to healthcare delivery.

Our objective is to provide insights for health policy makers, healthcare providers, and researchers to improve the design and reporting of telehealth research, with the ultimate goal of maximizing the quality and outcomes of healthcare services in non-urban areas.

2.3 Methods

2.3.1 Search strategy and inclusion criteria

This systematic review adheres to the PRISMA guidelines and is registered in the PROSPERO (CRD42023448755). Literature searches were conducted in Medline, Embase, and CINAHL (EBSCO). The initial search was undertaken between May and July 2023, with an update in August 2023. Keywords used were “telehealth,” “telemedicine,” “health inequities,” “rural health services,” and “access”. Table 2.2 presents the inclusion and exclusion criteria. We included both synchronous (real-time) telehealth interventions (e.g., audio-only calls, interactive video consultations) and asynchronous (store-and-forward) modalities (e.g., remote patient monitoring, web-based platforms) to capture the diverse range of telehealth practices. Reviews focusing exclusively on telephone-based support or text messaging were included if they met our other eligibility criteria (i.e., addressing at least

one dimension of access for non-urban populations). No limits were placed on the outcomes or access measures reported by the reviews. Full text review of all candidate reviews was undertaken, and reviews were excluded if there was insufficient information to confirm the methods used. The reference lists of included papers were hand searched for any additional papers not identified via the electronic literature searches. Details of the search strategy are in Table A 1 and a PRISMA (2020) flowchart is shown as Figure 2.1. This study is a systematic review of reviews and did not require human research ethics approval, as it does not directly involve human participants or primary data collection.

Table 2.2 Summary of the inclusion and exclusion criteria applied to published review articles

	Inclusion criteria	Exclusion criteria
Study Type	Peer-reviewed systematic or non-systematic review article.	Primary research studies, case reports, conference abstracts, editorials.
Publication Time Span	January 2012 - August 2023	Prior to 2012
Research Content	<p>Studies focusing on telehealth in non-urban settings, addressing at least one dimension of access: availability, accessibility, acceptability, affordability, adequacy, and awareness.</p> <p>Studies that address telehealth in both urban and non-urban settings are included if they provide substantial content and relevant findings concerning non-urban environments related to at least one of these dimensions of access.</p>	<p>Studies addressing telehealth in non-urban settings but failing to engage with any of the following dimensions of access: availability, accessibility, acceptability, affordability, adequacy, and awareness.</p> <p>Studies focusing solely on urban telehealth without substantive data or findings related to non-urban settings.</p>
Outcome Variable	Articles discussing or mentioning the actual impact of telehealth programmes on healthcare service access, whether they have been directly studied or merely mentioned.	Articles that do not discuss or mention the impact of telehealth on healthcare service access.
Language	English	Non-English articles

2.3.2 Data Extraction

After de-duplication, two authors (SW, AW) independently screened article titles, abstracts, and full texts for inclusion, with adjudication by a third author (SN or AvH) if discrepancies arose, with final decisions resolved by consensus. The following information was extracted using pre-agreed data extraction tables: first author, publication year, keywords, review type, corresponding author's country, countries or regions of interest, study aim, setting, diseases of interest, search details (databases searched, search span, number of included studies), and the Population Intervention Comparator Outcome (PICO) elements of their research question(s).

In addition to the details mentioned, we also extracted data related to the dimensions of healthcare access as defined by our study's conceptual framework. This included whether and how each review addressed the issues of availability, accessibility, affordability, acceptability, adequacy, and awareness of health services. During data extraction, if elements overlapped, we categorized them according to their predominant dimension (e.g., if a review discussed after-hours service, we coded that under Adequacy rather than Availability). To identify and assess these dimensions, we employed a structured data extraction form that included specific fields for each dimension. This form was developed based on the review's initial aims and objectives. The dimensions of healthcare access were then systematically analysed for each review during the data extraction phase. This analysis informed the subsequent synthesis and discussion of how well the included studies addressed each dimension of access within their respective scopes and contexts.

2.3.3 Assessment of included studies

There was no single quality assessment tool that could be applied across the range of review types included in our umbrella review. Instead, we inferred quality based on their reporting against the following minimum information: key details of their search strategy (databases searched, search dates and search span) and whether quality assessment was undertaken of included primary studies. Quality was determined as follows: Good, details provided for all minimum information; Fair, details provided for either the search strategy or quality assessment of primary studies; Poor, no details provided for any of the minimum information set (Table A 2).

2.3.4 Analysis of included studies

Judgements were made by the authors regarding the extent to which each included review addressed each of the six dimensions of access. To systematically assess the coverage of each dimension of access, we developed four levels of evaluation criteria (Table 2.3). These criteria emphasise specific indicators and the extent to which all indicators were addressed by the include reviews. For example, a “Good” rating required the article to: (1) address the dimension as a primary focus or one of the key components; (2) provide data and/or detailed analysis related to the dimension; and (3) offer actionable conclusions or recommendations. In contrast, a “Fair” rating required the article to address the dimension with some depth but without meeting all the criteria for a “Good” rating. Examples of how these ratings were applied during the evaluation process are included in Table 2.3. For instance, articles rated as “Good” for affordability provided detailed cost-effectiveness analyses, while those rated as “Poor” merely mentioned affordability as a limitation or area for future study without supporting data. Importantly, these ratings provided a consistent framework for us to judge

the depth of coverage for each dimension of access within each review, but they do not necessarily reflect the methodological quality of the included reviews.

Additionally, we have constructed a heatmap (Table 2.4) to visualize these ratings, where color intensity corresponds to the percentage of reviews in each rating category. The heatmap was created using Excel, applying a gradient from light blue to dark blue to indicate increasing coverage percentages.

The ratings were developed using an initial sample of 42 reviews, with detailed co-review by all authors to define, expand, and then refine the criteria before application of the final criteria to the full set of included reviews by one author (SW). To ensure the reliability and consistency of the ratings, a second reviewer (PS) conducted blinded judgements on a random 20% of the sample. Instances where the two reviewers' assessments differed by more than one-level on the rating scale were flagged for further discussion. In cases where a consensus could not be reached through discussion, a third reviewer (AW) was brought in to arbitrate. This reviewer independently assessed the contested dimension(s) and facilitated a final decision.

Meta-analyses were not conducted because of the wide variety of outcomes reported across the reviews, and because of the potential for individual primary research studies to be included in multiple reviews.

Table 2.3 Evaluation criteria of the coverage of dimensions of access

Rating	Description	Examples
Not Covered	The dimension of access is not mentioned at all within the article.	The review does not refer to any element related to the dimension (e.g., no mention of accessibility or availability).
Poor	The dimension is acknowledged, but only briefly, often in the discussion as a direction	The review mentions affordability in the discussion section, but does not delve into its

Rating	Description	Examples
	for future research or as a limitation of the current study. This rating also applies if data regarding the topic were collected by primary study authors, but findings were not discussed in the review article.	details or implications.
Fair	The dimension is addressed more extensively than in ‘Poor’ articles, but not as thoroughly as in ‘Good’ articles. Coverage goes beyond a mere mention but lacks sufficient detail, examples, or robust analysis.	The review discusses awareness and provides some relevant data, but does not provide an exhaustive analysis.
Good	The article comprehensively addresses the dimension, presenting relevant data, critical insights, and/or contextual analysis that illustrates how this dimension influences telehealth access. The review may also suggest evidence-based strategies or best practices. This represents the gold standard of coverage within the context of the article’s topic.	A review devoted a large amount of content to the acceptability, including qualitative and quantitative data, and offered strategies for improvement.

2.4 Results

2.4.1 Characteristics of the included reviews

The electronic and manual searches yielded 574 unique articles for title and abstract review, 81 underwent full-text screening, and 42 met the inclusion criteria (Figure 2.1).

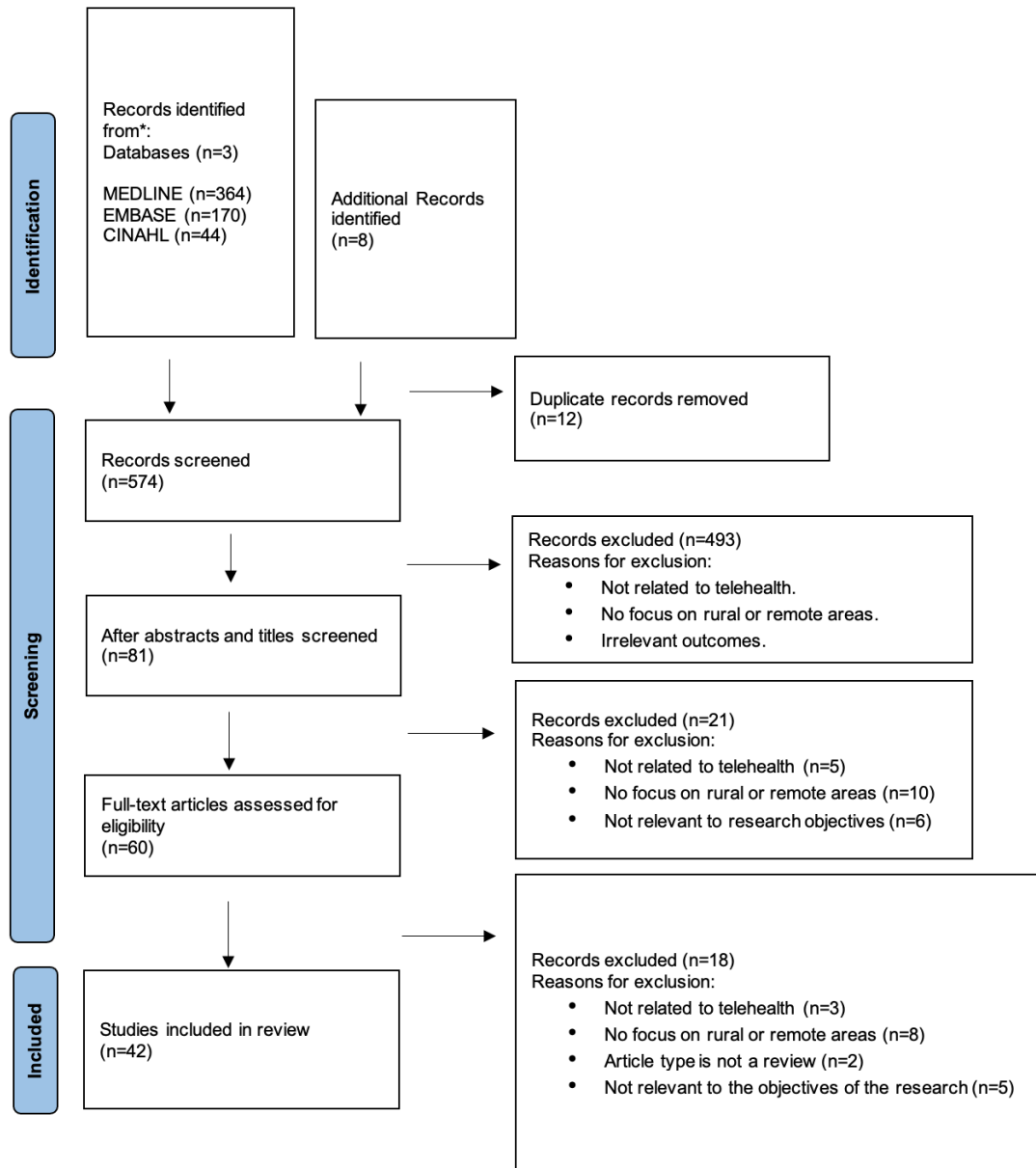


Figure 2.1 PRISMA flowchart of article review and selection

Table A 3 provides an overview of the 42 reviews. Between 2012 and 2023, the frequency of publication of reviews on this topic has increased, with 50% (n=21) published in the last two years of the search span. The most common type of review was systematic (43%, n=18), followed by literature (24%, n=10), scoping (12%, n=5), rapid (9%, n=4), narrative (7%,

n=3), and ‘comprehensive’ (5%, n=2). Most reviews focused on peer-reviewed literature (93%, n=39), 3 (7.1%) included grey literature, and 13 (31%) undertook quality assessment of the primary studies included in their review. Of the included reviews, 12 (28.6%) were judged to be of good quality, indicating a comprehensive reporting of both their search strategy and the quality assessment of primary studies, 23 (54.8%) were fair quality, suggesting that while they provided some necessary information there was room for improvement in their reporting, and 7 (16.7%) were poor quality, lacking in detail for what we judged to be the minimum reporting criteria.

The top three countries for corresponding author were the United States (50%, n=21), Australia (19%, n=8), and Canada (14.3%, n=6). Half the reviews (50%, n=21) did not specify any limits or focus by country or region. The most common types of condition studied were chronic diseases (31%, n=13), although, the majority (n=20, 48%) had no focus on specific diseases or symptoms. The PICO elements in the majority of reviews (95.2%, n=40) were aligned with our PICO criteria.

2.4.2 Analysis of findings from the included reviews

Each of the 42 included reviews described at least one of the six dimensions of access, with many reviews addressing multiple dimensions (see Table A 4). To illustrate this variation in coverage, Table 2.4 presents a heatmap showing the frequency of “Not Covered,” “Poor,” “Fair,” and “Good” ratings for each dimension across all reviews. As the table shows, coverage is unevenly distributed among the six dimensions.

Whilst all included reviews addressed at least one dimension of access, the coverage of each dimension was generally low. The most frequent assessment of dimension coverage was

‘poor’ (70.2% overall, 146/208; where the denominator is the total number of reviews (42) multiplied by the number of dimensions (6), minus the number of Not Covered results (44)). No review was judged to have ‘good’ coverage for all six dimensions. The dimension with the highest number of reviews with a ‘good’ rating was Acceptability (23.8%), but for the other dimensions, the number of reviews with a ‘good’ rating was lower (2% to 14%) (Table 2.4). This pattern is also evident in the heatmap, where cells corresponding to “poor” ratings dominate most dimensions except Acceptability.

There was no significant association between the quality of the reviews and the extent of coverage of the access dimensions. This suggests that while quality assessment is crucial for evaluating the methodological soundness of a review, it may not fully capture the review’s comprehensiveness in addressing the multifaceted issue of access to telehealth service. Accordingly, narrower coverage of certain dimensions should not be interpreted as an inherent shortcoming of the review itself, but may instead reflect differences in scope, intervention stages, or study objectives.

Overall, Table 2.4 highlights substantial gaps in how existing telehealth reviews address the six dimensions of access, indicating opportunities for more holistic evaluations in future research.

Table 2.4 The number (percentage) of reviews that covered or did not cover each dimension of healthcare access

Dimension of Access	Covered				Not Covered
	Good	Fair	Poor	Total	n (%)
	n (%)	n (%)	n (%)	n (%)	
Accessibility	3 (7.1%)	5 (12.0%)	30 (71.4%)	38 (90.5%)	4 (9.5%)

Availability	1 (2.4%)	5 (11.9%)	28 (66.7%)	34 (81.0%)	8 (19.0%)
Acceptability	10 (23.8%)	11 (26.2%)	17 (40.5%)	38 (90.5%)	4 (9.5%)
Affordability	6 (14.3%)	10 (23.8%)	19 (45.2%)	35 (83.3%)	7 (16.7%)
Adequacy	2 (4.8%)	7 (16.7%)	29 (69.0%)	38 (90.5%)	4 (9.5%)
Awareness	2 (4.8%)	1 (2.4%)	23 (54.8%)	26 (62.0%)	16 (38.0%)

2.4.3 Accessibility

Out of 42 reviewed articles, 90.5% (38/42) addressed accessibility issues in telehealth, but the majority of these (n=30) had “Poor” coverage. Reviews rated as having ‘Good’ coverage of this dimension (7.1%) discussed important factors, such as the ease of use of technology (digital literacy), having a stable and reliable internet connection (telecommunications infrastructure), and user-friendly platforms (e.g., tailored for the elderly or disabled). Additionally, the reviews with ‘good’ coverage of this dimension highlighted how concerns about patient data privacy and environmental privacy may limit the accessibility of virtual care (26-28).

2.4.4 Availability

Availability was covered by 81% (34/42) of the reviews, but the majority of these reviews (n=28) had ‘Poor’ coverage. Reviews that had ‘Good’ (2.4%) or “Fair” (11.9%) coverage included comprehensive discussion on aspects including the scope of service provided by telehealth, the technological infrastructure required to support these services, financial constraints, cultural barriers and regional disparities in the provision of services (such as the

availability of sufficiently trained professionals to results) (18, 26, 29-32).

2.4.5 Acceptability

Thirty-eight reviews (90.5%) covered issues related to acceptability. There was better coverage of this dimension overall; 21 reviews rated ‘good’ or ‘fair’ and 17 rated ‘poor’. Reviews with ‘Good’ coverage delved into the attitudes and perceptions of both patients and providers towards telehealth. From the patient’s perspective, common barriers to acceptability included factors such as age, education level, digital literacy, insurance coverage, cultural sensitivity, and a lack of understanding about, or familiarity with, the services. On the provider side, challenges included concerns related to cost, reimbursement, legal liabilities, privacy, data security, and the efficiency of telehealth services. Authors noted that these factors could make providers hesitant to fully embrace telehealth, thereby impacting its overall acceptability (17, 26, 28, 29, 32-34).

2.4.6 Affordability

Costs and economic issues were covered by 35/42 reviews (83.3%); 19 reviews had ‘poor’ coverage of this dimension. The six reviews with ‘Good’ coverage discussed technology costs, equipment costs, and insurance coverage as major barriers (11, 26, 27, 35, 36). Although affordability was considered in 35 reviews, only six undertook a specific cost-effectiveness analysis (8, 26, 32, 37-39). Ten reviews mentioned potential cost savings but lacked any formal type of economic analysis (10-13, 17, 18, 27, 29, 34, 40).

2.4.7 Adequacy

Adequacy was mentioned in 38 (90.5%) reviews, 29 of which had ‘Poor’ coverage. In the 2 reviews rated as having ‘good’ coverage, there was discussion around whether telehealth services can meet patients’ clinical needs, and whether patients could effectively utilize these services. These concepts included the ability of the service to accommodate patients (especially after-hours), the efficiency of the appointment system, and the suitability of facility structures, particularly for individuals with auditory, visual, or cognitive impairments, and the elderly. (11, 16, 26, 27, 29, 32).

2.4.8 Awareness

Awareness had the lowest coverage of the 6 dimensions with only 26 reviews addressing it, and only 3 of these reviews rated as ‘Good’ or ‘Fair’. Awareness relates to the perception and understanding of telehealth services by patients, providers, and the community. Reviews mentioned barriers to awareness of telehealth services such as older age, lower educational levels, and digital literacy. These factors contribute to a lack of understanding among patients, which refers to their limited knowledge or recognition of the availability, functionality, or potential benefits of telehealth services. This lack of understanding can hinder patients’ ability to effectively access and utilize telehealth services (17, 31).

2.5 Discussion

Telehealth continues to show promise in bridging healthcare gaps for non-urban populations. Our review highlights notable strengths and weaknesses in telehealth research across the six

dimensions of access. While telehealth improves Availability by extending specialist care to remote regions (34, 41), Accessibility remains constrained by infrastructure deficits, such as inadequate broadband and limited access to smartphones, which hinder large-scale telehealth implementation (13, 16, 27, 31, 42). Additionally, digital literacy challenges hinder effective use of telehealth platforms (19, 31, 42), particularly among elderly or low-literacy groups (31). Ensuring connectivity, user-friendly technologies, and ongoing support for digital skills will be crucial for improving the Accessibility and Availability of telehealth. Addressing these issues requires targeted investments in broadband infrastructure and community-based digital literacy training programs.

Overall, patients report satisfaction with telehealth when it saves time and effort (8, 10, 26, 38, 41, 43). However, cultural acceptability remains underexplored in certain contexts (13, 19, 33, 44-46). Strict religious practices, traditional health beliefs, or mistrust of technology can limit telehealth adoption (19, 33). Designing culturally sensitive telehealth platforms, incorporating translation services and respectful engagement with community-specific values is critical to overcoming these barriers. For instance, involving local leaders can build trust and improve acceptability among hesitant populations (19, 31). Additionally, providers' willingness to adopt telehealth may be tempered by concerns about effectiveness, legal liability, and technical limitations (26, 28, 47). Efforts to develop culturally adaptable telehealth solutions and offer targeted educational initiatives can increase confidence among both patients and providers, expanding telehealth's reach in diverse communities.

Although telehealth can reduce patient-related costs like transportation (8, 13-15, 17, 34, 39), affordability remains a concern for both providers and users. Only a few reviews reported formal cost-effectiveness studies (8, 26, 32, 37-39), and it is acknowledged that reimbursement models often lag behind technological innovations (34, 35, 46, 48). But initial

hardware expenses, maintenance costs, and lower reimbursement rates for telehealth services may undermine its economic viability (34, 35, 46). Several strategies can address affordability challenges: First, subsidy programs and grants could help low-income households overcome initial setup costs (42). Second, Policymakers and insurers could collaborate to establish standardized reimbursement rates for telehealth services, thus improving financial predictability for providers and patients (35). Third, investment in cost-efficient technologies and partnerships with internet providers can lower the overall cost of telehealth delivery (29). Future research should prioritize economic evaluations to identify sustainable models for telehealth implementation.

Adequacy reflects whether telehealth services are organized to meet patients' clinical needs. While telehealth shows promise in managing chronic conditions, such as Type 2 diabetes and mental health counseling (10, 14, 26, 37, 46), gaps remain in ensuring its adequacy for complex or specialized care (8, 19, 27, 31). Many reviews noted a lack of clinical outcome measurements, and relied instead on process-focused metrics (8, 36, 49-51). As telehealth increasingly becomes a mainstream mode of medical service delivery, more rigorous, outcome-based evaluations are needed to ensure that all patients benefit from telehealth in both routine and specialized contexts.

Many reviews highlight that telehealth's success depends as much on awareness as on technical delivery (11, 15, 26, 28, 31, 34, 49). Knowledge gaps persist among patients and healthcare providers, particularly in low-literacy or low-resource environments (14, 17, 27, 32, 52). At least four strategies have been identified to address these gaps.: First, engagement with local leaders, community health workers, and patient advocacy groups to design culturally tailored campaigns that highlight telehealth's benefits (19, 31);. Second, creating comprehensive training modules for healthcare professionals, focusing on culturally

appropriate communication strategies and a nuanced understanding of community needs (33, 38, 45). Third, collaborating with technology developers to simplify interfaces, prioritize language-accessible features, and incorporate assistive technologies for users with low digital literacy (44). Fourth, developing and administering regular surveys to measure public knowledge about telehealth, identifying misconceptions or barriers that can be addressed through targeted interventions (16). Future research is needed to evaluate the impact of these strategies on telehealth adoption and equity.

Throughout the 6A dimensions, key barriers—namely digital literacy deficits, infrastructure shortcomings, and cultural factors—frequently intersect and amplify one another. For instance, limited infrastructure hinders both Availability and Accessibility, while cultural acceptability affects community readiness (under Acceptability) and communication strategies (under Awareness). Addressing these barriers systematically and contextually is essential for truly equitable telehealth.

We acknowledge that many of the reviews we included focused on specific intervention stages (e.g., early feasibility vs. larger-scale implementation) and thus naturally emphasized one or two dimensions. For instance, reviews centered on pilot studies often highlighted Acceptability and Awareness, whereas reviews on more mature telehealth programs paid closer attention to Affordability or Adequacy. In Table 2.4, we provide an overview of how many reviews covered each dimension at various levels (Not Covered, Poor, Fair, Good). This distribution indicates that although most reviews did not address all six dimensions comprehensively, many offered in-depth insights into particular aspects of telehealth access. We do not interpret such narrower scope as an inherent shortcoming in a review, but rather a reflection of each review’s objectives and the maturity stage of the telehealth interventions being evaluated.

Each dimension of access offers a unique lens through which equity of telehealth services can be evaluated. Each dimension dynamically interacts with the others, allowing us to understand the barriers and facilitators to telehealth at the system level, providing a holistic view for policymakers, practitioners and stakeholders aiming to fully harness the potential of telehealth. Going forward, we encourage future reviews to adopt a more holistic framework where feasible, exploring multiple dimensions simultaneously. Future research should aim to fill the gaps identified in our discussion, particularly by conducting rigorous, outcome-based studies that provide a deeper understanding of how these dimensions affect real-world telehealth implementation. To support such activity, we aim to contribute a framework that is not only theoretically robust but also pragmatically informative, to guide the evolution of telehealth in a way that maximizes benefits for all users across diverse settings.

2.6 Limitations

This systematic review of reviews focused primarily on telehealth interventions in non-urban areas, so the findings might not be generalizable to urban settings or other healthcare delivery models. The studies included in the review varied in terms of study design, intervention, and outcomes. This heterogeneity could influence the synthesis of results and the conclusions drawn, but simultaneously highlights the breadth of applications for telehealth and the need for consistency in assessment.

The field of telehealth is rapidly evolving with technological advancements, and some of the reviews included in this overview might not reflect the current state of telehealth technology and its capabilities. Nonetheless, 50% of the included studies were published recently, between 2021 and 2023. Even though older articles may have studied telehealth technologies that have been superseded, we cannot assume that their overall findings and insights are no

longer relevant. Indeed, such studies are likely to offer longer-term insights into the evolution of telehealth practices and provide valuable context for relevant, current applications of the technology.

Potentially relevant research published in a language other than English, or not indexed in the search database may have been missed.

A further potential limitation of our study is the potential overlap of primary studies across the multiple reviews included in the synthesis. Such overlap could result in certain studies being overrepresented, potentially introducing bias in the findings. While this is a common challenge in umbrella reviews, we attempted to mitigate its impact by including a diverse range of reviews spanning different regions and timeframes. Furthermore, the broad trends and gaps identified in our analysis are unlikely to be substantially affected by this limitation, given the large number and variety of studies included.

2.7 Future Research Recommendations

There is a critical need for detailed economic analyses that explore the cost-effectiveness of telehealth technologies. This includes analyzing the setup, operational, and maintenance costs versus the economic benefits, such as reduced hospitalization rates and transportation costs.

There is also a need to examine the impact of different reimbursement models on the sustainability of telehealth services, particularly how these models influence provider adoption rates, patient access, and overall financial viability of telehealth solutions. In parallel, research should be directed towards improving patient-centric technology infrastructure necessary for delivering efficient telehealth services.

Studies should also focus on understanding cultural barriers to telehealth adoption and

developing strategies to overcome these barriers. Developing and testing user-friendly telehealth platforms that are easily accessible to various user groups, including the elderly, disabled, and those with limited digital literacy, would not only improve patient engagement, but also increase the overall effectiveness of telehealth services. This also involves training providers to be culturally competent and incorporating patient-centred designs that respect diverse cultural backgrounds. Engaging with communities to raise awareness about the benefits of telehealth can ensure that telehealth initiatives are adapted to meet the specific needs of different groups. There is a particular need for more detailed investigations into the adequacy of telehealth services. Future research should assess the efficacy of telehealth across a wider range of clinical conditions and explore its long-term effectiveness in managing chronic diseases. Studies should also evaluate the capabilities of telehealth systems to meet diverse patient needs, including those of vulnerable populations.

As telehealth continues to grow, the importance of ensuring data security and protecting patient privacy becomes paramount. Research should focus on developing and testing robust cybersecurity measures and governance frameworks that can safeguard patient information while maintaining the functionality and accessibility of telehealth services. Research must also consider the impact of current telehealth policies and identify potential policy changes that could promote the wider adoption and equitable distribution of telehealth services.

2.8 Conclusion

This systematic review underscores the significant potential of telehealth to enhance healthcare access, particularly in non-urban areas, by bridging critical gaps in service delivery. Despite its promise, our analysis identifies persistent challenges across various dimensions of access, including availability, accessibility, adequacy, affordability,

acceptability, and awareness, each presenting unique obstacles and opportunities.

Key findings reveal that while telehealth is becoming more widely available, substantial barriers remain in ensuring equitable service distribution and accommodating the diverse needs of different populations. Challenges such as limited digital literacy, inadequate infrastructure, and cultural barriers need focused attention to make telehealth truly inclusive and effective. Moreover, while telehealth can offer cost savings, the financial implications of technology setup and maintenance, alongside disparities in insurance coverage, demand more robust economic research to fully understand and address these economic barriers.

It is crucial that future telehealth initiatives and policies focus on enhancing service adequacy, improving affordability, and expanding awareness to ensure that all segments of the population can benefit equally from telehealth technologies. By addressing these critical dimensions, telehealth can fulfill its potential as a transformative healthcare delivery model, providing high quality, accessible, and equitable care.

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Chapter 3 Evaluation of Health Equity Frameworks in Telehealth and Digital Health: A Systematic Review and Narrative Synthesis

The material in this chapter has been published as:

Wang S, Killedar A, Von Huben A, Norris S, Wilson A. Evaluation of health equity frameworks in telehealth and digital health: a systematic review and narrative synthesis. *Frontiers in Public Health.* 2026; 13:1690117. doi:10.3389/fpubh.2025.1690117.

A statement of the specific contribution of the co-authors can be found in Appendix B.

Purpose of chapter

To critically examine existing health equity frameworks and assess their relevance to telehealth and digital health contexts, a systematic review and narrative synthesis was undertaken. This chapter identifies and compares key dimensions, conceptual approaches, and operational components across available frameworks, highlighting common elements as well as areas of divergence.

The findings are used to clarify how equity has been conceptualised and assessed in the literature, and to identify gaps in the coverage of telehealth-specific equity considerations. These insights inform the development of the comprehensive telehealth equity framework presented in the subsequent chapters and provide the conceptual foundation for the empirical analyses that follow.

3.1 Abstract

Introduction: The rise of telehealth and digital health solutions has been promoted as transformative approaches to bridging healthcare access gaps. However, these technologies may introduce new disparities related to digital literacy, internet access, and technology affordability. While several health equity frameworks exist for traditional healthcare delivery, their applicability to telehealth contexts remains unclear.

Methods: We systematically searched MEDLINE, CINAHL, and Scopus databases for peer-reviewed articles discussing health equity frameworks relevant to telehealth and digital health. A narrative synthesis approach was employed, complemented by a tailored quality appraisal assessing clarity, theoretical basis, comprehensiveness, and telehealth applicability. Framework elements were categorized into drivers, measures, and enablers/modifiers of health equity.

Results: The search yielded 707 records; after removing 25 duplicates, 27 full-text articles were assessed and 17 were included in the final synthesis. Thirteen unique health equity frameworks were identified. Six frameworks were explicitly developed for digital health, telehealth, or eHealth contexts, while seven were general health equity frameworks with potential applicability to telehealth. Eight frameworks demonstrated moderate-to-high quality scores. Across frameworks, notable gaps remain in addressing telehealth-specific challenges and in providing actionable guidance for real-world implementation.

Conclusion: Existing frameworks provide valuable insights but require adaptation to fully address telehealth-specific challenges. Tailored frameworks that incorporate digital determinants of health, prioritise equitable technology access, and facilitate system integration are essential. These advancements will enable telehealth to effectively reduce health disparities and advance equity in healthcare access.

3.2 Introduction

3.2.1 Background

Systematic differences in health by socio-economic or cultural characteristics, henceforth referred to as health inequity, remain a significant concern worldwide. Health inequities are largely determined by socioeconomic, geographic, and demographic factors but these can, in part, act through difference in the quality and accessibility of healthcare services for different population groups (1). In recent years, the rise of digital health solutions, particularly telehealth, has been heralded as a transformative approach to bridging these health care access gaps (2). Telehealth, defined as the use of digital communication technologies to deliver health services remotely, offers the potential to extend healthcare access to underserved and remote populations, thereby addressing some of the inequities in traditional healthcare delivery (3).

However, the introduction of telehealth also presents unique challenges that must be addressed to ensure that use of the technology contributes positively to health equity. While telehealth can mitigate geographic barriers and improve access to specialist care, it can also introduce new disparities related to digital literacy, internet access, and the affordability of technology (4). These challenges highlight the importance of applying a structured equity framework to telehealth, ensuring that digital health innovations do not exacerbate existing inequities.

Several health equity frameworks have been developed to assess equity considerations in healthcare delivery more broadly. However, relatively few of these frameworks are explicitly designed for telehealth or digital health contexts. This raises the question of whether existing frameworks are applicable to telehealth and, if not, whether modifications or new frameworks are needed to adequately evaluate digital health equity. This study systematically

reviews existing health equity frameworks, including those not originally developed for telehealth, to assess their relevance and applicability to telehealth contexts. By analyzing these frameworks, we identify whether telehealth introduces unique equity considerations that require adaptations to existing frameworks.

This work will deepen understanding of the concepts of health equity in relation to emerging digital technologies and provide practical insights for policymakers, healthcare providers, and researchers to ensure considerations of equity in the implementation of telehealth. By continually refining telehealth practices and policies from an equity perspective, we can move closer to a health care system that reduces disparities rather than widens them.

3.2.2 Objectives

The objectives of this systematic review are:

(1) **Critical Evaluation of Existing Frameworks:** Identify and analyse current frameworks that assess equity in healthcare access, identify common factors and differences, and evaluate the applicability of these frameworks to telehealth.

(2) **Clarify Telehealth-Specific Equity Considerations:** Synthesise observations across the included frameworks to identify any additional dimensions or considerations specific to telehealth that may be absent from general health equity frameworks.

3.2.3 Definitions

To ensure clarity, this review uses the following definitions:

Telehealth: Telehealth includes healthcare services provided using audio and video technology and is a subset of e-health (5). Telehealth typically involves direct patient-provider interactions (e.g., video consultations, remote monitoring) and is focused on the clinical delivery of care (6).

Digital Health: Digital health refers to the use of information and communication technologies in medicine and other health professions to manage disease and health risks and promote health, and it is broad in scope, including the use of wearable devices, mobile health, telemedicine, health information technology and telemedicine (7).

Technology (in the Context of Health Care): Refers to the digital tools, platforms, and infrastructures used to support health care delivery (8).

Health Equity Framework: A structured theoretical model or conceptual approach that identifies, analyses, and addresses the factors contributing to unfair health disparities across population groups. These frameworks provide a lens to examine how social, economic, cultural, and technological determinants interact to shape equitable access to health services and outcomes. They typically include three components: (1) key drivers or determinants of health equity, (2) measures or indicators for assessing equity, and (3) enablers or interventions that can modify equity outcomes.

3.3 Methods

This systematic review follows the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) statement (9). This review was prospectively registered with the International Prospective Register of Systematic Reviews (PROSPERO). A narrative synthesis of findings has been undertaken according to the methods of (Popay et al., 2006)

(10).

3.3.1 Eligibility Criteria

To ensure the inclusion of relevant and high-quality literature, we have established specific inclusion and exclusion criteria (see Table 3.1). We included both telehealth-specific and general health equity frameworks for several methodological reasons. First, the limited number of frameworks developed specifically for telehealth/digital health contexts necessitated a broader scope to ensure comprehensive coverage of relevant theoretical constructs. Second, general health equity frameworks provide foundational insights into core determinants of health disparities that remain relevant in digital health contexts, such as socioeconomic status, geographic location, and cultural factors. Third, examining general frameworks allows us to identify which elements translate effectively to telehealth settings and which require adaptation, providing crucial insights for framework development. Finally, this inclusive approach enables us to assess the theoretical maturity of health equity concepts and identify specific gaps that future telehealth-specific frameworks must address.

Operational definitions: In this review, we use telehealth as an umbrella term for the remote delivery of health-related services using information and communication technologies, including clinical care and non-clinical services. We use telemedicine to refer specifically to remote clinical services (e.g., diagnosis, treatment, and follow-up). We use digital health to refer broadly to the use of digital technologies to support health and healthcare, which may include telehealth/telemedicine as a subset. For consistency, the term “telehealth” is used throughout when referring to the review’s primary context unless a framework uses alternative terminology.

Table 3.1 Inclusion and exclusion criteria for peer-reviewed journal articles

Criteria Category	Criteria	Description
Inclusion Criteria	Content	Articles must explicitly discuss, evaluate, or apply health equity frameworks, including those not originally designed for telehealth/digital health, but with potential relevance to digital health equity.
	Language	Only literature written in English will be included to ensure accurate comprehension and analysis.
	Types of Literature	Peer-reviewed academic articles published in scholarly journals.
Exclusion Criteria	Non-Academic Literature	Excludes non-academic or non-peer-reviewed literature such as news articles, blog posts, opinion pieces, editorials, and grey literature (e.g., reports, dissertations).
	No Health Equity Framework	Excludes literature that does not discuss, evaluate, or apply health equity frameworks or models, even if it involves telehealth or digital health issues.
	Lack of health equity discussion	Studies focusing solely on clinical outcomes, technological aspects, or healthcare access without addressing equity considerations.
	Language	Non-English articles.

3.3.2 Information Sources and Search Strategy

A comprehensive literature search was conducted in MEDLINE (Ovid), CINAHL (EBSCOhost), and Scopus to identify peer-reviewed articles on health equity frameworks in telehealth/digital health (Table A 5). The initial search was run in July 2024 and updated in November 2024 (exact run dates and database yields are reported in Table A 5).

The search strategy was developed with the assistance of a medical librarian and included a combination of Medical Subject Headings terms and keywords related to health equity frameworks and telehealth. The search terms were adjusted for each database to account for differences in indexing and search functionalities (see Table A 6). No date or geographical

restrictions were applied to maximize the retrieval of relevant literature. Only articles published in English were considered to ensure accurate comprehension and analysis.

In addition to electronic database searches, we manually searched the reference lists of all included articles and relevant reviews to identify additional studies that may not have been captured in the database searches. Grey literature and non-peer-reviewed sources were excluded as per the inclusion criteria.

3.3.3 Selection Process

The study selection process is illustrated in a PRISMA flow diagram (Figure 3.1). All records retrieved from the database searches were imported into EndNote X9 reference management software, and duplicates were removed. The study selection process was conducted in two stages:

Stage 1: Title and Abstract Screening

Two reviewers (SW and SN) independently screened the titles and abstracts of all retrieved records against the inclusion and exclusion criteria outlined in Table 3.1. Studies that clearly met the inclusion criteria or where eligibility was uncertain were advanced to the full-text review stage. Discrepancies were resolved through discussion by a third reviewer (AW).

Stage 2: Full-Text Review

The same two reviewers independently assessed the full-text articles for eligibility. Reasons for exclusion at this stage were documented in detail. A full-text exclusion log (n=10), including citations and reasons for exclusion, is provided in Table A 6 (Part B).

Disagreements were resolved through discussion, and when consensus could not be reached,

a third reviewer (AW) was consulted to make the final decision.

3.3.4 Data Extraction

In our review, the data extraction process was designed to accurately summarize and assess the key information regarding health equity frameworks in the selected literature. Data extraction was conducted using a piloted extraction form. One reviewer (SW) extracted data from all included articles to ensure consistency. To minimise extraction or transcription errors, extracted information was cross-checked against the source articles during synthesis and table preparation, and uncertainties were discussed within the author team. For each selected article, we extracted the following information:

1. Name of the Health Equity Framework or Model: The specific title or designation of the framework discussed in the article.
2. Primary Purpose of the Framework: The main objectives or intended outcomes the framework aims to achieve in the context of health equity.
3. Key Elements of the Framework: The essential components, constructs, or domains that constitute the framework.
4. Theory Underpinning the Framework: The theoretical foundations or conceptual models that inform the development of the framework.

Additionally, we categorized the factors covered within each framework into three groups, derived from established health equity literature and empirical research: (1) drivers of health equity, which are core factors that lead to disparities such as Socioeconomic Status (SES), geographical location, and cultural background (11, 12); (2) measures, which are specific indicators or methods used to assess health equity, like inequalities in health outcomes and

accessibility of services (13, 14); and (3) enablers/modifiers of health equity, such as policy interventions, technological innovations, and educational initiatives (15). They represent factors or interventions that can directly change health equity by strengthening or hindering health equity.

3.3.5 Quality Assessment

As the review focuses on frameworks rather than empirical research studies, traditional risk of bias assessment tools were not appropriate. Instead, we developed a tailored quality assessment approach to evaluate the clarity, theoretical basis, comprehensiveness, and practical applicability of each framework to telehealth. The tool included explicit decision rules (score anchors) for each criterion (0-3) to support consistent scoring of conceptual frameworks. The full scoring rubric and a blank scoring template are provided in Table A 8.

Criteria

We assessed the quality and applicability of the frameworks using specific criteria:

1. Clarity of Purpose: Whether the framework's objectives are clearly defined.
2. Theoretical Basis: The extent to which the framework is grounded in existing theory and evidence.
3. Comprehensiveness: Coverage of relevant factors influencing health equity (from our previous research)(16).
4. Applicability: The framework's potential for practical application in telehealth settings.

Scoring System

Each criterion was scored on a 4-point scale:

0 (Not Met): The criterion is not addressed. [Red]

1 (Partially Met): The criterion is addressed but with significant limitations. [Orange]

2 (Mostly Met): The criterion is adequately addressed with minor limitations. [Light green]

3 (Fully Met): The criterion is fully addressed without significant limitations. [Dark green]

Overall Quality Classification

The scores for all four criteria were then summed to produce a total quality score ranging from 0 to 12. We classified each framework into one of four quality categories based on the total score:

High Quality (10-12): Dark Green

Moderate Quality (7-9): Light Green

Fair Quality (4-6): Orange

Low Quality (0-3): Red

Assessment Process

Three reviewers (SW, AW, and AK) conducted a quality and applicability assessment for all frameworks. SW independently evaluated all the frameworks, while AW and AK each assessed a subset (AW evaluated 9 frameworks, AK evaluated 8 frameworks). Any differences in assessments were discussed among the reviewers, and if agreement could not be reached, a fourth reviewer (SN) made the final judgement.

3.3.6 Data Synthesis

To assess the relevance of general health equity frameworks to telehealth or digital health, we conducted a sub-analysis distinguishing between:

1. Frameworks explicitly designed for telehealth or digital health
2. General health equity frameworks with potential applicability to telehealth or digital health

We synthesized the findings narratively, focusing on analysing and comparing the similarities and differences between the identified health equity frameworks. The narrative synthesis was structured around the objectives of the review and followed the approach outlined by Popay et al. (2006) (10). The data synthesis was conducted as follows:

Step 1: Developing a Preliminary Synthesis

We developed a preliminary synthesis by organizing data from the included studies into comprehensive tables that summarized the characteristics and key components of each framework.

Step 2: Common Factors and Key Differences.

We compared the frameworks to identify similarities and differences in how they address

health equity factors.

Step 3: Thematic Analysis of Framework Components

The factors within each framework were categorized into the three groups identified during data extraction: drivers of health equity, measures, and enablers/modifiers of health equity (as mentioned previously).

Step 4: Applicability of Frameworks to Telehealth Settings

To evaluate the relevance of the frameworks, we examined their applicability to telehealth-specific equity challenges.

3.4 Results

3.4.1 Study Selection

Figure 3.1 shows the article selection process for this review. The initial databases search yielded 707 articles. After removing 25 duplicates, 682 articles remained. Screening titles and abstracts excluded 663, leaving 19 for full-text review. Supplementary searches added 8 more articles, totalling 27 for full-text assessment. Of these, 17 met the inclusion criteria and were included in the final analysis.

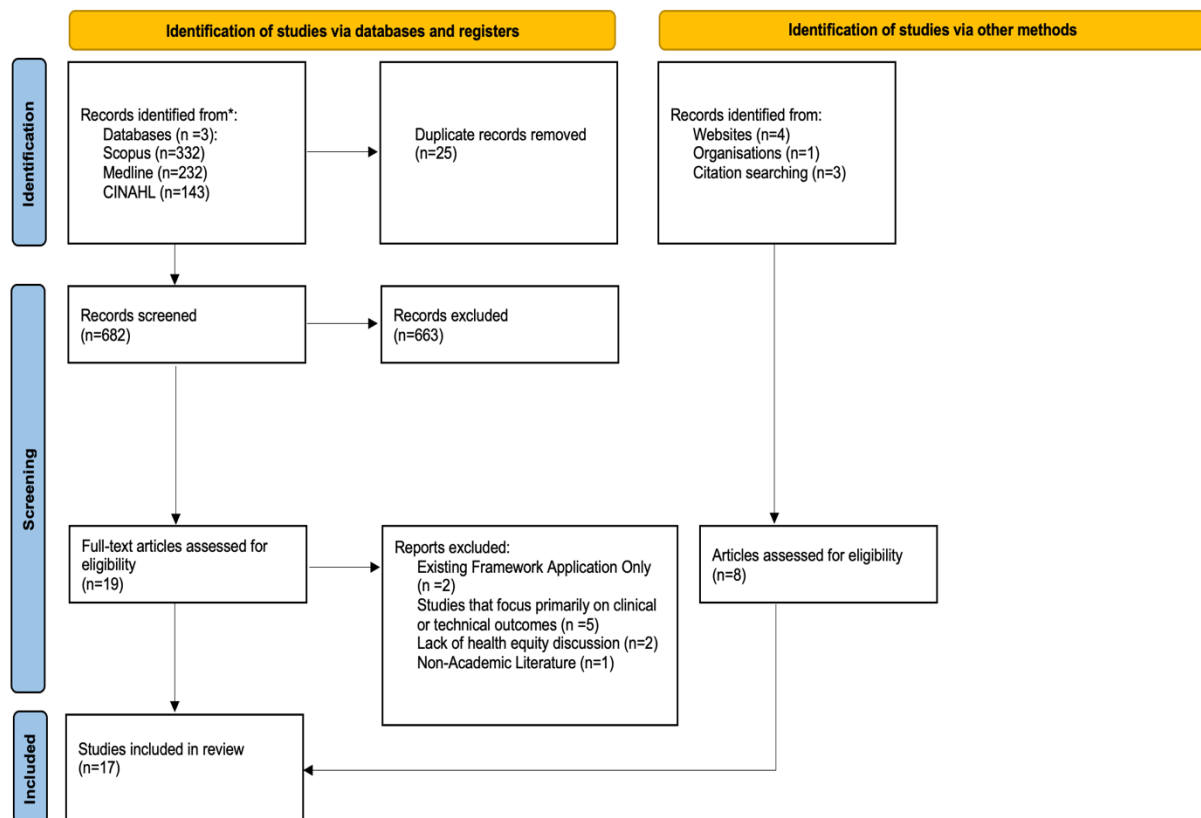


Figure 3.1 PRISMA flow diagram of study selection

Note: Database searches were run on 2 July 2024 and re-run on 11 November 2024; records from both runs were combined prior to de-duplication and screening.

3.4.2 Characteristics of Included Studies

We identified 13 unique health equity-related frameworks across the 17 included articles. Of these, six frameworks were explicitly developed for digital health, telehealth, or eHealth contexts (Table 3.3), while the remaining seven were general health equity frameworks originally developed for non-digital healthcare settings but considered potentially applicable to telehealth and digital health. Table A 7 provides a detailed summary of all 13 frameworks.

3.4.3 Quality Assessment Results

Table A 8 includes the appraisal rubric and scoring template, as well as the quality assessment results for all identified frameworks. Each framework was assessed against four criteria, Clarity of Purpose, Theoretical Basis, Comprehensiveness, and Applicability, scored on a scale from 0 (Not Met) to 3 (Fully Met). The total possible score ranged from 0 to 12, with higher scores indicating higher overall quality.

Overall, most frameworks demonstrated moderate to high quality. Eight frameworks achieved a total score of 10 or above, indicating strong theoretical grounding, clarity of purpose, and applicability to health equity assessments. Four frameworks were given the highest score of 11, reflecting robust theoretical foundations and applicability to both general healthcare equity and digital health contexts. However, comprehensiveness emerged as the weakest criterion across many frameworks, with several receiving low scores in this domain.

Specifically, the five frameworks scored only 1 for comprehensiveness, indicating that they lack holistic consideration of key dimensions of health equity or fail to integrate the broad determinants related to digital health equity. Among the lower-scoring frameworks, O'Neill et al. (2014) (PROGRESS framework) scored the lowest overall (6 points), mainly due to its limited comprehensiveness and weak theoretical foundation. The PROGRESS framework focuses narrowly on social stratifies (e.g., place of residence, race, gender, socioeconomic status) but does not fully integrate other systemic or structural factors influencing digital health equity, such as healthcare system barriers, digital infrastructure, or policy interventions. Similarly, Crawford & Serhal (2020) (The Digital Health Equity Framework) received a total score of 7, with particularly low scores in clarity of purpose and comprehensiveness. While the framework explicitly addresses digital health, its scope is limited to broad structural considerations and does not offer detailed, actionable guidance on

how to measure or operationalize equity outcomes in telehealth settings.

Other frameworks that scored moderately in comprehensiveness (score of 1-2) include Dover & Belon (2019) (Health Equity Measurement Framework) and the World Health Organization (WHO) (2010) (Conceptual Framework for Action on the Social Determinants of Health). While these frameworks provide strong theoretical models for analyzing general health equity, they fall short in addressing digital determinants of health, access to telehealth services, and technology-specific barriers. This suggests that general health equity frameworks, while foundational, may require adaptation to adequately assess telehealth-specific equity considerations. In contrast, the highest-scoring frameworks (e.g., Pullyblank et al., 2023; Szymczak et al., 2023; Woodward et al., 2019) incorporated more comprehensive multi-level assessments, integrating individual, community, and systemic factors.

3.5 Narrative synthesis

3.5.1 Analysis of Different Frameworks

3.5.1.1 Common Factors and Key Differences

Table A 9 highlights the common factors and differences found across the frameworks. We consider a factor common if it appears in six or more frameworks; otherwise, it is classified as a difference.

Common Factors

All frameworks acknowledge that health outcomes are not solely determined by medical care but are also shaped by social, economic, and environmental factors. Seven of the 13 frameworks emphasise various dimensions of access to healthcare services (17-24). Cultural and linguistic considerations appear in 11 frameworks (18-20, 22-33). Six frameworks underscore the importance of policies and systemic reforms (17, 19, 22, 23, 29, 32). Among frameworks focused on digital health or ehealth, digital determinants of health are consistently recognised as equity drivers (18, 22, 24, 25, 32, 33). Additionally, six frameworks incorporate feedback loops, continuous evaluation, and adaptation to facilitate sustained impact on health equity (17, 18, 22, 23, 32, 33).

Key Differences

Only one digitally focused framework explicitly mentions algorithmic bias, data standards, and hidden technology biases (25). Three frameworks stress the importance of patient engagement and trust (18, 22, 33). Frameworks vary in how they address measurement and evaluation. More traditional frameworks (e.g., Aday & Andersen model) centre on healthcare utilization metrics, while recent digital health frameworks stress the importance of collecting and analysing digital equity data, such as usage patterns, technology adoption rates, and culturally tailored evaluation metrics (18, 22, 33). Some frameworks remain broad and adaptable to multiple contexts (e.g., PROGRESS-Plus, which refers to place of residence, race/ethnicity, occupation, gender, religion, education, socioeconomic status, social capital, plus additional context-specific factors), enabling their use in numerous settings and populations. Others are highly specialized, focusing on integrating equity considerations throughout the lifecycle of specific health information technologies (e.g., eHealth Equity Framework).

3.5.2 Thematic Analysis of Framework Components

We categorized elements from all frameworks into Drivers, Measures, and Enablers/Modifiers (this classification is based on prior definitions). The Table 3.2 summarizes typical elements from various frameworks and categorizes them accordingly.

Table 3.2 Categorisation of framework components across included frameworks (n=13): drivers, measures, and enablers/modifiers.

Category	Elements (from various frameworks)
Drivers (Core Factors)	<ul style="list-style-type: none"> - Socioeconomic status (income, education, occupation) - Geographic location (urban-rural differences, regional characteristics) - Race/ethnicity, cultural background, language differences - Social stratification and structural inequalities - Digital literacy, technology access and affordability of devices
Measures (Indicators)	<ul style="list-style-type: none"> - Healthcare utilization rates (e.g., consultation rates, use of preventive services) - Indicators of disparities in health outcomes (morbidity, mortality, disease burden across different groups) - Digital health service usage indicators (e.g., rates of electronic health record usage, telehealth visits, adoption rates) - Patient satisfaction, trust, and cultural alignment measures - Quantitative measures of health inequality
Enablers/Modifiers (Promoters/Changers)	<ul style="list-style-type: none"> - Policy interventions and systemic reforms (policy recommendations, legislative action, funding aimed at reducing inequalities) - Technological innovations and design improvements (user-centered design, accessibility enhancements, training and technical support) - Community outreach and communication strategies (raising awareness, reducing information gaps) - Educational programmes to enhance digital literacy - Interdisciplinary collaboration and stakeholder engagement
<p>Note: Elements relevant specifically to digital health contexts are highlighted in bold.</p>	

All frameworks identified fundamental social determinants as core drivers of health equity. These included socioeconomic status, race/ethnicity, geographic location, language, cultural norms, and structural inequalities within health systems. Frameworks adapted for digital health further recognised digital literacy, access to broadband, and the affordability of devices as critical new drivers of equity in the digital health context (18, 22, 24, 25, 32, 33).

Measures

Common measures included healthcare utilization rates, patient satisfaction, and health outcomes stratified by equity-relevant demographic factors. In digital health-focused frameworks, new metrics, such as user engagement with digital health platforms, digital health literacy levels, and stable access to secure digital tools, were proposed (18, 22, 33). These measures help quantify the extent to which digital health services reach, and benefit underserved populations.

Enablers/Modifiers

Policy reforms, community outreach, culturally tailored communication, funding mechanisms, training for both providers and patients, and user-centered technology design emerged as key enablers/modifiers. Digital health-specific frameworks recommended targeted interventions such as offering multilingual digital health platforms, integrating digital health training in clinical curricula, subsidizing devices or internet connectivity, and creating iterative feedback loops to continuously improve the user experience.

3.5.3 Applicability of Frameworks to Telehealth Settings

From the quality assessment results presented in Table A 8, we observe that 8 frameworks received a score of 2 or higher in applicability, indicating that most frameworks are adaptable to telehealth settings to varying degrees. However, 5 frameworks scored only 1 point, highlighting notable limitations and gaps in their ability to comprehensively address the unique challenges of telehealth. Below, we explore the distinctions between digital health-specific frameworks and general framework.

3.5.3.2 Digital Health-Specific Frameworks

Frameworks explicitly designed for digital health often provide a more focused lens for assessing equity in telehealth. However, even among these, certain challenges persist (see Table 3.3).

Table 3.3 Strengths and limitations of digital health-specific equity frameworks (n=6)

Framework	Key Strengths	Key Limitations
Kepper et al., 2024 A Model for Advancing Digital Health Access to Foster Health Equity	Comprehensive access dimensions, user-centered design, focus on sustainability.	Limited telehealth-specific focus on operational challenges.
Crawford & Serhal, 2020 Digital Health Equity Framework	Addresses digital determinants of health, integrates equity into health systems, ensures person-centered care.	Lack of implementation metrics for telehealth.
Groom et al., 2024 Digital Health Equity-focused Implementation Research Model	Focus on planning, design, implementation, and equity-focused outcomes.	High resource demands for equity assessment.

Framework	Key Strengths	Key Limitations
Antonio & Petrovskaya, 2019 eHealth Equity Framework	Contextual and systemic focus, life course perspective, intermediary determinants of health.	Limited focus on telehealth service integration.
Richardson et al., 2022 Framework for Digital Health Equity	Multilevel approach addressing individual to societal factors, considers algorithmic bias.	Minimal guidance on practical implementation for telehealth.
Foley et al., 2021 Suggested Pathways of Access, Use and Benefit from Digital Health Services	Clear pathway (access → use → benefit), trust and literacy focus, hybrid care integration.	Overemphasis on population-level services, lacking nuance in individual telehealth interactions.

3.5.3.3 General Frameworks

General health equity frameworks are broader in scope but reveal significant limitations when applied to telehealth contexts. Table 3.4 outlines common gaps, equity implications, and suggestions for improvement in these frameworks and telehealth strategies.

Table 3.4 Equity implications of limitations in current health equity frameworks applied to telehealth

Gap/Limitation	Description	Equity Implications	Suggestions for Improvement
Limited Focus on Digital Divide	Existing health equity frameworks often overlook the digital divide, which refers to disparities in access to information and communication technologies. This includes the availability and quality of internet access, particularly in rural or underserved areas.	The digital divide leads to unequal access to telehealth services, potentially exacerbating health disparities for those without reliable internet access or necessary digital tools.	For Telehealth Strategies: Develop targeted strategies to enhance digital infrastructure and provide subsidized access to technology in underserved regions.

Gap/Limitation	Description	Equity Implications	Suggestions for Improvement
			For Frameworks: Include digital connectivity as a key domain for assessing health equity in telehealth
Socioeconomic Barriers	While Socioeconomic status is recognised as a driver of health equity, current frameworks may not fully address how telehealth interacts with these barriers. Telehealth can reduce some socioeconomic obstacles, such as travel costs, but the costs associated with technology and internet access can prevent vulnerable groups from benefiting fully.	Without addressing the costs and accessibility of technology and internet services, telehealth may inadvertently widen the gap between different socioeconomic groups, limiting the potential benefits of digital healthcare for vulnerable populations.	For Telehealth Strategies: Incorporate considerations of internet access costs and technological affordability into telehealth planning and subsidy programmes. For Frameworks: Include socioeconomic status-specific measures for telehealth affordability and access as part of health equity evaluations.
Overlooking Variations in Digital Literacy	Digital literacy, the ability to use digital technologies effectively, is often not addressed in traditional health equity frameworks. For telehealth to be effective, users need both access to technology and the skills to use it. Many individuals, particularly those with low health literacy, struggle with digital tools. This includes challenges related to age, cognitive abilities, and varying comfort levels with technology across cultural groups.	Low digital literacy can prevent individuals from effectively using telehealth services, leading to disparities in health outcomes. Different populations may face unique barriers that are not fully captured by current frameworks, necessitating more tailored approaches to digital health literacy.	For Telehealth Strategies: Include digital literacy training as part of telehealth services and create tailored educational programmes for diverse populations. For Frameworks: Incorporate digital literacy as a critical component in evaluating telehealth equity.
Ignoring Data Privacy and Security Concerns	Data privacy and security are critical concerns in telehealth, but these are often insufficiently addressed in existing health equity frameworks. Concerns about how personal health information is collected, stored, and shared can deter	Insufficient focus on data privacy and security may reduce trust in telehealth services (e.g., in groups whose past experiences may have resulted in poor trust in broader health systems), limiting their adoption and	For Telehealth Strategies: Strengthen data protection measures, ensure compliance with stringent security standards, and enhance user education on data privacy.

Gap/Limitation	Description	Equity Implications	Suggestions for Improvement
	people from using telehealth services. Even with encryption, platforms are vulnerable to data breaches, which could further erode trust in digital health solutions.	effectiveness. Addressing these concerns is essential for increasing user confidence and ensuring the broader acceptance of telehealth.	For Frameworks: Add data privacy and security as evaluative criteria to assess trust and adoption in telehealth systems.
Insufficient Focus on Health System Integration	Telehealth needs to be integrated into the broader healthcare system to ensure quality and continuity of care. Current frameworks may not adequately address how to integrate telehealth with existing services, risking care fragmentation and reduced quality of care.	Lack of integration of telehealth into the broader healthcare system can result in fragmented care, which impacts underserved populations. Without seamless integration, these patients may experience gaps in care continuity, leading to poorer health outcomes and exacerbating existing health disparities. A more integrated approach is essential for achieving health equity.	For Telehealth Strategies: Develop guidelines for integrating telehealth services within the broader health care system to ensure continuity and quality of care.
			For Frameworks: Include integration with health systems as a dimension for assessing telehealth's role in equity.

3.6 Discussion

This systematic review and narrative synthesis evaluated existing health equity frameworks to determine their applicability in telehealth contexts. We identified 13 unique frameworks across 17 included articles, spanning established models developed for broader healthcare settings and more recent frameworks designed for digital health. Six frameworks were explicitly developed for digital health, telehealth, or eHealth contexts (Table 3.3), while the remaining seven were general health equity frameworks with potential applicability to telehealth (Table A 7). Overall, most frameworks demonstrated moderate-to-high quality, with eight scoring $\geq 10/12$ on our tailored appraisal (Table A 8).

3.6.1 Contextualization Within Existing Literature

Our findings align with prior reviews of health equity frameworks, which also report variation in how equity is conceptualised, with some frameworks emphasising outcome disparities while others focusing on access barriers (14, 20). Our review additionally highlights complexities introduced by digital health that earlier analyses did not address, including the role of digital determinants of health (22, 25, 32). We also observed that algorithmic bias was explicitly addressed in only one framework, underscoring the nascency of this area despite its recognised importance in the literature (25, 33). Finally, our appraisal identified comprehensiveness as the weakest criterion, echoing long-standing concerns about the ability of frameworks to capture equity dimensions in a systematic way (11, 29).

3.6.2 Framework Analysis and Integration Potential

Despite different origins and intended applications, substantial theoretical convergence is evident. As coded in our review (see Table A 9), all frameworks acknowledge that health outcomes are shaped by social, economic, and environmental factors beyond medical care, and 11 of 13 explicitly incorporate cultural and linguistic considerations. Specific areas of convergence include access dimensions (seven frameworks) and policy or system-level interventions (six frameworks). Among digital health/eHealth frameworks, all six recognise digital determinants of health as equity drivers and extend traditional social determinants with technology-specific considerations such as digital literacy and algorithmic bias. These counts and themes are detailed in Table A 9.

This convergence suggests both theoretical maturity and opportunities for integration. The consistent appearance of core elements validates fundamental equity concepts while also

revealing redundancies across frameworks. Rather than proposing entirely new constructs, future development may benefit from explicit integration of existing elements into operational tools that can be applied consistently across telehealth services.

3.6.3 Applicability of Frameworks to Telehealth Settings

Our appraisal of applicability (Section 4.2) showed that while most frameworks can be adapted to telehealth to some extent, important limitations remain. Digital health-specific frameworks provided clearer pathways by explicitly addressing digital determinants of health and emphasising person-centred design, yet they often lacked operational metrics or required high resource commitments for equity assessment (25, 33). By contrast, general health equity frameworks offered a broad conceptual base but overlooked telehealth-specific domains such as digital literacy, privacy and security, and integration with health systems (see Table 3.3 and Table 3.4).

These omissions carry significant implications. A failure to account for the digital divide or the costs of connectivity may widen socioeconomic inequities. Insufficient attention to digital literacy and trust may reduce adoption among older adults, culturally diverse communities, or people with limited health literacy. Weak health system integration may fragment care and disproportionately affect underserved populations. Addressing these issues will require both the adaptation of existing frameworks and the development of tailored evaluation tools that explicitly incorporate digital access, literacy, privacy, and integration dimensions.

3.6.4 Implications for Telehealth Design and Implementation (practice)

Our synthesis supports concrete design requirements for equitable telehealth delivery. Health services and platform vendors should implement: (1) digital inclusion by default (low-bandwidth options, device-agnostic access, and simplified onboarding); (2) supported use (digital navigation support, clear step-by-step prompts, and accessible alternatives when users cannot complete digital steps); and (3) culturally safe delivery (language support and culturally adapted workflows). Without these elements, telehealth may shift barriers rather than remove them. It can replace travel and time constraints with digital access, usability, and trust barriers, which may widen inequities for groups already experiencing disadvantage.

3.6.5 Implications for Evaluation and Measurement (minimum expectations)

Equity-focused telehealth evaluations should move beyond utilisation alone and adopt a minimum, stratified indicator set across reach, use, experience/trust, and outcomes/continuity. At a minimum, evaluations should report: (a) reach (who was offered and able to access telehealth), (b) effective use (completion, drop-off points, repeat use), (c) experience and trust (including perceived privacy/security and cultural alignment), and (d) care outcomes and continuity (including follow-up completion and integration with in-person care). Reporting should be stratified using standard equity characteristics (e.g., geography, socioeconomic position, ethnocultural/language groups, age) to make inequities visible and enable targeted quality improvement. Without this, “equity-blind” evaluations risk overestimating benefit by averaging across groups with very different capacities to access and benefit from telehealth.

3.6.6 Implications for Policy (what must be enabled)

Equity-oriented telehealth requires enabling policy settings that support digital connectivity and device access (particularly for rural/remote and low-income communities), workforce capacity for digital navigation and support, and standards for privacy, security, and interoperability that protect trust and prevent fragmentation of care. When these enabling conditions are absent, even well-designed services may systematically under-serve populations with constrained digital resources, lower digital literacy, or historical reasons for low institutional trust.

3.6.7 Operationalizing the Integrated Framework

Synthesizing these insights, we propose a three-level approach: (1) a Foundational level incorporating universal determinants (for example, socioeconomic status, geography, and culture) drawn from established frameworks such as WHO's Social Determinants model and PROGRESS-Plus; (2) a Digital enhancement level layering technology-specific factors identified in digital health frameworks (for example, connectivity, device access, digital literacy, usability, and algorithmic fairness); and (3) an Implementation level providing practical guidance for assessment, intervention design, and evaluation, consistent with frameworks that emphasise monitoring, feedback, and continuous improvement. This multi-level integration addresses comprehensiveness gaps identified in our appraisal while maintaining theoretical rigor.

To translate the integrated framework into practice, we organised its elements into three functional components: drivers, measures, and enablers/modifiers. This structure provides a practical lens for assessing and addressing telehealth equity. Drivers include both

foundational social determinants and emerging digital determinants, while measures extend beyond conventional utilisation metrics to incorporate digital indicators such as telehealth adoption and sustained use. Enablers/modifiers encompass policy interventions, inclusive technology design, and digital literacy initiatives that shape the effectiveness of implementation. Together, these components support a systematic approach to embedding telehealth within broader strategies that address the social determinants of health. This operationalisation is illustrated in Figure 3.2, which shows how drivers, measures, and enablers or modifiers interact through implementation and feedback loops to advance health equity. In doing so, the framework supplies a practical basis for coordinated action and evaluation, and it sets out a clear programme for further development and testing across diverse contexts.

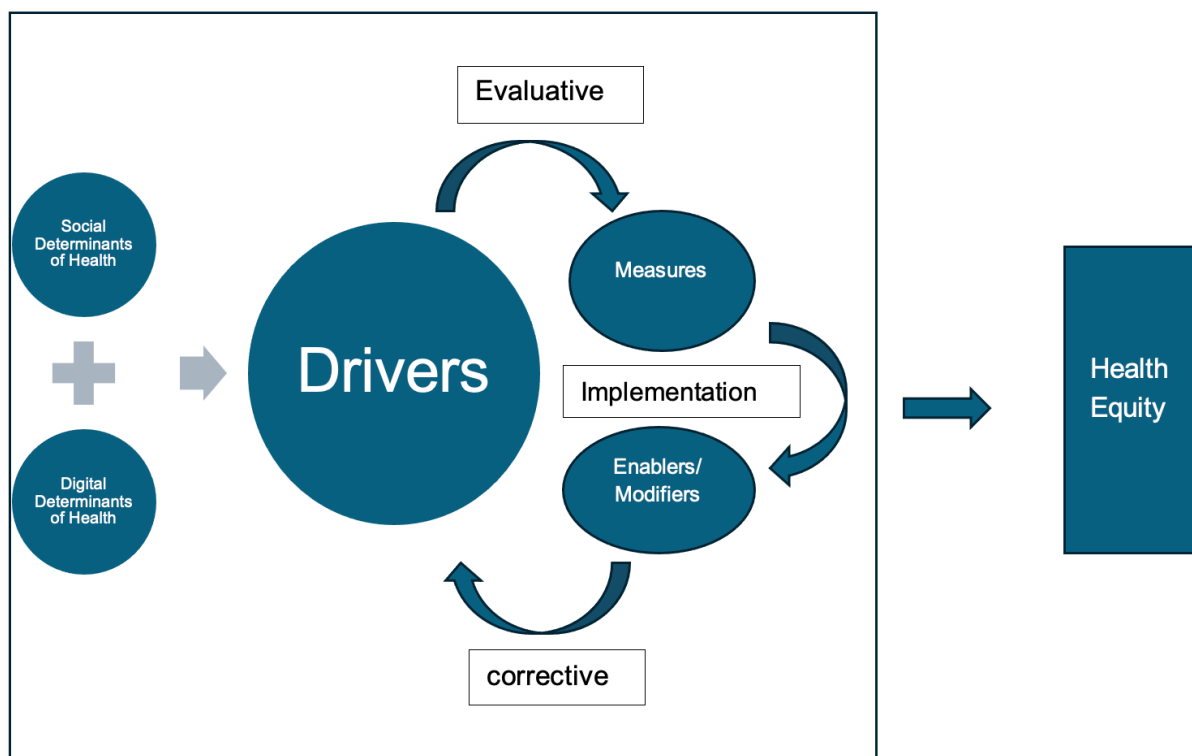


Figure 3.2 Proposed three-level integrated framework for assessing telehealth equity

3.6.8 Implications for Future Research

Future work should validate and operationalise the integrated framework by testing it in real-world telehealth services across diverse settings, assessing feasibility of routine equity reporting, and examining which implementation supports most effectively reduce observed inequities. This includes developing and evaluating practical reporting templates or checklists that can be adopted by services to standardise equity monitoring over time.

3.7 Limitations

A limitation is that data extraction was conducted by a single reviewer and we did not calculate formal inter-rater reliability statistics. Screening, however, was performed independently by two reviewers with adjudication, and extracted information was cross-checked against the source articles during synthesis and table preparation to minimise transcription errors.

Only English-language publications were included in this review, which may have led to the exclusion of relevant studies published in other languages. Future research should consider including non-English studies to provide a more comprehensive perspective.

As this review focuses on conceptual frameworks rather than empirical studies, we developed a tailored quality appraisal tool to assess the clarity, theoretical foundation, comprehensiveness, and applicability of each framework. While this approach allowed for a structured evaluation, the tool has not been externally validated, and its criteria may differ from established quality appraisal frameworks.

3.8 Conclusion

This systematic review examined existing health equity frameworks and assessed their applicability to telehealth. Many established frameworks, particularly those centred on social determinants, remain relevant but require deliberate adaptation to address challenges specific to telehealth, including connectivity and device access, digital literacy, usability and trust, and data and algorithmic fairness. Building on areas of convergence, we outline a three-part integration comprising foundational determinants, digital enhancements, and implementation guidance that clarifies how general and digital frameworks can be synthesised for telehealth evaluation and design. In doing so, we highlight the needs of underserved populations, especially rural and remote communities, and the importance of actionable measures to assess and mitigate digital health inequities. Priorities for future research include developing and validating an integrated telehealth equity framework; defining a core, stratified indicator set (access, use, experience, outcomes with PROGRESS Plus stratifies); conducting implementation studies with an equity focus that test framework utility in real services; pursuing longitudinal evaluations and evaluations across cultures; and advancing algorithmic equity through routine bias audits, representative data standards, and transparent reporting. Addressing these priorities will help ensure digital health functions as a leveller rather than a divider, providing researchers, providers, and policymakers with practical tools to design, implement, and evaluate equitable telehealth.

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Chapter 4 Evaluating Health Equity in Australian Telehealth Policies: A Policy Review

The material in this chapter has been published as:

Wang S, Killedar A, Norris S, Wilson A. Evaluating health equity in Australian telehealth policies: a policy review. *npj Digital Public Health*. 2026;1:4. doi:10.1038/s44482-025-00008-0.

A statement of the specific contributions of the co-authors can be found in Appendix B.

Purpose of this chapter

To examine how health equity is addressed within Australian telehealth policies and strategies, a systematic policy review was undertaken using the six-dimension access framework. This chapter analyses national, state, and territory telehealth policy documents to identify the extent to which equity considerations are embedded in policy objectives, implementation approaches, and evaluation mechanisms. The findings provide an overview of strengths and gaps in current policy approaches to telehealth equity and inform the subsequent empirical analyses presented in later chapters.

Additional detail on background and scope

Throughout the published chapter, the term “policies” is sometimes used as shorthand for the broader set of Australian telehealth policy and strategy documents included in the review. The analytic focus was therefore on both policies and strategies, rather than on policies narrowly defined. Rural and remote access was one prominent equity theme within the review, but the chapter’s aim was broader: to assess how equity considerations were articulated and operationalised across Australian telehealth policy architecture. Consistent with Chapters 2

and 3, the 6A framework was used here as the organising access lens for the thesis, rather than being introduced de novo within this chapter. Its use in Chapter 4 builds directly on the conceptual framing established in Chapter 1 and the evidence synthesis undertaken in Chapter 2.

Additional detail on methods

The policy review presented in this chapter used directed content analysis, organised around the 6A access framework introduced earlier in the thesis, to map equity-related content across Australian telehealth policy and strategy documents. The search strategy focused on official Australian government websites, Google site-restricted searches, and the Policy Commons database. This was complemented by a thematic analysis to identify patterns and themes not fully captured by the framework dimensions alone. Section 4.3 of the published chapter describes the search strategy, inclusion criteria, and analytic approach. The results present these two analytic strands together because the review aimed to capture both the breadth of equity coverage across documents and the depth of equity engagement within them. The numerical values reported in the chapter should therefore be read as descriptive summaries of the extent to which equity-related content was addressed across the included documents, rather than as a separate inferential quantitative analysis. The search strategy and full list of included documents are provided in Appendix Table A10.

4.1 Abstract

Introduction: Telehealth can expand healthcare access, yet the extent to which Australian telehealth policies embed health equity considerations remains unclear.

Methods: We conducted a systematic grey-literature review of Australian national and state/territory telehealth policies published between 2019 and 2024. Searches followed PRISMA-S principles and included government websites and targeted web searching. Policies were mapped to the 6A framework (Accessibility, Availability, Acceptability, Affordability, Adequacy, Awareness) and scored (0-4) for the extent of equity action.

Results: Fifteen policies met inclusion criteria. Equity was most commonly framed around rural/remote access. Actionable strategies were less consistently articulated for affordability, digital inclusion, culturally safe care, and monitoring of equity outcomes.

Conclusion: While policies emphasise geographic access, stronger commitments to affordability, digital inclusion, and equity monitoring are needed to ensure telehealth reduces rather than reinforces inequities.

4.2 Introduction

4.2.1 Background

Telehealth, the use of information and communication technologies to deliver care remotely, has become integral to healthcare delivery in Australia since the COVID-19 pandemic (1). It is a vital tool for improving access, particularly for people in remote or underserved regions (2). Australian governments, along with public and private healthcare providers, have embraced telehealth as a means to expand access, improve efficiency, and support continuity of care (3).

Across rural and remote Australia, several established telehealth programmes have delivered clear and measurable benefits. In digital psychology, the national MindSpot Clinic provides evidence-based assessment and treatment online and by phone and has reported clinically meaningful symptom improvements among regional and remote users (4). In allied health, the University of Queensland Telerehabilitation Clinic delivers occupational therapy remotely, enabling rehabilitation for patients with mobility limitations and those in geographically isolated areas, with outcomes reported as comparable to in-person care and with reduced travel burden (5). For children's communication needs, Royal Far West's Telecare for Kids provides school- and home-based speech-language therapy across regional New South Wales, demonstrating feasibility, high acceptability, and functional gains (6). In Aboriginal community-controlled primary care, an Indigenous-led virtual health service at Goondir Health Services in Queensland has improved culturally safe access and acceptability, as well as timeliness and continuity of care for community members (7). Together, these programmes show that when thoughtfully implemented, telehealth can bridge access gaps and reduce delays in care.

Despite these potential benefits, questions remain about the extent to which telehealth

initiatives adequately consider health equity. Health equity means eliminating differences in health outcomes among groups that are avoidable or can be remedied, particularly those based on social, economic, demographic, or geographic factors (8). It entails ensuring that “everyone has a fair opportunity to achieve their full health potential without disadvantages due to social status or other socially or geographically determined circumstances” (9). While this review primarily focuses on people living in rural and remote areas, Aboriginal and Torres Strait Islander peoples, and people experiencing socioeconomic disadvantage, it acknowledges broader dimensions of equity, including gender, disability, sexual orientation, and culturally and linguistically diverse (CALD) backgrounds, all of which intersect significantly with telehealth access and outcomes.

Health inequities continue to profoundly affect populations across Australia. First Nations Australians experience life expectancy gaps of approximately 8-9 years compared to non-Indigenous Australians (10). Rural and remote populations also face higher rates of preventable hospitalizations and increased mortality from conditions that could otherwise be managed effectively with timely healthcare access (11). These stark disparities underscore the critical need for innovative healthcare delivery models capable of addressing structural barriers to care.

Achieving health equity is a fundamental goal of the Australian healthcare system (12). Policies and strategies are continually developed to address the social determinants of health and reduce disparities (13). Telehealth is a promising tool in this context, offering innovative ways to improve access to healthcare services for people who have been marginalized by structural factors (2).

However, the implementation of telehealth must be carefully managed to ensure it does not inadvertently exacerbate existing inequities (13). For instance, telehealth can exacerbate

existing inequities when digital literacy barriers, inadequate internet infrastructure, or lack of suitable devices restrict access for people experiencing disadvantage (14). Older adults, people with disabilities, people from CALD backgrounds, and people living in lower-income households are at greater risk of being left behind if telehealth models are not designed with their needs in mind. Moreover, certain services that require hands-on physical examination or procedural care, complex diagnostics, or time-critical emergency interventions may not be appropriate for remote delivery.

To systematically evaluate how policies navigate these risks, this review applies the 6A framework, originally developed by Petchansky and Thomas and later expanded by Saurman to include six dimensions: Accessibility, Availability, Acceptability, Affordability, Adequacy, and Awareness (15, 16). The 6A framework is crucial because it provides a comprehensive lens for assessment. For example, a service may be technically Available, but it remains inequitable if users cannot afford data plans (Affordability) or if it lacks the language support and culturally safe arrangements required by Aboriginal and Torres Strait Islander and CALD communities (Acceptability). Systematically examining these dimensions is essential to determine whether policies are fostering genuine equity.

4.2.2 Rationale for the Review

Despite the potential of telehealth to enhance health equity, it is unclear whether and to what extent current government telehealth policies in Australia address this issue. Evidence shows that without intentional design, telehealth can miss those most affected by structural barriers and may even widen disparities (17, 18). Government policies are critical in shaping equitable telehealth by setting priorities, allocating resources, and establishing practice guidelines (19, 20). In Australia, such policies exist across national, state, and territory levels,

but their consistency and comprehensiveness regarding equity are unclear. Systematic analysis can reveal strengths, weaknesses, and opportunities to guide more inclusive future policy development.

4.2.3 Objectives

The primary aim is to assess how Australian national, state, and territory telehealth policies consider health equity. Specific objectives are:

1. To analyse how health equity is considered in national and state and territory telehealth policies and strategies.
2. To highlight gaps in current policies where health equity considerations are absent, insufficient or inconsistent.
3. To provide recommendations for policymakers to strengthen the consideration of health equity in telehealth policy and strategy making.

4.2.4 Terminology Clarification

In this review, we primarily use the term telehealth to refer to the delivery of health care services using telecommunications technologies, including both video and telephone consultations (21). The term digital health is broader, encompassing health-related digital infrastructure, data systems, and tools that go beyond direct clinical care (22). Virtual care is sometimes used in policy documents and usually refers to remote clinical services enabled by digital technology (23). While these terms are occasionally used interchangeably in source

documents, we use telehealth consistently throughout the manuscript unless citing specific policy documents that use alternative terms.

4.3 Methods

4.3.1 Search Strategy

We systematically collected and analysed grey literature on Australian telehealth policies at national, state, and territory levels. The search strategy followed PRISMA-S guidelines to ensure transparency and replicability (24).

Four main sources were searched:

1. Federal government websites: Including the Australian Department of Health and Aged Care and Australian Digital Health Agency portals
2. State and Territory government websites: Covering all eight Australian jurisdictions (NSW Health, VIC Health, QLD Health, WA Health, SA Health, TAS Health, NT Health, ACT Health)
3. Google site-restricted searches: Using the operator “site:.gov.au” to limit results to Australian government domains
4. Policy Commons database: A specialized repository for policy documents with geographic and temporal filters applied

The search strategy combined telehealth-related keywords (“telehealth,” “digital health,” “virtual care,” “telemedicine”) with policy-related terms (“strategy,” “framework,” “policy,” “guideline”) and geographic identifiers (e.g., “NSW,” “Victoria,” “Australia”). For the Policy Commons database, the specific Boolean query used was: (“telehealth” OR “digital health”

OR “virtual care” OR “telemedicine”) AND Australia AND (policy OR strategy OR framework OR guideline).

The search covered documents from 2019-2024, reflecting post-COVID-19 expansion of telehealth. This timeframe was chosen because the COVID-19 pandemic marked a turning point in telehealth policy development, prompting rapid adoption and reform of virtual care models across Australia. Eligible documents focused on telehealth (or related terms) and explicitly addressed health equity, disparities, people who are underserved by healthcare services, or access barriers. To ensure feasibility, the first five pages of results (~50 per source) were screened for each website search and Google site-restricted query. Title, abstract (where available), and full-text screening were consistently applied (see Section 4.3.2). Full search strings and results by source are detailed in Table A 10.

4.3.2 Selection Criteria

A three-stage screening process (title; abstract/executive summary where available; full text) aligned with PRISMA was used.

4.3.2.1 Inclusion criteria

Documents were included if they:

- Formally published by the Australian national, state, or territory governments;
- Published between 2019 and 2024;
- Focused on telehealth, including related terms such as “digital health,” “virtual care,” or “telemedicine,” in the context of a policy, strategy, framework, or guideline;

- Explicitly discussed health equity, health disparities, people who are underserved by healthcare services, or access barriers;
- Substantively addressed equity (see definition below);
- Remained current and relevant at the time of analysis (i.e., policies still in effect, under implementation, or guiding telehealth equity planning as of 2025).

Title screening was used to exclude documents clearly unrelated to healthcare or telehealth.

Abstracts or executive summaries (when available) were reviewed in the second stage to determine alignment with both telehealth and equity themes. Documents meeting both criteria proceeded to full-text review, during which keyword searches (e.g., “equity,” “Aboriginal,” “access,” “barriers,” “digital inclusion”) were used to identify substantive discussion of health equity.

4.3.2.2 Operational definition of “substantive discussion” of health equity

At full-text screening, a document was considered substantive if it met ≥ 1 of the following:

- Explicit equity aim/goal or principle (e.g., reducing disparities; “Closing the Gap”);
- Identified priority populations and barriers (e.g., Aboriginal and Torres Strait Islander peoples, rural/remote, CALD, disability, low-income groups);
- Specific strategies/actions mapped to any 6A dimension (e.g., interpreter provision; device/data subsidies);
- Measurement/monitoring of equity impacts (e.g., indicators, audit, reporting);
- Dedicated governance/funding directed to equity actions.

Documents excluded for “not substantively addressing equity” were those with only

generic/rhetorical mentions (e.g., “equitable access” as a value statement) without any of the five criteria appearing in strategy, implementation, or evaluation sections.

4.3.2.3 Exclusion criteria

Documents were excluded if they:

- Did not mention telehealth or equivalent terms;
- Did not substantively address health equity as defined above;
- Were published by non-governmental, academic, or private organisations (e.g., journal articles, opinion pieces);
- Focused solely on technical/administrative issues without policy implications;
- Had expired or been superseded by 2025.

4.3.3 Data Extraction

A standardised template was applied to ensure consistent data collection. Extracted information was grouped into four domains:

- General details - author(s), publication date, title, document type, source, and geographic scope (national or state/territory).
- Content summary - concise overview of telehealth policy or strategy.
- Equity relevance - direct quotations and analysis of how health equity was addressed.
- Actionable insights - identified gaps, areas for improvement, and recommendations.

4.3.4 Analysis

We applied content and thematic analyses, organised in Excel. Content analysis quantified the frequency of equity-related terms in each policy, while thematic analysis identified common themes, gaps, and actionable insights. To guide the assessment, we used the 6A framework (15, 16, 25), a model of healthcare access encompassing Accessibility, Availability, Acceptability, Affordability, Adequacy, and Awareness.

4.3.4.1 Keyword Identification and Coding Process

To operationalise “equity” for content analysis, we developed an a priori dictionary of equity-related terms anchored in the 6A framework. Terms were derived from: (1) mapping key concepts from each 6A dimension; (2) reviewing telehealth-equity literature (including our umbrella review) to capture common constructs and synonyms; and (3) incorporating Australian-specific terminology (e.g., Aboriginal, Torres Strait Islander, CALD). The dictionary was finalised before full coding and applied uniformly.

The dictionary was used for case-insensitive text searches, with additional full-text review to capture implicit equity content mapped to 6A domains even when “equity” was not stated (e.g., device/data subsidies → Affordability; interpreter provision, Aboriginal workforce, or co-design → Acceptability).

For transparency, Table 4.1 lists the representative keywords and concepts used for each 6A domain (the list is comprehensive for our analysis but not intended to be exhaustive of all possible phrasing in policy). One reviewer (SW) conducted coding using the predefined dictionary; co-authors oversaw its development and reviewed outputs for consistency.

Table 4.1 Complete list of equity-related terms and concepts mapped to the 6A framework (dictionary used in content analysis)

6A Dimension	Key Terms and Concepts Searched
Accessibility	Geographic location, transportation accessibility, broadband access, infrastructure, rural and remote access, connectivity, travel barriers, distance, isolation, low bandwidth/telephone options
Availability	Availability, telehealth service provision, workforce distribution, clinical capacity, operational hours, waiting times, service shortages, specialist access, healthcare workforce, resource allocation, referral pathways
Acceptability	Acceptability, cultural safety/competence, culturally appropriate, interpreters, language support, CALD, diversity, Aboriginal, Torres Strait Islander, First Nations Australians, disability inclusion, person-centred, privacy, confidentiality, trust, co-design, community engagement, community health worker; Aboriginal workforce
Affordability	Affordable, affordability, cost, costs, out-of-pocket, co-payment, subsidy, reimbursement, financial barriers, funding, device cost, data plan/internet cost, bulk billing, economic, low-income plans
Adequacy	Quality of service, evaluation, monitoring, health system integration, long-term sustainability, assessment, outcomes, effectiveness, quality assurance, performance, continuity of care
Awareness	Digital literacy, telehealth education, information dissemination, community outreach, promotion, communications, plain-language, multilingual materials, health literacy, digital skills, training, knowledge, navigation support; care coordinators
General equity terms	equity, equitable, disparities, marginalised, underserved, disadvantaged, socioeconomic, digital divide, digital inclusion, barriers, First Nations, LGBTQIA+

4.3.4.2 Thematic Analysis

For thematic analysis, flagged excerpts were organised under the six dimensions of the 6A framework. For instance, texts related to geographic location, transportation accessibility, or infrastructure were classified under Accessibility. References to service provision, workforce, or operational capacity were mapped to Availability. Mentions of costs, subsidies, or reimbursement were assigned to Affordability. Content addressing cultural appropriateness or

specific needs of people disproportionately affected by structural barriers to care was grouped under Acceptability. Initiatives promoting digital literacy, outreach, and information dissemination were grouped to Awareness. Finally, evidence of assessment mechanisms, monitoring, or organisational support was coded as Adequacy.

4.3.5 Scoring Scale for Equity Considerations in Policies

To enhance the assessment, a scoring scale was developed to quantify the extent to which equity considerations were addressed across the identified themes in each policy, with scores ranging from 0 to 4:

- 0 = Not addressed - no reference to equity or related concepts;
- 1 = Brief mention - equity referenced only in passing or rhetorically;
- 2 = General discussion - equity recognised but without clear strategies;
- 3 = Detailed strategies - explicit strategies or actions proposed, but limited in scope;
- 4 = Comprehensive and actionable strategies - systematic, well-defined, and implementable measures.

Scoring was undertaken by one reviewer (SW) based on predefined criteria. Co-authors (AW, SN, AK) contributed to the development and refinement of the scale, reviewed the application of scores, and provided oversight to ensure consistency and appropriateness. Queries raised during review were discussed and resolved by consensus prior to finalisation. While independent dual scoring was not performed due to resource constraints, the collaborative review process enhanced reliability.

4.3.6 Reflexivity Statement

Our analysis was shaped by the research team's backgrounds in public health, health services, and digital health, which may have led to greater emphasis on geographic and socioeconomic disparities. To reduce bias, we: (1) applied the 6A framework to structure coding and limit subjective interpretation; (2) defined explicit criteria for what constituted substantive discussion of equity; (3) conducted data extraction and coding by the first author (SW) with regular co-author (AW, SN, AK) oversight and validation; and (4) ensured transparency through detailed reporting of search strategies and scoring criteria.

4.3.7 Ethical Considerations

All information was sourced from publicly accessible government documents. No individual specific sensitive or confidential information was accessed during the review. No Human Research Ethics Committee approvals were required for this research.

4.4 Results

4.4.1 Document Selection

The searches yielded 4,756 records: 2,500 from federal and state/territory websites, 250 from Google site-restricted searches, and 2,006 from Policy Commons. After de-duplication and removal of irrelevant or technical documents, 32 records were retained for screening.

Of these, 24 underwent full-text review, and 15 policy documents met the inclusion criteria. Seven excluded documents contained no substantive mention of equity; these are listed in

Table A 11. The selection process is shown in Figure 4.1.

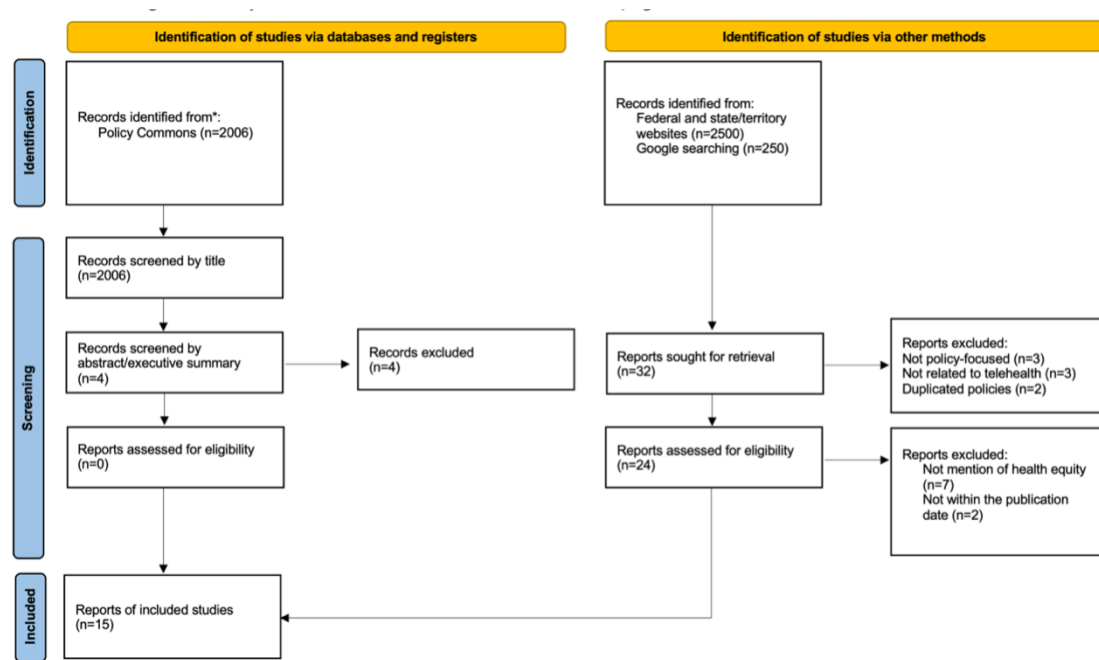


Figure 4.1 Flowchart of document selection process

4.4.2 Characteristics of Included Documents

The 15 included documents (Table 4.2) spanned national and state/territory levels. Most of the documents were Strategic Plans (10), of which nine were state/territory-level initiatives (9 out of 10). Two were described as Frameworks (one national and one state level), another two were described as national Guidelines (2) and one as a national level Action Plan (1). Given varied terminology, we refer to them collectively as policies and strategies.

Table 4.2 Policy type and geographic scope distribution of included documents

Document Type	Number of Documents	National Level	State/Territory Level
Strategic Plans	10	1(37)	9(27, 31-36, 40, 42)

Document Type	Number of Documents	National Level	State/Territory Level
Frameworks	2	1(30)	1(38)
Guidelines	2	2(47,48)	0
Action Plans	1	1(39)	0
Total	15	5	10

4.4.3 Common Equity-Related Terms

We searched for a broader set of equity-related keywords, but only those terms that appeared at least once were reported. The term “Access” or “Accessible” appeared most frequently, with 714 mentions, highlighting the central role of improving healthcare access in telehealth initiatives. Terms related to “Rural and Remote” were the next most common terms (257 mentions), emphasizing the priority placed on addressing geographical barriers. Other frequently mentioned terms included “Cost/costs/costly”, “Equity” or “Equitable”, “Cultural”, and “Financial/ financially” (59 to 109 mentions). These references reflect ongoing efforts to promote financial accessibility and culturally appropriate healthcare services within policies. However, terms such as “Affordability”, “Availability” and “socioeconomic” were mentioned considerably less often (16-29 mentions), suggesting that cost-related challenges and resource allocation may not be comprehensively addressed. “Digital Inclusion”, “Diversity”, “Indigenous”, and “Disparities” appeared infrequently (5-12 mentions), indicating areas where greater attention may be needed to ensure inclusivity and equity for all groups. Lastly, “Broadband” and “Digital divide” (3 mentions each) were scarce, suggesting under-appreciation of infrastructure and connectivity challenges as equity

issues in telehealth implementation.

4.4.4 Themes Identified Through Thematic Analysis

The thematic analysis generated several key themes regarding how health equity is addressed in these telehealth policies and strategies. Table 4.3 summarizes these themes, their sub-themes, and examples from the analysed documents.

Policies and strategies frequently emphasised improving digital accessibility, ensuring affordable services, and reducing geographic barriers, particularly in rural and remote areas. However, limited broadband infrastructure and affordability gaps were consistently highlighted as significant remaining issues. Efforts to improve digital literacy and subsidize access to devices and internet connections were highlighted. Indigenous health was often prioritised, with examples of culturally tailored care models. Tailored approaches for CALD populations were mentioned. Policies identified people who may face greater barriers to care, including people with disabilities and older adults. Equity impact assessments were identified as crucial for ensuring telehealth does not exacerbate disparities. Collaboration and co-design emerged as critical themes in promoting equity.

Table 4.3 Key themes and sub-themes identified in telehealth policies

Key Themes:	Sub-themes:	Associated 6A Dimensions	Examples from Policies
Equity in Healthcare Access	Digital Accessibility	Accessibility, Availability	<p><i>“Connectivity, bandwidth, and digital disadvantage in remote and other locations are recognised challenges that need to be addressed to ensure equitable access to telehealth services.”</i></p> <p>(Queensland Government, 2021, Page 9) (27)</p>
	Geographic Equity	Accessibility, Availability,	<p><i>“Telehealth enabled care offers the greatest benefit to rural and remote communities, enabling high quality care without the need to travel to a large tertiary hospital....”</i></p> <p>(Queensland Government, 2021, Page 6) (27)</p>
	Affordability	Affordability	<p><i>“The Strategy endeavours to support services that are fit for purpose, affordable to people and our system, and accessible to all stakeholders. This includes those with limited access to digital technologies, goods, and services.”</i></p> <p>(Northern Sydney region, 2021, Page 9) (36)</p>
Digital Inclusion	Improving Digital Literacy	Awareness	<p><i>“Any designs must be mindful of the requirements of consumer groups with poor connectivity and/or low digital literacy.”</i></p> <p>(Western Australia, 2020, Page 8) (33)</p>
	Subsidizing Devices and Internet	Affordability	<p><i>“For personal devices to become a core information source for clinical care and personal health management, their cost must support inclusive and equitable service delivery. Similarly, digital health relies on the ability of healthcare provider organisations, individuals, and families to share health information and data. This means that access to broadband infrastructure at a reasonable price is essential.”</i></p> <p>(Australian Digital Health Agency, 2023, Page 20) (37)</p>
Cultural Competence and Inclusion	Indigenous Communities	Acceptability	<p><i>“Hospital care integrated with local Indigenous care to meet the patient’s needs and preferences... This provides culturally appropriate care, tailored to meet the needs of Indigenous populations and improving health outcomes for these communities.”</i></p>

Key Themes:	Sub-themes:	Associated 6A Dimensions	Examples from Policies
			(Queensland Government, 2021, Page 19) (27)
	Culturally and Linguistically Diverse (CALD) Populations	Acceptability	<p><i>“Any information would be contextualized for the individual consumer based on their demographic profile (e.g., location, culturally and linguistically diverse (CALD) groups).”</i></p> <p>(Western Australia, 2020, Page 8) (33)</p>
	Targeted Approaches	Acceptability	<p><i>“Create models that are culturally safe, inclusive, and appropriate for diverse groups in Victoria including: people living in rural and regional areas, older people, Aboriginal Victorians, people from diverse cultural and language backgrounds, people with disability, people experiencing mental health issues, and people who are homeless.”</i></p> <p>(Victorian Government, 2023, Page 11) (35)</p>
	Community Health Workers	Adequacy, Awareness	<p><i>“Consideration in the implementation of Virtual Care needs to ensure that it is culturally safe for all patients and NSW Health workforce... The Aboriginal workforce will be instrumental in ensuring that Aboriginal patients are provided with Virtual Care opportunities.”</i></p> <p>(NSW Health, 2022, Page 15) (40)</p>
Monitoring and Evaluation of Equity Outcomes	Equity Impact Assessments	Adequacy	<p><i>“A defined equity action plan will ensure that virtual care improves the access and effectiveness of healthcare for all Territorians by understanding the potential impacts on vulnerable populations. Appropriate measures will be monitored to avoid worsening existing disparities.”</i></p> <p>(NT Health Virtual Care Strategy, 2021, Page 12) (34)</p>
Collaborative Approaches and Stakeholder Engagement	Community Involvement	Acceptability, Awareness	<p><i>“Collaboration with Indigenous communities will ensure that digital health solutions are culturally safe and aligned with the health needs of Aboriginal and Torres Strait Islander peoples, with a focus on supporting digital inclusion and data sovereignty.”</i></p>

Key Themes:	Sub-themes:	Associated 6A Dimensions	Examples from Policies
			(The Department of Health and Aged Care, 2023, Page 19) (39)
	Co-design of Services	Adequacy	<p><i>“Actively increase the level of co-design with consumers. Example activities to achieve this include:</i></p> <ul style="list-style-type: none"> • <i>Promote an approach to identify digital champions in the community and enable consumer representatives to participate in an informed way and beyond their own experience</i> • <i>Build capacity of consumer representatives and staff to work together in the development and implementation of digital health solutions.”</i> <p>(NSW Government, 2022, Page 37) (40)</p>

4.4.5 Depth of Equity Considerations

To assess the extent to which equity was substantively integrated across telehealth policies, each document was evaluated against five thematic domains:

- (1) Equity in Healthcare Access,
- (2) Digital Inclusion,
- (3) Cultural Competence and Inclusion,
- (4) Monitoring and Evaluation of Equity Outcomes, and
- (5) Collaborative Approaches and Stakeholder Engagement.

Scores were assigned using the five-point scale described in Section 4.3.5, ranging from 0 (Not Addressed) to 4 (Comprehensive and Actionable Strategies). Table 4.4 presents a comprehensive assessment matrix showing how each policy document performed across the

five equity dimensions. The bolded scores (3 or higher) indicate policies that provided detailed, actionable strategies rather than general statements of intent.

Across the 15 policies, healthcare equity was the strongest domain, with 13 documents scoring 4. Digital inclusion was less consistently addressed, with only five scoring ≥ 3 .

Cultural competence and inclusion showed variation: 10 policies, mainly from states/territories (e.g., NSW, VIC, NT, TAS), scored 4 with detailed strategies such as Indigenous-focused care, CALD digital access, and co-design initiatives (Table 4.3). In contrast, most national policies scored only 1-2, offering limited implementation detail (e.g., the 10 Minimum Standards for Telemedicine).

Stakeholder engagement was also stronger in state-level policies. NSW strategies, for instance, specified digital champions, consumer participation, and culturally appropriate workforce initiatives, with three of four documents scoring 3-4 (Table 4.4). National policies tended to score 1-3, with less actionable language.

Monitoring and evaluation remained the weakest area. Most national documents scored only 1, lacking structured frameworks, while individual state policies (e.g., NT Health Virtual Care Strategy, Victorian and Tasmanian strategies) included action plans and monitoring processes, achieving scores of 3.

Overall, state and territory policies demonstrated stronger commitments than national ones, though findings reflect qualitative scoring without statistical testing.

Table 4.4 Depth of equity considerations across key themes

Document Name	Jurisdiction	Equity in Healthcare Access	Digital Inclusion	Cultural Competence and Inclusion	Monitoring and Evaluation of Equity Outcomes	Collaborative Approaches and Stakeholder Engagement
National Digital Health Strategy 2023-2028 (37)	National	4	4	2	3	3
Action Plan for the Digital Health Blueprint 2023-2033 (39)	National	4	2	4	1	2
Australian Digital Health Capability Framework -A standard framework in digital health capabilities for those working in health and care (30)	National	4	3	4	1	3
10 Minimum Standards for Telemedicine (48)	National	2	1	1	1	1
10 Minimum Standards for Advancing Digital Health in General Practice (47)	National	2	1	1	1	1
NT Health Virtual Care Strategy (34)	NT	4	3	4	3	2
Strengthening our Health System Strategy (2020 - 2025) (42)	NT	4	2	4	1	3
Digital Health Transformation Strategy (2022 to 2032) (31)	TAS	4	2	4	3	3
WA Health Digital Strategy 2020-2030 (33)	WA	4	2	2	2	3

Document Name	Jurisdiction	Equity in Healthcare Access	Digital Inclusion	Cultural Competence and Inclusion	Monitoring and Evaluation of Equity Outcomes	Collaborative Approaches and Stakeholder Engagement
Telehealth Strategy 2021-2026 (27)	QLD	4	2	2	1	3
Victorian virtual care strategy (35)	VIC	4	3	4	3	3
DIGITAL STRATEGY 2021- 2026 (36)	NSW	4	3	4	3	4
Digital Health Strategy 2022-2027 (32)	NSW	4	2	4	3	4
NSW Virtual Care Strategy 2021-2026 (40)	NSW	4	2	4	3	2
Sydney North Health Network (SNHN) Digital Health Strategy 2021 (38)	NSW	4	2	4	3	3

4.4.6 Summary of Gaps and Actionable Insights

The analysis identified gaps across key equity themes, with corresponding actionable insights to strengthen telehealth policies. Responsible stakeholders were determined through analysis of: (1) existing policy mandates and jurisdictional responsibilities within the Australian health system, (2) current organizational roles as identified in the reviewed policy documents, and (3) stakeholder patterns referenced across multiple policies. Table 4.5 summarises the gaps and recommendations.

Table 4.5 Summary of gaps and actionable insights across included telehealth policies

Theme	Gaps and Areas for Improvement	Actionable Insights	Responsible Stakeholders
Equity in Healthcare Access	Limited detail on overcoming systemic barriers (e.g., affordability).	Implement subsidies or cost-sharing models to make telehealth services affordable.	Department of Health and Aged Care
	Insufficient focus on underserved areas beyond general mentions.	Launch regional pilot programmes to enhance telehealth delivery in rural and remote areas.	State Health Department
Digital Inclusion	Lack of targeted digital literacy programmes for people and communities experiencing health disadvantage (e.g., elderly, disabled)	Create community-driven initiatives to improve digital literacy and device usage.	Australian Digital Health Agency; Community Organisations
	Insufficient access to affordable devices and connectivity.	Partner with telecom companies to provide affordable or subsidized internet and devices.	Department of Infrastructure; NBN Co; Services Australia
Cultural Competence and Inclusion	Policies often highlight Indigenous and CALD needs but lack implementation details.	Involve Indigenous and CALD leaders in co-designing culturally appropriate telehealth services.	State and Territory Health Departments
	Limited cultural competence training for healthcare workers.	Invest in training healthcare providers on cultural awareness and service adaptation.	State Health Departments
	Absence of LGBTQIA+ community considerations in all reviewed policies.	Include sexual and gender minority populations in equity frameworks and service design.	State and Territory Health Department; LGBTQIA+ Health Australia
Monitoring and Evaluation of Equity Outcomes	Few policies define measurable equity metrics or propose impact assessments.	Develop clear KPIs (e.g., telehealth adoption rates among people who are underserved by healthcare services, improvements in healthcare outcomes).	Australian Institute of Health and Welfare
	Lack of transparency in monitoring and reporting on equity progress.	Introduce regular equity audits and publicly share progress reports to ensure accountability.	State and Federal Health Departments

Theme	Gaps and Areas for Improvement	Actionable Insights	Responsible Stakeholders
	Insufficient evaluation of long-term sustainability and scalability of equity interventions.	Establish systematic evaluation frameworks to assess programme sustainability and scalability across different contexts.	Australian Institute of Health and Welfare; State Health Departments
Collaborative Approaches and Stakeholder Engagement	General mentions of stakeholder engagement, with little evidence of actionable plans.	Foster public-private partnerships with technology companies to scale digital health innovation.	Local Health Districts
	Limited involvement of local communities in designing telehealth initiatives.	Actively involve communities in the co-creation of telehealth policies tailored to their needs.	Local Health Districts

4.5 Discussion

Our recent umbrella review applied the 6A framework to assess telehealth equity (15, 16, 26). Using the same lens, this policy analysis examined Australian telehealth strategies across the six dimensions. Of 24 full-text documents screened, 15 met inclusion criteria; seven contained no equity references, underscoring substantial gaps and the absence of equity considerations in parts of the policy landscape.

4.5.1 Equity in Healthcare Access

The analysis showed a strong emphasis on improving geographic accessibility. Terms such as “access” and “rural and remote” appeared frequently (714 and 257 mentions respectively), reflecting recognition that telehealth can help overcome distance-related barriers, reduce travel time, and extend specialized services to underserved areas.

However, this geographic focus, while important, may overshadow other critical access

barriers. The relatively low frequency of terms such as “digital divide” (3 mentions) and “broadband” (3 mentions) indicates that infrastructure challenges, which are fundamental to telehealth accessibility, receive insufficient policy attention. For example, the Queensland Telehealth Strategy acknowledges that connectivity, bandwidth, and digital disadvantage in remote and other locations are recognised challenges but offers limited specific strategies to address them (27). Without targeted investment in digital infrastructure, telehealth risks remaining inaccessible to the communities it aims to serve.

4.5.2 Digital Inclusion

Digital inclusion was inconsistently addressed, with only five policies scoring 3 or higher in this domain (Table 4.4). While connectivity was often acknowledged, digital literacy and the affordability of devices and data received limited attention. True inclusion requires reliable internet, user skills and confidence, and the financial means to sustain access (28, 29).

Without targeted measures, existing disadvantages may persist or widen as telehealth expands.

To implement digital literacy programmes effectively, policymakers could fund targeted, community-led initiatives through mechanisms such as local Primary Health Networks (PHNs) or state-funded digital inclusion grants. Programmes should be co-designed and delivered in collaboration with public libraries, community centres, and Aboriginal Community-Controlled Health Organisations (ACCHOs), tailored to the needs of older adults, CALD populations, and people with disabilities. These programmes may include one-on-one coaching, multilingual support materials, and partnerships with trusted service providers.

4.5.3 Affordability

Affordability was under-addressed, with only 16 mentions across all documents. Many policies acknowledged financial barriers but offered few concrete mechanisms (30-35). For example, the Northern Sydney region's strategy emphasised supporting “services that are affordable to people and our system,” but lacked specific mechanisms to achieve this goal (36).

Where measures existed, they varied by jurisdiction and were largely indirect, reducing costs via virtual care that minimises travel and hospitalisation (27, 34), ensuring sustainable funding and reimbursement mechanisms (e.g., integration with the Medicare Benefits Schedule) (37), providing loan devices or bundled connectivity for patients (32), supporting digital literacy to avoid additional access costs (38), and emphasising financial sustainability through value-based care models and coordinated investment strategies (35, 39). For example, the Sydney Local Health District strategy commits to providing loan mobile devices and data packages to virtual care patients, reducing out-of-pocket costs for those without reliable access (32).

A comprehensive approach should consider consultation fees and the costs of devices, connectivity, and technical support. Policymakers could expand existing models through means-tested subsidies, standardised bulk-billing arrangements for telehealth, public-private partnerships with telecommunications providers to reduce data costs, and discounted device programmes for low-income populations.

4.5.4 Cultural Competence and Inclusion

In alignment with the Acceptability dimension, many policies acknowledged the importance of culturally appropriate care, with 10 policies scoring 4 in this domain. However, a critical gap exists between recognition and implementation. While policies frequently acknowledged culturally appropriate care (“cultural” mentioned 88 times and “Indigenous” appearing 12 times), most provided limited detail on how culturally safe telehealth services would be delivered in practice (37) (27, 33) (40) (32). For instance, the Victorian Virtual Care Strategy identified the need to “create models that are culturally safe, inclusive, and appropriate for diverse groups including Aboriginal Victorians, people from diverse cultural and language backgrounds, people with disability,” yet offered limited guidance on implementation mechanisms (35).

To ensure telehealth services are genuinely inclusive, policies must embed specific, measurable actions. This includes investing in mandatory cultural safety training for the healthcare workforce, promoting the recruitment of a diverse workforce (including Aboriginal Health Workers), and ensuring that telehealth platforms offer language support and are co-designed with community representatives. Notably, most policies did not reference LGBTQIA+ communities, despite evidence that these groups face distinct barriers in accessing healthcare (41). This omission limits the comprehensiveness of equity considerations.

4.5.5 Monitoring, Evaluation, and Integration

Adequacy emerged as the most underdeveloped dimension, encompassing service quality, monitoring and evaluation, health system integration, and long-term sustainability. While

several policies mentioned evaluation, no policy achieved a score of 4 in this domain, and 7 of 15 scored only 1-2 (see Table 4.4), making monitoring and evaluation the only dimension without any comprehensive and actionable strategy.

The limited attention to sustainability represents a critical gap. Many policies lacked clear strategies to ensure quality assurance, coordinate care across modalities, or sustain services over time (30, 39) (42) (27). For telehealth to genuinely advance health equity, services must not only be accessible but also of high quality, well-integrated with existing health systems, and financially and operationally sustainable over the long-term.

Future policies must establish clear, measurable key performance indicators (KPIs) to track equity outcomes, such as telehealth adoption rates among different socioeconomic, cultural, and geographic groups, and corresponding changes in health outcomes. Regular, transparent reporting through equity audits would ensure accountability. Furthermore, stakeholder consultation and co-design processes are critical mechanisms for ensuring service quality and effective health system integration.

4.5.6 Collaborative Approaches

The importance of engaging communities and partners, particularly local communities, Indigenous groups, and people experiencing health disadvantage, emerged as a key theme reflecting the Awareness dimension. Some policies acknowledged the value of community co-design and collaboration with private and public sector partners (32, 42). However, the extent to which these recommendations will be operationalized remains uncertain. Genuine co-design processes not only ensure Acceptability by incorporating community values but also boost Awareness and trust (43).

4.5.7 Reflections on the 6A Framework and Next Steps

The 6A framework was useful for systematically assessing policy, offering a holistic view of access and revealing where equity is recognised but not operationalised. To better fit digital health contexts, it should be augmented with additional considerations, including data privacy and digital trust, algorithmic bias and AI integration, digital sovereignty for Indigenous communities, and policy sustainability (44-46). These factors increasingly shape the fairness and effectiveness of telehealth and merit explicit integration.

Building on these insights, our next step is to develop a practical, equity focused assessment tool, such as a checklist or scoring instrument, that embeds the enhanced 6A dimensions and supports both policy design and programme evaluation. Such a tool would help decision makers embed equity from the outset and monitor progress over time, positioning telehealth not only as an access solution but also as a vehicle for health justice.

4.5.8 Limitations

This study has several important limitations that should be considered when interpreting the findings.

Search Strategy and Document Selection: Although guided by PRISMA-S, we limited Google screening to the first five results pages (~50 records per query) to balance feasibility and reproducibility with available time and resources. This may have excluded lower-ranked but relevant items, especially given result variation from personalisation and geolocation. We mitigated this by using site-restricted queries, hand-searching federal and state/territory

portals, and cross-checking Policy Commons, but some documents may have been missed. Future reviews could expand page screening and consult policy experts to identify additional sources.

Subjective Scoring: The development and application of our 0-4 scoring scale for assessing equity considerations, while providing a systematic framework for evaluation, introduced an element of subjectivity that could affect the reliability of our results. The scoring process was conducted primarily by one reviewer (SW), with oversight and validation from co-authors (AW, SN, AK), but formal inter-rater reliability testing was not performed. Future studies would benefit from multiple independent reviewers and formal reliability testing to strengthen the methodological rigor of policy assessment frameworks.

Operational Definition and Classification: Our definition of “substantively addressing equity” required at least one of five criteria, which may misclassify policies that address equity implicitly. We sought to reduce false negatives by mapping implicit content (for example, device and data subsidies, interpreter provision, Aboriginal workforce initiatives, co-design requirements) to the 6A domains, but some nuance may remain uncaptured. Expert panels or qualitative interviews could refine classification.

Exclusion of Internal and Draft Policies: Internal drafts, working documents, and unreleased reforms were excluded. These materials may contain more detailed equity strategies, so our findings may underestimate policy intent. Partnerships with government agencies could enable secure access in future work.

Limited local-level implementation detail: The review focused on high-level policies and may not capture operational practices or local adaptations. Although some regional strategies were included, a comprehensive review of local implementation was beyond scope. Future research should include implementation studies and stakeholder interviews at the service

delivery level.

Temporal Constraints and Policy Currency: We focused on documents published between 2019 and 2024 to reflect the post-pandemic expansion of telehealth, and included only those current as of 2025. However, the rapidly evolving digital health policy landscape means some documents may have been updated or superseded. These findings represent a snapshot in time. Longitudinal tracking and periodic policy updates are recommended for future work.

4.6 Conclusion

This policy review and analysis examined how health equity is addressed within Australian national, state, and territory telehealth policies. The findings show that while improving access (especially for rural and remote communities) consistently emerged as a core objective, considerations of affordability, digital literacy, cultural competence, and comprehensive evaluation frameworks were less developed. Although all reviewed documents acknowledged health equity as an important goal, the level of detail and the specificity of implementation strategies varied widely.

The analysis revealed that the Adequacy dimension, which includes service quality, monitoring and evaluation, health system integration, and sustainability, was the most underdeveloped across policies. Without robust evaluation frameworks and sustainable implementation strategies, even well-intentioned telehealth initiatives risk failing to deliver lasting equity improvements or may inadvertently worsen disparities.

True equity in telehealth requires proactive efforts to ensure affordable services, the provision of devices and reliable connectivity for people who are underserved by healthcare services, culturally tailored care models for Indigenous and CALD communities, and regular

monitoring of equity outcomes. Moreover, meaningful community and partner engagement, particularly with community members, people experiencing disadvantage, and people from diverse backgrounds, is necessary for telehealth solutions to be truly responsive and inclusive.

Strengthening policies with measurable targets, comprehensive evaluation, and sustainability planning is critical. We recommend establishing baseline equity indicators within 6-12 months, embedding equity assessment frameworks in new initiatives within 2-3 years, and institutionalising annual equity audits with dedicated funding to support long-term impact.

Australia's experience as one of the world's most advanced digital health landscapes offers valuable lessons for international policy development. Our findings align with the World Health Organization's Global Strategy on Digital Health 2020-2027, which emphasises that digital health interventions must be designed with explicit attention to equity and inclusion to avoid exacerbating health disparities (20). Even in well-resourced health systems like Australia's, our analysis demonstrates that deliberate policy frameworks are essential to prevent telehealth from widening existing inequities. The systematic 6A framework approach demonstrated here provides a replicable model for global policy assessment, while identified gaps in affordability, digital inclusion, and equity monitoring likely reflect broader international challenges that require coordinated attention as outlined in WHO's global strategy.

Only through such systematic attention to all dimensions of access can telehealth fulfill its potential as a tool for health justice rather than inadvertently perpetuating existing disparities.

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Chapter 5 Health Equity in Telehealth: Demonstrating a Nine-Dimension Equity Framework in Two Australian Programmes

Purpose of this chapter

To evaluate how equity is addressed in the design and implementation of Australian telehealth programmes, a comparative case study of the Virtual Rural Generalist Service (VRGS) and the RPA Virtual Hospital was undertaken. Using the nine-dimension telehealth equity framework developed in earlier chapters, this chapter systematically assesses and compares equity considerations across both programmes and identifies key gaps relevant to equitable telehealth delivery.

5.1 Abstract

Background: Telehealth has expanded rapidly, yet evaluation approaches do not consistently operationalise equity across both proximal access determinants and system-level enablers. Existing approaches often emphasise selected aspects of access or state broad principles without providing an operational structure for systematic programme-level assessment.

Objective: To develop and demonstrate a comprehensive equity framework for telehealth evaluation that can be applied across programme design, implementation, and evaluation.

Methods: We developed a nine-dimension framework through iterative synthesis across the preceding thesis components, including a systematic review of equity-related frameworks relevant to telehealth and digital health, synthesis of telehealth equity and access evidence (2012-2023), analysis of Australian telehealth policies (2019-2024), and research team consultation and pilot refinement. The framework distinguishes five core dimensions, covering access, affordability, digital capacity, inclusion, and quality and outcomes, and four supporting dimensions, covering privacy and security, governance, sustainability, and health system integration. We then applied the framework to two Australian telehealth programmes, a metropolitan multi-stream virtual hospital and a rural hospital-support service, using programme documentation, peer-reviewed literature, and factual stakeholder verification of extracted information. Implementation depth was summarised using a standardised 0-4 rubric. Where relevant evidence was unavailable in the reviewed materials, items were recorded as not reported.

Results: Application of the framework was feasible across both delivery models and provided more systematic coverage than utilisation and aggregate outcomes reporting alone. Coding items as not reported highlighted recurring evidence gaps in the reviewed materials, including limited equity-stratified reporting of platform performance and clinical outcomes at whole-of-

programme level, unclear equity-related commissioning or reporting expectations, and limited publicly visible accountability signals.

Conclusions: This framework may provide a practical foundation for more systematic telehealth equity evaluation across the programme lifecycle, and could inform minimum equity reporting standards for more equitable telehealth implementation.

5.2 Introduction

Telehealth has expanded rapidly in Australia and internationally, accelerated by the response to the COVID-19 pandemic and by ongoing pressures on health systems to improve access, efficiency, and continuity of care (1). While telehealth has been promoted as a strategy to enhance access and service flexibility, its implications for health equity remain mixed and context-dependent (2). Evidence suggests that telehealth can reduce geographic barriers to care (3), but it can also widen existing inequities when disadvantaged groups face challenges related to affordability, digital literacy, cultural appropriateness, continuity of care, or the availability of enabling infrastructure and support (2, 4, 5).

Recent Australian telehealth policy documents frequently invoke equity, particularly in relation to rural and remote access, but provide fewer concrete measures to ensure affordability, digital inclusion, clinical equivalence of care, or systematic monitoring of impacts (6, 7). More broadly, existing telehealth evaluation approaches do not consistently provide an operational structure for examining equity across both proximal access determinants and system-level enablers. Some approaches focus primarily on selected aspects of access or utilisation, while others articulate broad equity principles without specifying how these should be examined systematically at programme level (2, 5, 8). In the earlier chapters of this thesis, the 6A framework proved useful as an interpretive lens for examining access-related evidence, frameworks, and policy. However, those analyses also highlighted additional telehealth-specific determinants that are not fully captured by access concepts alone, including digital capability support, privacy and trust, governance, sustainability, and system integration.

For this reason, a more explicitly operational framework was needed for the case study component of the thesis. The intention was not to replace earlier access frameworks, but to

extend them into a telehealth-specific evaluative structure that could be applied to programme design, implementation, and available evaluation evidence. The nine-dimension framework presented in this chapter therefore emerged iteratively from the preceding thesis components, including synthesis of telehealth equity and access evidence, review of health equity and digital health frameworks, analysis of Australian telehealth policies, and iterative refinement within the multidisciplinary research team. It was designed as a practical tool for structured comparative assessment rather than as a definitive ranking instrument. This clarification responds directly to the concern that the chapter currently moves too quickly from earlier reviews to framework application without a sufficiently explicit statement of the gap being addressed.

Australia provides a particularly relevant setting for this work. Its dispersed population, substantial rural and remote disadvantage, diverse metropolitan populations, and sustained telehealth expansion create an important context in which to examine how equity considerations are operationalised in practice (9). These challenges are shaped not only by geography, but also by differences in digital infrastructure, socioeconomic resources, cultural and linguistic diversity, workforce capacity, and the degree of health system integration.

The present study applies the framework to two contrasting Australian telehealth programmes: the RPA Virtual Hospital (RPAV), a metropolitan tertiary-led initiative extending acute, subacute, and community care across Sydney and selected regional districts (5), and the Virtual Rural Generalist Service (VRGS), which supports small rural hospitals across Western New South Wales(10). In this chapter, the term virtual care is used where appropriate to reflect the broader service scope of the selected case studies, while remaining analytically aligned with the thesis focus on telehealth. Using the framework, we synthesise existing documentation and evaluation evidence, supplemented by information from

programme leads, to examine how equity considerations were addressed, partially addressed, or not reported. The intention is not to determine which programme performed “better”, but to demonstrate the practical applicability of the framework across contrasting service contexts. This also addresses the concern that the framework might otherwise be interpreted as a ranking device rather than as a structured tool for identifying strengths, gaps, and shared system-level constraints.

This chapter has two linked aims. First, it introduces the nine-dimension telehealth equity framework and explains the rationale for its component dimensions. Second, it applies the framework to two Australian telehealth programmes, RPA Virtual Hospital (RPAV) and the Virtual Rural Generalist Service (VRGS), to illustrate how it can be used in practice and to identify where programme-level equity evidence remains limited. By doing so, the chapter contributes a practical basis for strengthening telehealth equity evaluation while remaining cautious about claims of formal framework validation.

Objectives

This study aimed to:

1. apply a nine-dimension telehealth equity framework to two major Australian virtual care programmes to demonstrate feasibility and practical usefulness;
2. assess the extent to which equity considerations were explicitly incorporated, partially addressed, or not reported in programme design, implementation strategies and reported outcomes, drawing on verified programme data;

3. use structured synthesis to demonstrate how the framework captures both universal equity challenges and context-specific implementation strategies across rural and metropolitan settings; and
4. reflect on how the framework could be used prospectively to guide the design, commissioning, monitoring, reporting and evaluation of future telehealth initiatives and to inform policy on embedding equity into virtual care.

By demonstrating structured framework application across contrasting telehealth programmes, this research may provide a practical foundation for strengthening equity evaluation methodology and may help inform the development of minimum equity reporting expectations for virtual care.

5.3 Methods

5.3.1 Theoretical framework

We applied a comprehensive nine-dimension equity framework specifically designed for telehealth evaluation. This framework synthesises three conceptual foundations: (i) patient-centred access theory (11), conceptualising healthcare access as the interaction between health system characteristics and population abilities; (ii) social determinants of health equity (12), recognising that healthcare access is shaped by structural conditions including economic resources, education, and systemic discrimination; and (iii) digital equity frameworks (13), distinguishing between access to technology, digital skills, and tangible outcomes from digital engagement.

This framework was developed to address a remaining gap in telehealth evaluation methodology. Earlier chapters of the thesis showed that existing approaches, including

access-oriented and digital equity frameworks, provide useful insights for examining equity-related issues in telehealth. However, they do not consistently offer an operational structure for assessing telehealth equity across the programme life cycle, including design, implementation, monitoring, and evaluation (13-15). By integrating the three theoretical traditions described above into a cohesive assessment structure spanning both proximal, individual-level access barriers and upstream, system-level enablers, the framework provides a structured way to identify equity gaps that may be overlooked in standard programme evaluations.

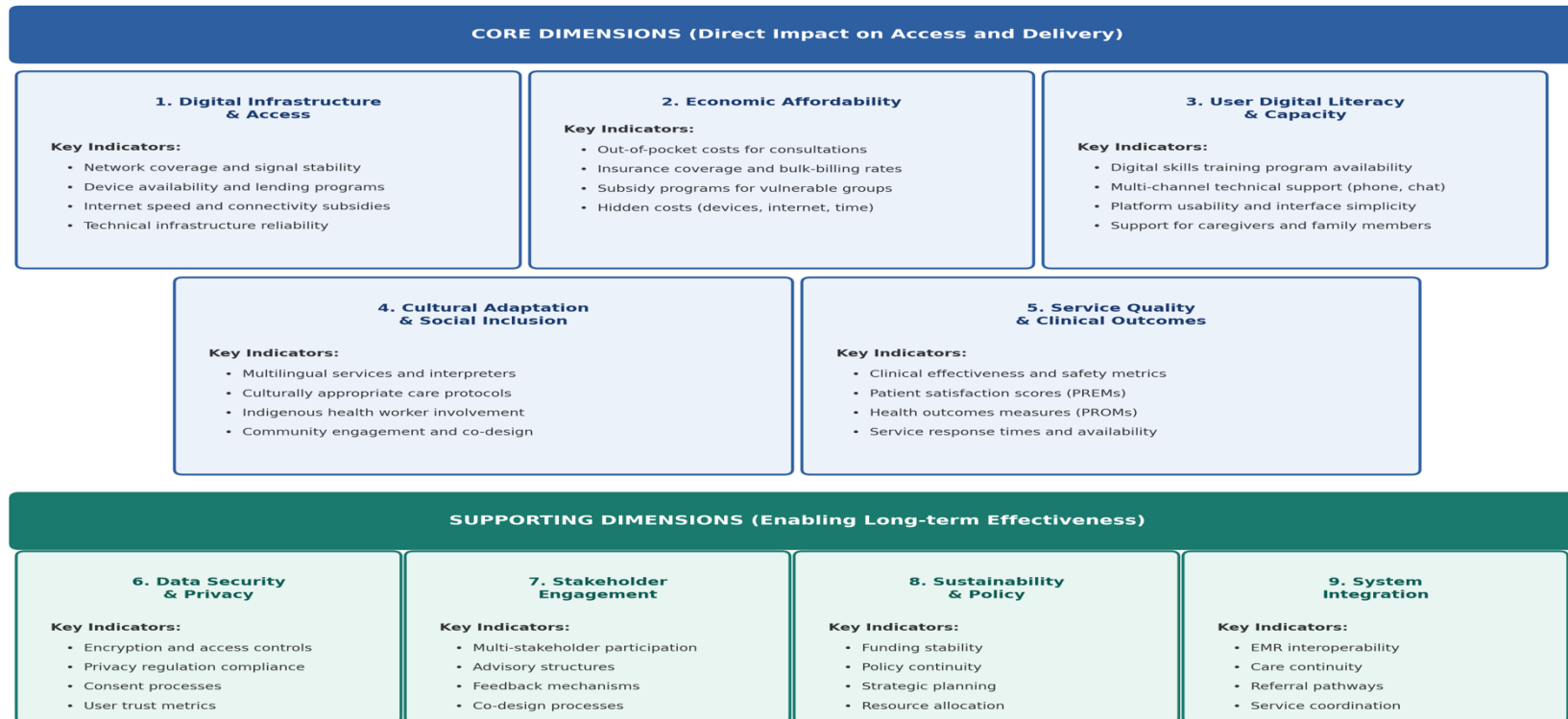
The framework spans nine dimensions (Figure 5.1) and distinguishes five core dimensions, which directly determine whether different groups can access and benefit from telehealth, from four supporting dimensions, which enable sustained equitable services at scale. Core dimensions (n=5) represent immediate, direct determinants of whether individuals can access telehealth and derive clinical benefit: (i) Digital Infrastructure and Access examines network coverage, device availability, and internet reliability; (ii) Economic Affordability assesses financial accessibility for patients (out-of-pocket costs) and providers (system costs); (iii) User Digital Literacy and Capacity evaluates skills, confidence, and support mechanisms; (iv) Cultural Adaptation and Social Inclusion considers linguistic diversity, cultural responsiveness, and community engagement; and (v) Service Quality and Clinical Outcomes measures effectiveness, safety, and patient-centredness of care.

Supporting dimensions (n=4) represent structural conditions enabling sustained, trustworthy services: (6) Data Security and Privacy Protection addresses technical safeguards and user trust; (7) Stakeholder Engagement and Collaborative Governance evaluates inclusion of diverse voices in programme design and implementation; (8) Sustainability and Policy Support assesses funding stability and policy continuity; and (9) Healthcare System

Integration examines coordination between telehealth and face-to-face services, including interoperability and care pathways.

The framework was developed through: (1) an umbrella review of evidence on telehealth and health-care access inequities, particularly rural-urban differences (8); (2) a systematic review and narrative synthesis of health equity and digital health frameworks (14); (3) an analysis of Australian telehealth policies and strategies (16); and (4) iterative discussions within the multidisciplinary research team to refine the structure and wording of dimensions and sub-components. Together, these steps informed the selection and refinement of dimensions and sub-components, with attention to digital determinants of health, service delivery processes and health system context. Figure 5.1 presents a schematic overview of the framework. The framework emerged iteratively from the preceding thesis components, including the synthesis of telehealth equity evidence, review of equity frameworks relevant to digital health, and analysis of Australian telehealth policy.

Comprehensive Framework for Evaluating Equity in Telehealth



Note: Core dimensions directly influence telehealth access and delivery, while supporting dimensions ensure sustainable and effective implementation.

Figure 5.1 Comprehensive framework for evaluating equity in telehealth

5.3.2 Study design

We undertook a multiple case study to demonstrate how the telehealth equity framework can be applied to existing virtual care programmes (17, 18). The study retrospectively applied the framework to two established Australian programmes using documentary data supplemented by stakeholder validation. The design was descriptive and interpretive: our aim was to explore how equity considerations were articulated and operationalised within each programme, and to identify patterns and gaps, rather than to determine which programme performed “better”. Reporting follows the Standards for Reporting Implementation Studies (StaRI) guidelines (19).

5.3.3 Case selection

Programmes were purposively selected using criterion-based sampling against five criteria: (i) contextual diversity (metropolitan vs rural/remote); (ii) programme maturity (established or substantially scaled since 2020); (iii) richness of documentation, including publicly available evaluations sufficient for detailed extraction and triangulation; (iv) stakeholder accessibility (leaders available for verification); and (v) equity relevance (explicit focus on populations experiencing inequities and/or documented equity objectives).

Programme maturity was defined as being established or substantially scaled from 2020 onwards. This threshold was used not because telehealth began in 2020, but because the

period from 2020 marked a major expansion in the scale, policy salience, and operational maturity of telehealth in Australia following the COVID-19 response. Focusing on this period enabled the study to examine contemporary telehealth models operating under current policy and service conditions, while also increasing the likelihood that sufficient programme documentation and evaluation material would be available to support structured comparative assessment.

The selected cases were:

RPA Virtual Hospital (RPAV): a metropolitan, tertiary-led virtual hospital (established 2020, Sydney Local Health District) serving diverse urban and selected regional populations through multiple clinical pathways (20, 21).

Virtual Rural Generalist Service (VRGS): a rural hospital-support model (established February 2020, Western NSW Local Health District) providing hybrid virtual and in-person medical support to small rural emergency departments across Western and Southern NSW (10, 22).

These cases represent contrasting delivery models and population contexts. RPAV operates in a highly diverse metropolitan setting with multiple clinical streams and substantial infrastructure for linguistic and navigation support, while VRGS addresses rural workforce constraints through a hybrid hospital-support model serving communities with high Aboriginal population representation. Their differences enabled examination of how the

framework captures both shared equity challenges and context-specific implementation strategies across diverse telehealth settings.

5.3.4 Data collection

5.3.4.1 Document review

We conducted a targeted review of official programme materials, prioritising documents published by the programmes or by their Local Health Districts (LHDs). LHDs are regional public health service organisations responsible for managing public hospitals and community health services in New South Wales. Included sources comprised webpages, evaluation reports, board papers and technical briefs. We also searched relevant government repositories and grey literature databases to identify additional official sources.

Documents published between programme inception (2020) and December 2024 were reviewed. Early 2025 publications were additionally included if they analysed data from within the evaluation period (2020-2024) and did not introduce evidence of substantive post-2024 operational changes. Stakeholder validation was conducted in April 2025.

Documents were included if they (a) were official publications, (b) described programme design, implementation or evaluation, and (c) contained information relevant to one or more equity dimensions. General telehealth policies not specific to the programmes and purely promotional media without substantive detail were excluded as primary evidence, although

such materials could be used to locate relevant official sources.

Using templates aligned to the nine dimensions, we systematically extracted: (i) service model descriptions and governance structures, (ii) equity-relevant features and implementation strategies, (iii) monitoring data and outcome evidence, and (iv) integration mechanisms. For each dimension, we assessed whether it was addressed, implementation depth (policy statements versus operational practice), strategies and mechanisms used, outcome evidence where available, and documented gaps. Items not identified in documents were flagged for stakeholder validation rather than assumed absent. A complete document list is provided in Table A 12.

5.3.4.2 Stakeholder validation

To complement documentary evidence and address evidence gaps, we developed a structured questionnaire aligned to the framework. Each questionnaire was pre-filled with extracted information and specific verification prompts. One senior programme lead from each programme (n=2) was invited to review the pre-populated extraction summary for their respective programme and to confirm, amend, or clarify the information presented. Both invitees returned completed questionnaires in April 2025 (response rate 100%).

The purpose of this step was not to obtain a general evaluative opinion about programme performance, but to verify whether the documentary record had been interpreted accurately,

whether relevant factual details had been missed, and whether clarification was needed regarding implementation arrangements or reported evidence. Stakeholder input therefore functioned as a factual verification step intended to improve the accuracy and completeness of the case summaries derived from documented sources.

This approach has limitations. Restricting verification to a senior programme lead may introduce a favourable institutional perspective and does not provide a full multi-stakeholder or 360-degree assessment. Broader stakeholder perspectives, including those of frontline staff, consumers, or community representatives, were beyond the scope of this comparative chapter and were not collected as part of the verification process. Where questionnaire responses were the only evidence for an item, without corroboration in published or official documentation, we applied conservative scoring and required stronger supporting detail for higher scores.

5.3.5 Data analysis

5.3.5.1 Evidence synthesis and dimension-level assessment

For each programme, we synthesised documentary evidence and stakeholder verification responses to assess implementation across the nine equity dimensions. For each dimension, we examined whether it was explicitly addressed in programme design, policy, or operational practice; the depth of implementation, distinguishing policy statements from operational

delivery with dedicated resources, assigned roles, and routine processes; strategies and mechanisms used; available outcome evidence; and documented gaps or barriers constraining fuller operationalisation.

Evidence was systematically appraised and recorded with source-referenced rationales to support transparent scoring and structured synthesis across programmes; full rationales are reported in Tables 5.4-5.5. When information for a component could not be verified in the reviewed materials, it was coded as not reported (NR) rather than assumed absent. This approach was used to maintain transparency about evidence availability and reporting quality.

Consumers were not included in the stakeholder verification step for this comparative assessment. This reflects the scope of the chapter, which aimed to compare programme-level equity considerations using documented sources and factual verification rather than to undertake a primary qualitative study of user experience. Consumer perspectives were not collected as part of this cross-case verification process and are acknowledged as an important limitation of this comparative analysis.

5.3.5.2 Scoring rubric and agreement

We used a stepwise approach to interpret NR items. First, NR was coded using publicly available programme documentation and published evaluations. Second, we revisited NR items following stakeholder verification to determine which gaps reflected under-reporting

versus the absence of an established activity. Items that remained NR after verification were treated as priorities for future evaluation and, where applicable, may indicate equity components not yet systematically embedded in programme implementation.

To distinguish NR from a score of 0 (confirmed not implemented), a score of 0 was assigned only when available evidence actively indicated the absence of a given component. NR was reserved for situations in which relevant information could not be verified from the reviewed materials.

To provide a structured summary of implementation across dimensions, we applied a standardised 0-4 equity implementation score for each dimension:

- 0 = Not addressed: no evidence of consideration
- 1 = Acknowledged only: mentioned without specific actions
- 2 = Strategy without implementation: plans described but lacking clear resources, roles or indicators
- 3 = Implemented with structure: operational with assigned responsibility and some resource allocation
- 4 = Fully operationalised: comprehensive implementation with dedicated resources, monitoring and continuous improvement

Scores were used as heuristic summaries to support interpretation and synthesis, not as quantitative measures for ranking programmes or making causal claims about effectiveness.

5.3.5.3 Scoring process and cross-case synthesis

Scoring was conducted by the first author with a documented rationale for each dimension.

Ambiguous cases were discussed with the research team and resolved by consensus. Where questionnaire responses were the sole evidence for a component without corroborating documentation, conservative judgements were applied and stronger supporting detail was required for higher scores. The full rubric with examples is provided in Table 5.1.

We then conducted within-case analysis followed by structured cross-case synthesis to identify implementation patterns and equity-relevant evidence gaps across the nine dimensions. Descriptive synthesis used comparative matrices to tabulate supporting evidence, implementation features, and items coded as NR for each dimension. Cross-case synthesis focused on identifying shared constraints, context-specific adaptations, and dimensions where equity-related components were systematically under-documented, rather than on quantifying programme differences.

Table 5.1 Scoring anchors and illustrative examples (0-4)

Dimension	0 Not addressed	1 Acknowledged only	2 Strategy w/o implementation	3 Implemented with structure	4 Fully operationalised
1) Digital infrastructure & access	No mention of virtual modalities, devices, connectivity, or access support.	Generic statement that telehealth/video is available; no access supports.	Plan/pilot for loan devices or onboarding, but no roles/scale/SOPs; BYOD only.	Routine multi-channel access; defined help desk; documented device OR data support; named team/role.	Device AND data support at scale; SOPs; uptime/drop-call monitoring with fixes; equity-focused access tracking (e.g., rural uptake).
2) Economic affordability	No information on fees, subsidies, or patient costs.	Aspirational ‘no out-of-pocket’ statement without detail.	Waivers/subsidies mentioned but eligibility/funding/process is unclear.	Zero OOP in public system OR clear subsidy/waiver rules with roles/workflows.	Stable funding line (e.g., block grant); periodic review of financial burden with corrective actions.
3) User digital literacy & capacity	No assistance beyond basic instructions.	Static guides/webpage; no proactive support.	Training concept/pilot only; no dedicated staff or coverage standards.	Dedicated digital navigator/tech support; scheduled onboarding; assisted setup (phone/video/home) with SOPs; named lead.	Routine support PLUS monitoring of tech difficulties/completion; targeted adaptations for low-literacy/LOTE; iterative improvements.
4) Cultural	No mention of	Principle	Interpreter OR translations	Interpreter and translations; defined	Co-governance with

Dimension	0 Not addressed	1 Acknowledged only	2 Strategy w/o implementation	3 Implemented with structure	4 Fully operationalised
adaptation & social inclusion	interpreters, translations, or priority pathways.	statement on 'cultural safety' only.	present, but no pathway/roles/coverage.	pathways for priority groups (e.g., Aboriginal and Torres Strait Islander/LOTE/disability/homelessness); assigned roles (e.g., Aboriginal Health Worker).	Aboriginal/multicultural/consumer reps; cultural safety training tracked; PREMs/complaints stratified and used for improvement.
5) Service quality & clinical outcomes	No KPIs or outcomes.	Anecdotal satisfaction only.	Some KPIs or PREMs/PROMs ad hoc; no clear owner/frequency.	Routine KPIs and PREMs/PROMs with named owner; fixed reporting cadence.	Measures stratified (e.g., Aboriginal and Torres Strait Islander/language/age/ARIA+); CQI cycles documented with actions closed.
6) Data security & privacy	No privacy/security statements.	Generic compliance statement only.	Mentions encryption/consent but lacks access control/audit/owner.	EMR integration; role-based access; MFA; audit logs; incident response; named security lead; periodic internal reviews.	External/enterprise audits; regular risk assessments; incidents tracked with corrective actions.
7) Stakeholder engagement & collaborative governance	No governance or engagement.	Committee named but inactive/no roles.	Ad hoc meetings; limited representation; irregular cadence.	Standing governance with defined cadence; consumer and Aboriginal/multicultural representation; feedback channels and logs.	Documented feedback → decision → change loops (action registers); co-design activities; transparent reporting to LHD/board.
8) Sustainability & policy	No funding/workforce plan.	Intent to seek funding only.	Short-term grants/pilot FTE; unclear beyond pilot.	Ongoing budget/FTE; embedded in service plan; capability building; tech refresh cycle; succession plan.	Evaluations inform commissioning; scale-up/replication criteria; periodic portfolio review and

Dimension	0 Not addressed	1 Acknowledged only	2 Strategy w/o implementation	3 Implemented with structure	4 Fully operationalised
support					re-investment.
9) Healthcare system integration	No linkages to in-person care or EMR.	States coordination will occur, without process.	Partial/referral forms; EMR write-back uncertain; vague escalation.	Clear escalation/step-down protocols; EMR documentation/write-back; discharge summaries to primary/community care via secure messaging; named coordinators.	Routine shared-care workflows; interoperability metrics monitored; integration issues tracked and resolved.

Abbreviations: SOPs, standard operating procedures; OOP, out-of-pocket (Zero OOP = no patient charges at point of care); BYOD, bring your own device; EMR, electronic medical record; MFA, multi-factor authentication; PREMs/PROMs, patient-reported experience/outcome measures; LOTE, language other than English; ARIA+, Australian Remoteness Index (Plus); CQI, continuous quality improvement; FTE, full-time equivalent; LHD, Local Health District

5.3.6 Ethical considerations

This study received approval from the University of Sydney Human Research Ethics Committee (2024/HE001354, approved 31 January 2025). The research analysed publicly available programme documents and voluntary questionnaire responses from programme staff in their professional capacity. No patient-level data were collected or analysed for this study. Participating programme managers provided written informed consent, with the option to review findings before publication.

5.4 Results

5.4.1 Programme characteristics

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Table 5.2 summarises the key contextual features of the two programmes relevant to equity evaluation.

RPA Virtual Hospital (RPAV): RPAV is a metropolitan, tertiary-led virtual hospital embedded within Sydney Local Health District. It delivers multiple clinical pathways including urgent care, hospital substitution, and chronic disease management (21, 23, 24). Programme documentation describes targeted initiatives intended to support priority populations,

including Aboriginal and Torres Strait Islander patients and culturally and linguistically diverse communities, through Aboriginal cultural support roles, interpreter pathways, translated patient materials, and digital navigation support (20, 25). Governance arrangements described in programme materials include clinical and evaluation oversight structures and consumer involvement mechanisms (20).

Virtual Rural Generalist Service (VRGS): VRGS launched in February 2020 and provides a 24/7 rural hospital-support model in Western New South Wales (10, 22). The service provides hybrid virtual and in-person medical support to emergency departments and inpatient wards when local workforce capacity is limited (10, 21). VRGS integrates with local electronic medical records to support remote assessment and escalation (10). Early implementation reporting (February to August 2020) indicated that Aboriginal people accounted for a substantial proportion of emergency department presentations and admissions across participating hospitals (22).

These two programmes provide contrasting contexts for demonstrating the framework's application. RPAV operates in a highly diverse metropolitan setting with multiple clinical streams and substantial infrastructure for cultural and linguistic support, while VRGS addresses rural workforce constraints through a hybrid delivery model serving communities with high Aboriginal representation. Their differences enable examination of how the framework captures both context-specific implementation strategies and shared equity considerations across diverse telehealth settings.

Table 5.2 Key programme characteristics relevant to equity evaluation

Characteristic	RPA Virtual Hospital (RPAV)	Virtual Rural Generalist Service (VRGS)
Geographic setting & footprint	Metropolitan Sydney based programme; services extend to nine Local Health Districts, including regional areas such as Illawarra Shoalhaven and Central Coast.	Western NSW rural and remote hospitals and multipurpose service sites; expanded to Southern NSW from July 2023.
Target or eligible population and context	Eligible patients referred or enrolled into RPAV clinical streams. The programme operates in a highly diverse urban catchment, with 38.4% of residents born in non-English-speaking countries in 2020/21 (context indicator). Aboriginal patient representation was approximately 9% in 2023/24 (stakeholder validation).	Eligible patients presenting to participating rural hospitals supported by VRGS for emergency and inpatient care. Early implementation reporting (Feb-Aug 2020) indicated Aboriginal people accounted for 25% of emergency department presentations and 16% of admissions across participating hospitals.
Service scope	Multiple clinical pathways, including urgent care, hospital substitution, rehabilitation and chronic disease management; targeted initiatives for priority groups including Aboriginal patients, people experiencing homelessness and culturally and linguistically diverse communities.	24/7 hybrid medical support model (approximately 75% virtual, 25% in-person), including emergency department support, inpatient ward rounds and residential aged care support.
Key equity-relevant implementation features	Aboriginal cultural support and care navigation roles; interpreter pathways and translated materials in multiple languages; Digital Patient Navigator role; consumer involvement mechanisms described in programme governance.	Nurse-facilitated bedside video consultations that reduce patient digital literacy requirements; hybrid model with an in-person component to address rural workforce constraints; site-based facilitation within participating hospitals.
Governance	Multilayer governance described in programme documentation, including an	Routine clinical governance processes described in programme

Characteristic	RPA Virtual Hospital (RPAV)	Virtual Rural Generalist Service (VRGS)
	Aboriginal Health Steering Committee (operational from 2021), a Consumer Network and clinical and evaluation oversight structures.	materials, including morbidity and mortality meetings and clinician co-design. Consumer governance and Aboriginal specific governance structures were not described in publicly available evaluation documentation.

Abbreviations: ED = emergency department; eMR = electronic medical record; M&M = morbidity and mortality.

5.4.2 Systematic Application of the Framework

Table 5.3 summarises the dimension-level heuristic equity implementation scores (0-4) assigned to each programme using the standardised rubric described in Methods (Section 5.3.5.2). Application of the framework supported a structured assessment of equity considerations across all nine dimensions by applying the same criteria to both programmes. Detailed evidence rationales underpinning each score, together with extracted supporting examples and sources, are provided in Tables 5.4-5.5.

The case studies were used to demonstrate the practical applicability of the framework and to assess whether it could support a transparent and systematic examination of equity considerations across different telehealth models. They were not intended to constitute formal validation of the framework in a psychometric or comparative benchmarking sense.

Similarly, the scores should be interpreted as heuristic summaries used to support structured

synthesis rather than as definitive indicators of programme performance.

Despite major differences in context and service design, the framework was able to capture both common and programme-specific equity features. Across both programmes, scores clustered most often at 3, indicating structured implementation with some supporting evidence, but not full operationalisation with routine equity-stratified monitoring and continuous improvement across all components. This pattern suggested that the programmes had moved beyond simple policy acknowledgement, but that some dimensions remained constrained by limited reporting, incomplete system-level infrastructure, or insufficient evidence for stronger scoring.

Table 5.4 and 5.5 provide detailed evidence summaries and scoring rationales for RPAV and VRGS respectively, while Table 5.6 later synthesises shared constraints and context-specific implementation strategies across the nine dimensions.

Table 5.3 Equity implementation scores by dimension

Dimension	RPA Virtual score (0-4)	VRGS score (0-4)
Digital infrastructure & access	3	3
Economic affordability	3	4
User digital literacy & capacity	3	3
Cultural adaptation & social inclusion	4	2
Service quality & clinical outcomes	3	3

Dimension	RPA Virtual score (0-4)	VRGS score (0-4)
Data security & privacy protection	3	3
Stakeholder engagement & collaborative governance	4	3
Sustainability & policy support	3	3
Healthcare system integration	4	3
Total	30	27
Mean	3.33	3

Table 5.4 RPAV: dimension-level evidence summary and scoring rationale

Dimension	Score (0-4)	Evidence summary (key items and evidence source)	Gaps / limitations
Digital infrastructure & access	3	Home/community access with device loan schemes and a Digital Patient Navigator; multi-channel pathways; an early COVID-19 survey of participating users reported that 95.4% found videoconferencing easy to use.	No routine publication of platform performance metrics (uptime, drop rates) or equity-stratified access analytics.
Economic affordability	3	Economic evaluation reports heterogeneous benefit-cost ratios by model (approx. 0.59-2.2). Benefits in Trauma and Fracture; marginal in ED-to-Community. Zero out-of-pocket costs for patients.	Equity programmes with BCR <1.0 lack protected funding; long-term transition to activity-based arrangements not yet confirmed.
User digital	3	Digital Patient Navigator	Digital difficulty metrics not

Dimension	Score (0-4)	Evidence summary (key items and evidence source)	Gaps / limitations
literacy & capacity		support; interpreter pathways and translated materials; early survey findings indicated high usability among participating users who engaged with the service.	routinely stratified by language/age; population-level utilisation disparities among older non-English speakers despite supports.
Cultural adaptation & social inclusion	4	Aboriginal, Multicultural and Consumer governance committees; interpreter pathways (local and national); materials in multiple languages; targeted programmes (e.g., Yudi Aboriginal 48-hour follow-up; Homelessness Hub). Population-level study shows disparities for non-English speakers, while interpreter use strongly associated with higher engagement.	Persistent disparities indicate need for proactive rather than reactive language support and outreach.
Service quality & clinical outcomes	3	PREMs collected at scale (3,198 in Year-2; 5,173 total to Oct 2024) with high reported experience; PROMs battery in routine use; research governance in place.	Clinical outcomes are not routinely stratified by Aboriginal status, language or remoteness.
Data security & privacy protection	3	Secure videoconferencing and documentation within eMR/eMeds; no major breaches reported in public materials for the period reviewed.	External cybersecurity audit details and incident closure processes not publicly reported; user-trust tracking not described.
Stakeholder engagement & collaborative governance	4	Formal multi-layer governance (Executive, Clinical Council, Research, Consumer Network, Aboriginal Health Steering,	—

Dimension	Score (0-4)	Evidence summary (key items and evidence source)	Gaps / limitations
		Multicultural, Education, Digital/Information). Consumers represented across committees; co-design activities documented.	
Sustainability & policy support	3	Block-funded as an ‘innovative project’; economic evaluation recommends activity-based transition with a minimum funding guarantee and equity-sensitive commissioning.	Long-term funding arrangements not policy-mandated; equity programmes may be vulnerable if not cross-subsidised.
Healthcare system integration	4	Bidirectional eMR documentation; Miya Precision dashboards enabling semi-automated monitoring; secure GP messaging and NSW Patient Flow Portal integration; standardised referral, escalation and step-down pathways; partnership operating as a digital front door across multiple LHDs.	—

Note: Where percentages are reported, the denominator and respondent group are specified in the evidence summary where available. Reported usability or experience findings refer to the participant group identified in the cited evaluation material.

Table 5.5 VRGS: dimension-level evidence summary and scoring rationale

Dimension	Score (0-4)	Evidence summary (key items and evidence source)	Gaps / limitations
Digital	3	Hospital-centred	No routine publication of

Dimension	Score (0-4)	Evidence summary (key items and evidence source)	Gaps / limitations
infrastructure & access		infrastructure using fixed ceiling cameras and ‘Wallie’ mobile carts with high-definition peripherals; encrypted Pexip video; bedside nursing facilitation maintained service continuity.	platform performance metrics or equity-stratified coverage analytics.
Economic affordability	4	Provider-side cost advantages vs comparators during evaluation: activity-unit cost A\$1,047 vs A\$1,753; ED encounter cost A\$134 vs A\$239 ($\approx 44\%$ lower). Locum days reduced from 1,456 to 609 ($\approx 58\%$) under recurrent funding.	Locum reduction figures verified via questionnaire (Apr 2025); specific locum figures are not reported in public documents.
User digital literacy & capacity	3	Nurse-facilitated bedside consultations minimise patient digital burden; structured onboarding for doctors and nine training modules for nurses; staff report skill mismatch and workload growth with virtual care.	Digital difficulty metrics not stratified by population groups.
Cultural adaptation & social inclusion	2	High Aboriginal representation in early period (25% ED; 16% admissions), but evaluation materials do not document interpreter services, multilingual materials, cultural liaison roles or Aboriginal governance structures.	Need for formal cultural governance and language support proportional to Aboriginal service use.
Service quality &	3	Linked-data evaluation	Outcomes not routinely

Dimension	Score (0-4)	Evidence summary (key items and evidence source)	Gaps / limitations
clinical outcomes		showed equivalent mortality (aOR ~0.78), lower inter-hospital transfers (aOR ~0.66), shorter length-of-stay for VRGS-only patients (aOR ~0.51), and lower ED encounter costs; elevated did-not-wait (aOR ~3.69) and left-at-own-risk (aOR ~1.90) require monitoring.	stratified by Aboriginal status, language or remoteness.
Data security & privacy protection	3	Encrypted video (Pexip), VPN access and full eMR/eMeds integration; incidents captured in IMS+; no major breaches reported in public materials.	External audit details and incident closure processes not publicly reported; user-trust tracking not described.
Stakeholder engagement & collaborative governance	3	Monthly team and M&M meetings open to LHD clinicians; biannual workshops; documented clinician co-design; executive sponsorship and credentialing; issues log in use.	No formal consumer or Aboriginal governance structures identified in available evaluation materials.
Sustainability & policy support	3	Positioned as essential operational capacity with recurrent LHD funding; demonstrated cost-effectiveness and pandemic resilience; no specific state policy mandate beyond operational need (questionnaire).	Equity-protected, policy-mandated funding not achieved.
Healthcare system integration	3	Complete eMR/eMeds integration; vCare escalation protocols with role	Broader alignment with other virtual services and GP discharge mechanisms not

Dimension	Score (0-4)	Evidence summary (key items and evidence source)	Gaps / limitations
		delineation; mandated video ward rounds recorded in eMR; aligned with NSW guidance; coordinated transfers.	described; unified referral flows across virtual domains are not evident.

Note: Where percentages are reported, the denominator and respondent group are specified in the evidence summary where available. Reported usability or experience findings refer to the participant group identified in the cited evaluation material.

5.4.3 Identification of Evaluation Gaps Through Framework Application

A central contribution of applying the framework was the systematic identification of components coded as not reported (NR) across both programmes. NR coding reflects the absence of verifiable information in the reviewed documentary sources and, where applicable, stakeholder validation materials. It does not necessarily indicate that an activity did not occur. Instead, NR patterns highlight potential blind spots in routine telehealth evaluation and reporting practices, particularly for equity-relevant components that require granular measurement, stratified analyses, or explicit accountability mechanisms.

Across both programmes, several recurring evidence gaps were observed. First, equity-stratified platform performance metrics were not routinely reported in published evaluations. We did not identify service-level reporting of connectivity or platform performance indicators, such as call completion rates or connection quality, disaggregated by geography, remoteness, device type, or other equity-relevant characteristics. Second, equity-stratified

clinical outcomes were not consistently reported at a whole-of-programme level.

Comparative outcomes (e.g., readmissions, length of stay, escalation events) were reported in aggregate rather than stratified by Aboriginal status, language background, rurality, or socioeconomic indicators. Third, long-term funding and policy mechanisms that explicitly protect or incentivise equity-oriented delivery were not clearly documented in publicly available materials during the evaluation period. Fourth, we did not identify public reporting of independent cybersecurity audit findings or other external accountability indicators specific to programme-level virtual care platforms.

Framework application also highlighted programme-specific gaps in documented equity components. For VRGS, publicly available evaluation materials did not describe formal interpreter pathways, multilingual patient-facing materials, or dedicated Aboriginal or consumer governance structures, although general engagement with local services and communities was noted. For RPAV, while documentation described digital navigation supports and high overall acceptability for some streams, routine reporting of platform difficulties and access barriers stratified by population subgroups was not identified.

Taken together, these patterns suggest that certain equity dimensions, particularly those dependent on systematic data stratification and formal accountability structures, are under-reported in telehealth programme evaluations. By making NR items explicit, the framework provides a practical basis for strengthening future evaluation design and specifying minimum equity-relevant reporting expectations. Items remaining NR after stakeholder validation

represent priority areas for targeted data collection in prospective use of the framework.

Dimension-level NR items are documented in the shared constraints column of Table 5.6, with corresponding evidence rationales in Tables 5.4-5.5.

5.4.4 Context-Specific Implementation Strategies Captured by the Framework

The framework's nine dimensions captured how equity-relevant implementation strategies were adapted to each programme's context, service model and target populations. Table 5.6 summarises documented context-specific strategies across all dimensions, alongside shared constraints and items not routinely reported in reviewed materials. NR indicates items not identified in programme documentation and, where applicable, stakeholder validation materials; NR should not be interpreted as evidence of absence.

Across the core dimensions, the framework highlighted how the delivery model shaped equity mechanisms. RPAV's home-based and multi-stream model emphasised navigation supports and multilingual access infrastructure, while VRGS's hospital-support model reduced patient-facing digital burdens through nurse-facilitated bedside delivery and site-based equipment integrated into clinical workflows. Across the supporting dimensions, the framework differentiated formal governance structures and system linkages, while also making visible where reporting and accountability mechanisms were limited or not routinely described.

Together, the nine-dimension summary demonstrates how the same framework can describe equity strategies tailored to metropolitan linguistic diversity and rural workforce constraints, while also identifying shared areas where stronger, more systematic reporting would be required for prospective equity monitoring.

Table 5.6 Framework-captured implementation strategies and shared constraints across all nine equity dimensions

Dimension	Context-specific strategies (documented)	Shared constraints and items not routinely reported
CORE DIMENSIONS		
Digital infrastructure & access	<p>RPAV: Multi-channel access pathways (e.g., video and phone, with some in-home components described); navigation support roles; interpreter and translated resources described in programme materials.</p> <p>VRGS: Nurse-facilitated bedside video consultations using site-based equipment integrated with local clinical systems.</p>	<p>Platform performance and connectivity metrics were not routinely reported in an equity-stratified way (e.g., by remoteness, device type, language) (NR).</p>
Economic affordability	<p>RPAV: Economic evidence varied across clinical streams, with differences in reported returns and optimisation needs.</p> <p>VRGS: Evaluations reported provider-side cost implications relevant to rural workforce coverage (e.g., reduced locum reliance, lower service costs in reported analyses).</p>	<p>Patient-borne costs (e.g., data use, time, residual travel) were not routinely quantified or reported across programmes (NR).</p>
User digital literacy & capacity	<p>RPAV: Digital navigation support and onboarding assistance described; high ease-of-use reported in surveyed cohorts for some streams.</p> <p>VRGS: Bedside nurse facilitation reduces patient-</p>	<p>Routine equity-stratified reporting of digital difficulties or access barriers by subgroup was not identified (NR).</p>

Dimension	Context-specific strategies (documented)	Shared constraints and items not routinely reported
	facing digital demands; structured staff training and onboarding reported.	
Cultural adaptation & social inclusion	<p>RPAV: Aboriginal cultural support roles and governance mechanisms described, including Aboriginal health governance structures; interpreter pathways and translated resources described.</p> <p>VRGS: Local engagement approaches noted in implementation materials.</p>	Systematic reporting of cultural safety processes and outcomes (including equity-stratified acceptability and experiences) was limited or not routinely reported (NR).
Service quality & clinical outcomes	<p>RPAV: Patient-reported experience measures collected at scale for some streams; remote monitoring workflows and clinical oversight structures described.</p> <p>VRGS: Programme evaluations reported service outcomes relevant to rural hospital support (e.g., transfer patterns and selected utilisation indicators).</p>	Whole-of-programme clinical outcomes were not consistently reported in an equity-stratified manner (e.g., by Aboriginal status, language background, remoteness) (NR).
SUPPORTING DIMENSIONS		
Data security & privacy protection	<p>RPAV: Use of enterprise platforms and incident management processes described in evaluation and governance materials.</p> <p>VRGS: Encrypted videoconferencing platform and secure access arrangements described; integration with clinical systems.</p>	Public reporting of independent cybersecurity audit findings and equity-relevant user trust measures was limited or not identified (NR).
Stakeholder engagement & collaborative governance	<p>RPAV: Multi-layer governance with consumer involvement mechanisms and Aboriginal health governance described.</p> <p>VRGS: Clinical governance structures described (e.g., routine meetings, M&M review, clinician co-design).</p>	Systematic reporting on governance participation, representativeness and decision impacts was limited.
Sustainability & policy support	<p>RPAV: Operational learning and efficiency changes described over time, with evolving funding and pricing discussions.</p> <p>VRGS: Sustainability discussions linked to rural</p>	Explicit equity-protected funding mandates or commissioning requirements were not clearly documented

Dimension	Context-specific strategies (documented)	Shared constraints and items not routinely reported
	workforce efficiency and Local Health District operational funding.	during the evaluation period (NR).
Healthcare system integration	<p>RPAV: Cross-system linkages described, including integration with eMR and broader system coordination tools and partnerships across multiple districts.</p> <p>VRGS: Mandated documentation within local clinical systems; escalation protocols described for acute care support.</p>	Reporting on standardised interoperability protocols and cross-service continuity mechanisms was limited or inconsistently reported.

Note Context-specific strategies are summarised from programme documentation and stakeholder validation; shared constraints reflect items not routinely reported (NR) in reviewed materials. Detailed evidence rationales and identified gaps for each dimension are provided in Tables 5.4-5.5.

5.4.5 Synthesis: Framework Utility and Shared System-Level Constraints

Applying the framework to two contrasting programmes demonstrated both its practical utility and the equity challenges that extend beyond individual programme design. The nine-dimension structure enabled systematic coverage across proximal access barriers and system-level enablers, supporting consistent synthesis of equity-relevant evidence. Explicit NR coding distinguished evidence gaps from confirmed absence of activity and, together with stakeholder validation, clarified where equity-oriented practices were present but under-reported. Table 5.3 provides a summary of dimension-level heuristic scores as an interpretive aid, while Table 5.6 summarises how the framework captured context-specific strategies and shared constraints across all dimensions.

Across both programmes, several dimensions were consistently assessed as “implemented with structure” (score 3) rather than “fully operationalised” (score 4). Scores are heuristic summaries intended to support structured synthesis rather than to rank programme performance. Nonetheless, the observed clustering aligns with a set of shared system-level constraints that appear to limit more comprehensive operationalisation of equity.

First, monitoring infrastructure and equity stratification were not routinely documented at a whole-of-programme level. Publicly available materials did not consistently report platform performance indicators (e.g., connectivity quality or call completion) disaggregated by equity-relevant characteristics such as remoteness, Aboriginal status, or language background. Similarly, programme-level clinical outcomes and patient experience reporting were more often presented in aggregate than systematically stratified for equity monitoring, even where substantial data collection was occurring.

Second, commissioning and policy mechanisms that embed equity expectations into routine monitoring and reporting were not clearly documented during the evaluation period. This indicates that achieving fully operationalised equity may require system-level specification of minimum equity indicators, standardised data elements, and reporting requirements, alongside programme-level implementation and resourcing.

Third, external accountability signals were limited in the public domain. We did not identify routine public reporting of independent cybersecurity audit findings or formal programme-level equity-stratification protocols in the reviewed materials. Strengthening transparency and

accountability mechanisms may therefore be necessary to support consistent equity monitoring across telehealth programmes.

Overall, these findings indicate that moving from structured implementation to fully operationalised equity will depend on coordinated investments in data infrastructure, commissioning requirements, and accountability frameworks. The framework's value lies not only in enabling structured assessment of individual programmes, but also in revealing system-level barriers that constrain equity implementation across diverse telehealth models and settings.

5.5 Discussion

5.5.1 Framework as a Systematic Equity Evaluation Tool

This study developed and demonstrated a comprehensive nine-dimension framework to support more systematic evaluation of equity in telehealth programmes. The framework responds to a methodological gap in telehealth evaluation practice: equity is frequently invoked, yet evaluation approaches do not consistently operationalise equity across both proximal access barriers and system-level enablers (2, 5, 14). Unlike approaches that focus on single aspects of access or provide broad digital equity principles without specifying assessable components, this framework integrates patient-centred access theory, social determinants of health equity and digital equity principles into a cohesive assessment

structure that can inform programme design, implementation and evaluation.

Applying the framework to two contrasting Australian telehealth programmes, a metropolitan multi-stream virtual hospital and a rural hospital-support model, demonstrated its practical utility and yielded contributions relevant to telehealth equity evaluation.

First, systematic coverage and structured transparency. The nine-dimension structure enabled assessment across domains that are often addressed incompletely or inconsistently in standard telehealth evaluations, ranging from digital infrastructure, economic affordability, and user digital capacity to governance, sustainability, privacy, and health system integration. The rubric-based scoring approach, combined with explicit coding of items as not reported (NR), provided a structured method for summarising the extent to which each equity component was operationalised, while maintaining transparency about evidence availability. Importantly, scores functioned as heuristic summaries to support structured synthesis rather than quantitative rankings, reducing the risk that findings are interpreted as definitive programme comparisons.

Second, identification of systematic evaluation gaps. By explicitly coding NR items, the framework made visible components that were not routinely documented in reviewed programme evaluations. Recurring gaps included equity-stratified platform performance reporting, equity-stratified outcome reporting at the whole-of-programme level, explicit equity-related commissioning or funding expectations, and publicly visible accountability signals such as independent cybersecurity assurance. These patterns suggest that equity

components requiring granular data stratification and external accountability are not always well documented in telehealth evaluations. In this sense, NR coding should not be interpreted as a strength of the framework in itself, but rather as a transparent indicator of evidence and reporting gaps. The framework therefore provides not only a tool for assessing individual programmes but also a basis for strengthening minimum evaluation and reporting standards for equity evaluation.

Third, feasibility across contexts and programme stages. Despite major differences in setting, service model, and target populations, the framework captured equity-relevant considerations in both programmes, supporting application across diverse telehealth delivery models. The framework is also structured for use across the programme lifecycle, prospectively as a checklist during programme design, operationally as a monitoring structure during implementation, and retrospectively as a structured evaluation lens. This demonstration of practical applicability, however, should not be interpreted as formal validation of the framework in a psychometric or benchmarking sense.

Fourth, system-level constraints and context-specific adaptations. Framework application highlighted shared constraints that may limit progression from structured implementation toward fully operationalised equity, including limited routine equity-stratified monitoring, the lack of clearly specified equity-related reporting expectations in reviewed materials, and limited publicly visible accountability mechanisms. Such constraints transcend individual programme design and point to the importance of coordinated investments in data

infrastructure, commissioning requirements, and accountability frameworks to support equitable telehealth at scale. At the same time, the framework captured context-specific adaptations aligned with local challenges, including strategies to address metropolitan linguistic diversity and approaches shaped by rural workforce constraints, while retaining a consistent assessment structure across all dimensions. Provider and workforce digital capability is also relevant here, as equitable telehealth delivery depends not only on users' capacity to engage with services, but also on staff ability to implement, support, and adapt digital models of care in practice.

5.5.2 Implications for Practice and Policy

Framework application yields implications for telehealth programme planning, evaluation practice, and health system policy. Three areas warrant particular attention.

5.5.2.1 Using the Framework for Programme Design and Evaluation

The framework's demonstrated feasibility across contrasting service models supports practical use across the programme lifecycle.

Programme design and commissioning. The nine dimensions can be used as a structured checklist to ensure equity considerations are specified from the outset rather than retrofitted

during evaluation. Commissioners can incorporate the framework into service specifications and procurement by requiring proposals to describe how each dimension will be operationalised and monitored, including minimum indicators and clear responsibilities. The distinction between core dimensions (more directly shaping individual access and benefit) and supporting dimensions (enabling sustained equitable delivery at scale) provides a practical organising principle for prioritising investment across patient-facing supports and system enablers.

Implementation monitoring and quality improvement. During delivery, periodic rubric-based review can support structured internal assessment across dimensions, identify where implementation depth remains limited, and guide targeted improvement plans. Explicit documentation of items as not reported (NR) makes visible what is and is not being measured or publicly described, prompting development of monitoring infrastructure for under-specified components. Used prospectively, the framework supports iterative learning rather than one-off assessment.

Evaluation and learning across programmes. For post-hoc evaluation, the framework provides a comprehensive structure for evidence collection and synthesis beyond utilisation and aggregate satisfaction metrics. The standardised rubric supports more transparent assessment across settings and time points, while explicit NR documentation distinguishes evidence gaps from confirmed absence of activity. This transparency enables more defensible cross-programme learning because it clarifies whether apparent differences reflect implementation

variation or differences in evaluation scope and data availability.

Several practical considerations apply to prospective use. Comprehensive application requires sufficiently detailed programme documentation and, ideally, stakeholder input to verify operational practices not captured in public sources. Scoring should be undertaken with documented rationales and explicit rules for resolving uncertainty, recognising scores as heuristic summaries to support synthesis rather than precise quantitative measures. NR coding should be applied conservatively and consistently, recording the basis for coding decisions and distinguishing genuine evidence gaps from information that may exist but is not accessible to evaluators.

5.5.2.2 Addressing System-Level Barriers Revealed by Framework Application

The framework's application also highlights barriers that exceed the capacity of individual programmes to address alone, indicating the need for coordinated policy and infrastructure investment.

Data infrastructure and equity monitoring. Equity-stratified reporting was not routinely documented despite substantial operational data collection within programmes. This points to a system-level need for routine equity-stratified reporting within telehealth evaluations. In many settings, equity-relevant characteristics, such as remoteness and area-level socioeconomic measures mapped from postcode, are already captured in, or readily linkable

to, healthcare administrative datasets. However, routine stratified analysis depends less on collecting new fields and more on the governance, ethics, data linkage pathways, and reporting standards required to enable appropriate use. Reporting by Aboriginal and Torres Strait Islander status, for example, typically requires explicit ethics approval and culturally safe governance arrangements, including appropriate custodianship and data sovereignty considerations. Investments should therefore focus on establishing governance frameworks that support culturally safe data use, standardised reporting protocols specifying minimum indicators and disaggregation requirements, and jurisdictional guidance that balances analytical need with ethical obligations and data sovereignty.

Commissioning and funding mechanisms. Fully operationalised equity commonly requires resourcing for equity-intensive components, including language supports, cultural safety infrastructure, navigation assistance, and ongoing monitoring. Commissioning arrangements can better protect these components by embedding explicit equity expectations, defining minimum service and monitoring requirements, and aligning funding mechanisms with the additional costs of equitable delivery. Equity requirements should be specified as core commissioning features rather than optional enhancements.

Accountability and transparency mechanisms. Publicly visible accountability signals were limited in reviewed materials. System-level approaches can strengthen accountability by specifying a small set of core equity indicators to be reported routinely, alongside requirements for transparent documentation of evaluation scope and limitations. Where

appropriate, external assurance processes for privacy, security, and equity-related governance can support trust and consistency. Accountability arrangements should be designed to enable learning and improvement, not only compliance.

Together, these system enablers can support progress from structured implementation toward fully operationalised equity by providing the data infrastructure, funding stability, and accountability expectations that individual programmes cannot establish alone.

5.5.2.3 Strengthening Telehealth Equity Evaluation Standards

The framework may provide a practical foundation for strengthening evaluation standards beyond individual programmes.

Minimum equity reporting requirements. A minimum reporting set can be derived from the nine dimensions, establishing baseline expectations that telehealth programme evaluations should address, even where full framework application is not feasible. At minimum, evaluations should document how access barriers were assessed and addressed; how affordability was considered for users and the system; how cultural inclusion and governance were operationalised; what privacy and security practices were in place; how integration and sustainability were supported; and which outcome and experience indicators were monitored, including whether stratified reporting was feasible.

Standardised indicators and data elements. Consistency across evaluations requires agreed

definitions and data elements to support stratified reporting. Priority indicators will vary by setting, but the framework provides a structure for specifying a core subset spanning access, digital capability supports, cultural inclusion, governance, platform performance, and outcomes. Common measurement guidance would improve comparability across programmes and over time. At the same time, what is easiest to measure is not always what is most important for constructive improvement in equity. Evaluation standards should therefore avoid over-reliance on readily available utilisation data alone and encourage attention to the dimensions most relevant to equitable service design and delivery.

Transparent documentation of gaps and limitations. Explicit reporting of what could not be assessed should become standard practice, using an approach analogous to NR coding. This avoids ambiguity about whether a component was absent, not measured, or not reported, and supports cumulative learning about where data, methods, or resources constrain equity evaluation. The present findings are consistent with the possibility that some equity-relevant dimensions of telehealth implementation are under-documented in programme-level materials, but this chapter cannot determine in all cases whether this reflects absence, under-measurement, or under-reporting. A cautious interpretation is therefore warranted.

Funders, commissioners, professional bodies, and journals can reinforce these standards through evaluation guidance, funding requirements, and publication expectations. As telehealth becomes a sustained feature of health systems, robust and transparent equity evaluation standards are essential to ensure virtual care advances rather than undermines

health equity.

5.5.3 Strengths and Limitations

This study has several strengths. First, it develops and demonstrates a comprehensive nine-dimension equity framework designed to support systematic telehealth equity evaluation. The framework addresses an important methodological gap by operationalising equity across both proximal access determinants and system-level enablers, integrating patient-centred access theory, social determinants of health equity, and digital equity principles into a structured assessment approach applicable across programme design, implementation, and evaluation stages. Existing frameworks provide valuable insights, but many require adaptation to address telehealth-specific equity challenges and to offer more operational guidance for programme-level assessment, as shown in the preceding framework review (5, 14, 15).

Second, the framework's systematic structure, combined with explicit coding of items as not reported (NR), makes under-specified equity components visible and supports transparent interpretation. By distinguishing documented practices from under-reported components, the approach helps identify evaluation and reporting gaps that might otherwise remain implicit, providing a practical basis for strengthening programme-level evaluation design and broader minimum reporting expectations for equity. This should not be interpreted to mean that NR itself is a framework strength; rather, it is a transparent way of signalling where evidence is

insufficient for confident assessment.

Third, application to two contrasting delivery models, a metropolitan multi-stream virtual hospital and a rural hospital-support service, demonstrated feasibility across diverse contexts. Despite differences in setting, scale, target populations, and service models, the framework captured equity-relevant considerations in both programmes and highlighted context-specific strategies alongside shared system-level constraints, supporting its potential utility for a wider range of telehealth programmes, subject to contextual adaptation.

Fourth, the study used structured evidence synthesis, triangulating programme documentation, peer-reviewed literature, and stakeholder verification via pre-filled questionnaires with programme leads. The standardised rubric, documented rationales, and conservative interpretation where questionnaire responses were not corroborated enhanced methodological transparency.

Several limitations should be noted. First, this demonstration relied on two illustrative cases within a single Australian jurisdiction. While appropriate for proof-of-concept, broader application across additional programmes, jurisdictions, and health system contexts is required to test transferability, refine indicators, and assess whether further sub-components are needed under different policy and funding environments.

Second, the retrospective assessment relied primarily on publicly available materials

supplemented by stakeholder questionnaire responses. Items coded as NR may reflect under-reporting rather than absence of activity, although stakeholder verification helped clarify this distinction where possible. Prospective application from programme inception would enable more complete and standardised data collection, real-time monitoring, and iterative refinement of equity strategies.

Third, the reviewed period (largely 2020-2024) reflects a snapshot during rapid telehealth expansion and service evolution; subsequent developments may not be captured.

Longitudinal framework application would enable tracking of equity implementation trajectories over time and assessment of responsiveness to changing needs and policy contexts.

Fourth, while the framework provides systematic structure, scoring necessarily involves judgement. Although a standardised rubric, documented rationales, and team discussion were used to support consistency, some variation across evaluators is possible. The primary value of the framework lies in systematic coverage and transparency about evidence and limitations, with scores serving as heuristic summaries to support synthesis and prioritisation rather than definitive quantitative measures. This chapter therefore demonstrates practical applicability rather than formal validation.

Fifth, the comparative assessment did not directly incorporate consumer or community perspectives. User perspectives are central to equity evaluation, particularly for dimensions such as usability, acceptability, cultural inclusion, and digital capability support. In this

chapter, however, the analysis relied primarily on documented programme materials and factual verification of extracted information rather than primary qualitative data collection from consumers. The chapter should therefore be understood as a structured programme-level assessment rather than a full multi-stakeholder evaluation.

Sixth, stakeholder verification was restricted to one senior programme lead per case.

Although this was useful for checking the accuracy and completeness of extracted information, it may also have introduced a favourable institutional perspective. Broader qualitative engagement with frontline staff, consumers, or community stakeholders may have provided a more nuanced view of implementation challenges and lived experience. No additional data collection was undertaken in this thesis correction process, however, consistent with the limited scope of the revisions.

Overall, the study demonstrates that systematic, multi-dimensional equity evaluation of telehealth programmes is feasible and can surface insights not routinely captured in standard evaluations. The framework provides a foundation for further refinement, validation, and prospective application in diverse telehealth contexts.

5.5.4 Future Research

This proof-of-concept demonstration provides a foundation for several priorities to strengthen telehealth equity evaluation methodology and practice.

First, broader validation across contexts and health systems is needed. Future studies should apply the framework to diverse telehealth programmes across jurisdictions, funding models, and service environments to assess transferability, identify context-specific indicator needs, and refine sub-components where required. Multi-site applications would also enable assessment of inter-rater reliability and refinement of scoring guidance to improve consistency.

Second, prospective and longitudinal application should be tested. Embedding the framework at programme inception would enable evaluation of its utility as a planning and monitoring tool, support real-time collection of equity-relevant data elements, and reduce reliance on retrospective inference. Longitudinal studies could examine equity implementation trajectories and assess whether framework-guided course correction improves equity-relevant processes and outcomes.

Third, integration with qualitative and participatory methods would strengthen validity and explanatory power. Combining framework application with interviews, user journey mapping, ethnographic observation, or participatory approaches could capture lived experiences of equity barriers and enablers that documentary evidence cannot fully represent, particularly for cultural adaptation, digital capability supports, and governance. Mixed-methods work could assess whether framework-identified NR gaps correspond to user-reported inequities in access, experience, and care quality.

Fourth, development and validation of standardised indicators is a priority for comparability.

Research should define a minimum equity dataset aligned to the nine dimensions, including agreed definitions and feasible stratification variables, and establish measurement guidance for components that are difficult to operationalise, such as cultural safety, meaningful governance participation, and equity-sensitive economic assessment. Where appropriate, measurement studies could test construct validity, sensitivity to change, and feasibility in routine monitoring systems.

Fifth, implementation research on adoption and impact is needed to move from demonstration to routine use. Implementation science approaches can examine barriers and facilitators to uptake by programme teams, commissioners, and evaluators, and test strategies for embedding the framework into commissioning, accreditation, and quality improvement workflows. Evaluations comparing programmes or time periods with and without framework-guided monitoring could assess whether adoption improves reporting completeness and influences equity-relevant service improvements.

Finally, research should address system-level enablers highlighted through framework application. This includes developing feasible approaches to equity-stratified data infrastructure, commissioning and funding mechanisms that protect equity-oriented components, and accountability arrangements that support transparency while enabling learning. Evidence on culturally safe data governance, routine stratified outcome reporting, and practical security assurance reporting will be particularly important to support progression toward fully operationalised equity in telehealth.

Collectively, these directions would advance telehealth equity evaluation toward more systematic, transparent, and comparable approaches. The framework provides a structured foundation for this work, but requires continued validation, refinement, and implementation research to maximise its value for policy and practice.

5.6 Conclusion

This study developed and demonstrated a comprehensive nine-dimension equity framework for systematic telehealth equity evaluation, addressing a key methodological gap in how equity is operationalised and assessed in virtual care. Application to two contrasting Australian telehealth programmes demonstrated practical applicability across diverse delivery models and highlighted several contributions, including broader coverage beyond standard evaluation domains, more explicit identification of evaluation and reporting gaps through structured coding of items as not reported (NR), and use of the framework across programme design, implementation, and evaluation stages.

Framework application also highlighted constraints that may limit progression from structured implementation toward fully operationalised equity. Recurring gaps included limited routine equity-stratified monitoring, weak specification of equity-related commissioning and reporting expectations in reviewed materials, and limited publicly visible accountability signals. These constraints extend beyond individual programme capacity and

indicate a need for coordinated investments in data infrastructure, commissioning requirements, and accountability standards to support equitable telehealth at scale.

The framework may provide a practical foundation for strengthening telehealth equity evaluation in three ways. It can guide programme planning and evaluation through a structured multi-dimensional lens, inform minimum equity reporting requirements and indicator development, and support identification of system-level barriers requiring policy action. Future work should prioritise broader application across settings, prospective use from programme inception, and stronger integration of patient, community, provider, and workforce perspectives. As telehealth becomes a sustained feature of health systems, systematic equity evaluation frameworks will be increasingly important to help ensure that virtual care advances, rather than undermines, health equity.

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Chapter 6 Geographic Disparities in Telehealth Service Preferences and Acceptability:

A Best-Worst Scaling Study

Purpose of this chapter

To quantify and compare public priorities for key telehealth service features using a Best-Worst Scaling (BWS) survey, and to examine how these preferences and telehealth acceptability vary across geographic groups to inform equity-sensitive telehealth design and implementation.

6.1 Abstract

Introduction: This chapter examined whether telehealth willingness varies across population groups and quantified which service attributes consumers prioritise when accessing telehealth.

Methods: A cross-sectional online survey of adults in New South Wales was conducted between 28 October and 24 November 2025 via a commercial panel. Willingness across ten scenarios was dichotomised and analysed using multivariable logistic regression with adjustment for sociodemographic characteristics and geography. Preferences were elicited using Best-Worst Scaling mapped to a nine-dimension telehealth equity framework. Conditional logit models were estimated using pooled and geography-specific specifications.

Results: The analytic sample comprised 2,882 adults. The results showed a clearer age-related gradient than a geographic gradient in telehealth willingness: age was the most consistent predictor across scenarios, while geographic differences were smaller and more context-specific. Rural/remote respondents had higher odds of internet access problems than major city respondents (aOR 1.88; 95% CI 1.45-2.44; $p < 0.001$), but geographic differences in digital confidence were largely explained after adjustment for age, education, and income. In Best-Worst Scaling, the highest-priority attributes related to clinician quality (12.1% of overall attribute importance), prescription or referral access (9.4%), and timely care (7.5%). Preference heterogeneity by geography was limited: six attributes showed statistically significant differences for regional city/large town respondents compared with major city

respondents, while no statistically significant attribute-level deviations were detected for rural/remote respondents.

Conclusion: Equitable telehealth should prioritise clinically effective, high-quality service models integrated with existing healthcare pathways while adding targeted supports to address capability barriers, particularly for older adults and digitally excluded groups. Core clinical care expectations were broadly shared across geographic groups, supporting universal service quality standards complemented by locally adapted enabling supports.

6.2 Introduction

Telehealth has become a sustained feature of Australian healthcare delivery rather than a temporary pandemic response (1-3). In Australia, telehealth use in general practice increased from very low levels in 2019 to peak levels during the COVID-19 period and has remained materially higher than baseline as in-person services resumed, stabilising at around one fifth of GP activity in recent years (4, 5). This shift is important for the wider thesis because it moves the question of telehealth equity beyond emergency adoption and into the domain of longer-term service design, implementation, and evaluation. If telehealth is now part of routine care, then understanding who is willing to use it, under what circumstances, and which service features people prioritise becomes central to equitable telehealth policy and practice.

While telehealth offers potential to reduce geographic barriers to healthcare, particularly for populations in regional and remote areas who face substantial travel burdens and workforce shortages, evidence also suggests that digital health innovations may exacerbate rather than reduce inequities if they are not designed and implemented with explicit attention to access, capability, trust, and service quality (6, 7). Geographic location remains a fundamental axis of health inequality in Australia. Rural and remote residents experience poorer health outcomes, reduced healthcare workforce availability, longer travel times to services, and higher out-of-pocket costs than metropolitan populations (8-10). Telehealth has therefore been promoted as a strategy to address these disparities by reducing travel requirements and extending the

effective reach of care beyond urban centres (11, 12). However, telehealth itself depends on a set of preconditions that may vary across contexts, including reliable infrastructure, digital capability, and willingness to substitute remote for in-person care in specific clinical situations (13-15).

Earlier chapters of this thesis examined telehealth equity from the perspectives of existing evidence, conceptual frameworks, policy, and programme implementation. Chapter 5 in particular developed a nine-dimension telehealth equity framework spanning digital infrastructure and access, affordability, user digital literacy and capacity, cultural adaptation and social inclusion, service quality and outcomes, privacy and security, governance, sustainability, and healthcare system integration. Chapter 6 complements that work by bringing in the user perspective. Rather than evaluating programme design directly, it examines how consumers differ in telehealth readiness, acceptability, and preferences for equity-relevant service attributes. In this way, the chapter provides demand-side evidence that complements the policy- and programme-level analyses presented earlier in the thesis. More specifically, Chapter 6 helps interpret how the Chapter 5 framework relates not only to programme design and implementation, but also to consumer-facing priorities and barriers. It therefore adds a user-level perspective to the wider thesis, linking the policy- and programme-level analyses in Chapters 4 and 5 with evidence on telehealth readiness, scenario-specific willingness, and preferences for equity-relevant service attributes.

Studies examining user preferences for telehealth features remain limited, and those that exist

often assess general acceptance or rejection rather than preferences for specific service design attributes that could inform equitable implementation (16, 17). In addition, much of the literature treats geographic populations as internally homogeneous, without distinguishing between major cities, regional centres, and rural or remote areas that may differ in infrastructure, service availability, and prior experience with the healthcare system. The absence of rigorous evidence on how geography shapes not only access barriers but also consumer priorities for telehealth service design represents an important gap for policy development. Equity-focused telehealth policy requires understanding whether different geographic populations face different barriers, hold different attitudes toward remote care across clinical scenarios, and prioritise different service attributes when evaluating telehealth offerings. Without this understanding, telehealth services risk being optimised for better-resourced or more digitally capable groups while failing to address the needs and preferences of populations facing greater structural disadvantage.

This chapter addresses these gaps through primary data analysis of adults residing in New South Wales (NSW). Using cross-sectional survey data collected between 28 October and 24 November 2025 (N=2,882), the chapter examines four linked dimensions of telehealth experience across Major city, Regional city/large town, and Rural/remote populations: (1) structural barriers and digital capability, including internet access problems and digital confidence; (2) scenario-specific willingness to use telehealth across ten clinical contexts varying in complexity and familiarity; (3) relative preferences for 24 telehealth service

attributes spanning nine equity-relevant domains using Best-Worst Scaling (Case 1); and (4) the extent to which preference structures differ systematically by geographic location. These four dimensions correspond to the main empirical questions addressed in the chapter and are discussed in the same order in the Methods, Results, and Discussion sections that follow.

The analysis contributes to the telehealth equity literature in three ways. First, it distinguishes between infrastructure barriers, which constrain whether telehealth is technically feasible; digital capability and confidence, which shape whether users can engage effectively with technology; scenario-specific acceptability, which reflects judgements about when telehealth is appropriate; and attribute preferences, which reveal priorities for service design features.

This multidimensional approach recognises that equity encompasses not only access, but also meaningful use and user-centred design. Second, by comparing Major city, Regional city/large town, and Rural/remote populations rather than treating non-metropolitan areas as homogeneous, the analysis is able to identify whether different forms of geographic disadvantage may require different policy responses. Third, the use of Best-Worst Scaling to elicit preferences for specific service attributes provides more actionable evidence about how telehealth should be designed to meet diverse population needs, rather than only whether telehealth is acceptable in principle.

6.2.1 Study Aims and Research Questions

The overarching aim of this chapter is to quantify geographic differences in telehealth access, capability, acceptability (defined here as conditional willingness to use telehealth across varying clinical and social contexts), and service design preferences, and to examine whether any systematic geographic heterogeneity should inform equity focused policy and service design.

Four specific research questions guide the analysis:

RQ1: To what extent does geographic location predict structural barriers to telehealth access and capability?

We examine whether Rural or remote and Regional city or large town residence is independently associated with (a) internet access problems in the past three months and (b) low digital confidence, after controlling for age group, gender, education, household income, and disability or long-term condition status. This question establishes the access and capability context within which telehealth operates across geographic settings.

RQ2: How does geographic location shape willingness to use telehealth across diverse clinical scenarios?

We assess whether Rural or remote and Regional city or large town residents differ from Major city residents in willingness to use telehealth across ten clinical scenarios that vary in clinical complexity, provider familiarity, and communication requirements (including

interpreter needed). Unwillingness is defined as responses “Unlikely” or “Very unlikely” versus all other responses. This question tests whether acceptability varies by context and whether geographic groups apply different thresholds for when telehealth is considered appropriate.

RQ3: Do telehealth service attribute preferences differ systematically by geographic location?

Using Case 1 Best-Worst Scaling (MaxDiff), we quantify preferences for 24 telehealth service attributes mapped to nine equity-relevant domains (digital infrastructure and access, economic affordability, user digital literacy and capacity, cultural adaptation and social inclusion, service quality and clinical outcomes, data security and privacy protection, stakeholder engagement and governance, sustainability and policy support, and healthcare system integration). Case 1 BWS was used because it requires respondents to make explicit trade-offs between attributes, thereby providing stronger discrimination of priorities than simple rating or ranking tasks and reducing some forms of scale-use bias. Panel multinomial logit models test whether Regional city or large town and Rural or remote respondents exhibit different attribute utilities relative to the Major city baseline, and identify which specific attributes show statistically detectable geographic heterogeneity

RQ4: When geographic preference heterogeneity is observed, is it concentrated in specific types of attributes or dispersed across the framework domains?

Rather than interpreting summed domain weights (which can be mechanically influenced by the number of attributes within each domain), we examine whether any statistically significant geographic deviations at the attribute level cluster within particular equity domains or enabling feature types (for example, infrastructure accommodations, affordability, cultural adaptation, or feedback mechanisms). This question informs whether equity oriented adaptation should focus on a targeted subset of service features versus more comprehensive redesign.

Together, these research questions move beyond simple access metrics to integrate capability, acceptability across clinical contexts, and consumer stated preferences for service design, providing evidence relevant to equitable telehealth policy and implementation in Australia.

6.3 Methods

6.3.1 Study design and setting

This chapter reports a cross-sectional analysis of an online stated-preference survey conducted among adults (aged 18 years or older) residing in New South Wales (NSW), Australia. The survey was administered in Qualtrics and fielded via Pureprofile, a commercial online panel provider that recruits panel members who opt in to complete surveys in exchange for incentives. The survey captured: (i) sociodemographic characteristics and access barriers relevant to telehealth equity; (ii) willingness to use telehealth across a set

of common clinical scenarios; and (iii) preferences for telehealth service design attributes elicited using Best-Worst Scaling (BWS). The NSW focus was chosen to align with the broader thesis context and to enable analysis of geographic heterogeneity within a single jurisdictional setting.

6.3.2 Sample, recruitment, sample size rationale, and data cleaning

Recruitment and eligibility

Panel members were eligible if they were aged 18 years or older and currently residing in NSW. Pureprofile distributed survey invitations to eligible panel members and managed screening and quota monitoring. Participants indicated consent via an initial online consent screen before proceeding to the questionnaire.

To support planned comparisons across geographic groups, recruitment targets were monitored to maintain sufficient representation from Major city, Regional city/large town, and Rural/remote respondents. Although the final sample is not population-representative of NSW and remains subject to the limitations of online panel recruitment, this approach was intended to avoid an overwhelmingly metropolitan sample that would have limited subgroup analysis.

Sample size rationale

A formal power calculation is not straightforward for Case 1 BWS (MaxDiff) designs because precision depends on the experimental design, number of tasks per participant, and the strength of underlying preferences (19, 20). Sample size was therefore determined pragmatically to: (i) support stable estimation of BWS preference parameters; and (ii) enable planned subgroup comparisons by geographic residence and key sociodemographic characteristics in regression analyses.

Data quality filters and analytic cohorts

Survey responses were downloaded from Qualtrics, excluding preview and test records. Data cleaning followed a pre-specified sequence of quality filters implemented in the study scripts to remove low-quality or invalid responses. Filters were applied in the same order as reported in the Results: (i) removal of automated or likely fraudulent entries using Qualtrics reCAPTCHA scores (<0.5 or missing); (ii) removal of likely “speeders” (completion time \leq one-third of the median); (iii) exclusion of very low survey completion (Progress <86%); and (iv) exclusion of respondents who did not complete all 12 BWS choice tasks (i.e., missing any best or worst selections). The resulting analytic cohort comprised respondents who passed all quality filters and completed all BWS tasks (BWS-complete analytic cohort; N=2,882).

Three analysis datasets were derived from the analytic survey export:

1. an analytic survey dataset for descriptive summaries and regression analyses;

2. a BWS modelling dataset requiring complete best and worst selections across all tasks and valid block assignment; and
3. outcome-specific regression datasets created using complete-case analysis for each model after applying outcome- and covariate-specific missing-data rules (see Section 6.3.5.2).

Regression analytic samples

Digital access barrier models were estimated on a common complete-case regression sample (N=2,667), derived from the BWS-complete analytic cohort (N=2,882) after excluding respondents with missing or non-analysable covariate values required for adjustment (predominantly household income “Prefer not to answer”, n=213, plus small numbers for other covariates).

Scenario-based willingness analyses used two nested samples derived from the BWS-complete analytic cohort. Descriptive summaries (Figure 6.1) were based on respondents with complete responses to all willingness items (N=2,879). Multivariable willingness models were estimated on a common complete-case regression sample (N=2,664 per scenario), additionally requiring complete, model-usable covariate data (Geo3, age group, gender, income, education, disability/long-term condition); non-informative categories (e.g., “Prefer not to answer”) were treated as missing. A common regression sample was used across scenarios to support comparability of adjusted associations.

6.3.3 Measures and covariates

Geographic grouping (Geo3 and Geo2)

Geographic residence was classified using a three-level grouping (Geo3) comprising Major city, Regional city/large town, and Rural/remote. This grouping was used as the primary geography variable throughout the chapter because it aligns with the substantive aim of distinguishing major metropolitan, regional, and more remote contexts rather than collapsing all non-metropolitan areas together.

A secondary two-level grouping (Geo2), contrasting Major city with Regional city/large town plus Rural/remote combined, was examined only for selected model comparisons in the BWS analysis. Geo2 was used as an alternative specification to assess whether a simpler metropolitan versus non-metropolitan contrast improved model fit or interpretability, but Geo3 remained the primary geography classification used for substantive interpretation throughout the chapter.

Throughout this chapter, “Major city”, “Regional city/large town”, and “Rural/remote” are used as variable category labels and are capitalised accordingly when referring to analytic categories. In thesis-level prose, such as the Abstract, these terms are written in sentence case.

Socio-demographic covariates

The survey captured age group, gender, highest educational attainment, household income, and disability status. For modelling, categorical covariates were coded using pre-specified reference categories. Responses such as “Prefer not to say” (and other non-informative categories where applicable) were treated as missing for regression covariates.

Access barrier outcomes

Two binary access-barrier outcomes were constructed:

- Internet access problems: derived from a question asking how often respondents had experienced internet access difficulties in the past three months. Responses were dichotomised as any problem (rarely/sometimes/often/always) versus no problem (never). This measure captures self-reported experienced difficulties rather than objective connectivity performance.
- Low digital confidence: derived from a self-reported confidence item asking how confident respondents felt using digital technology for health purposes. Responses were dichotomised as low confidence (not confident/somewhat confident) versus high confidence (confident/very confident).

Willingness-to-use outcomes (scenario-based)

Willingness to use telehealth was assessed across multiple clinical scenarios using a Likert-type response scale. For regression modelling, each scenario was dichotomised as unwilling (responses “Unlikely/Very unlikely”) versus not unwilling (“Neutral/Likely/Very likely”).

Neutral responses were retained on the “not unwilling” side to preserve interpretability of the outcome as unwillingness.

6.3.4 Best-Worst Scaling (BWS) methodology

Best-Worst Scaling (BWS) was used to quantify the relative importance of telehealth service design attributes while forcing respondents to make explicit trade-offs. This study used Case 1 BWS (also known as object case or MaxDiff), in which respondents repeatedly selected the most important and least important attribute from a small set. Compared with simple rating or ranking tasks, Case 1 BWS provides stronger discrimination between attributes and reduces some forms of scale-use bias, making it well suited to identifying priorities for telehealth service design (19, 20).

Telehealth service attributes were identified through a multi-stage process drawing on: (i) the preceding evidence synthesis chapters (Chapter 2-3); (ii) the Australian telehealth policy review (Chapter 4); and (iii) the telehealth equity framework developed in Chapter 5. The final instrument included 24 attributes mapped a priori to nine equity-relevant domains.

Domain labels were used descriptively to organise interpretation, but the BWS design elicited trade-offs between attributes rather than between domains, so domain-level importance scores were not computed.

A D-efficient, near-balanced incomplete block design was generated in SAS v9.4. The final

design comprised 96 choice sets with three attributes per set and was blocked into eight versions of 12 tasks to reduce respondent burden. Respondents were randomly assigned to one of the eight blocks.

6.3.4.1 Attribute identification and selection

Telehealth service attributes were identified through a multi-stage process drawing on: (i) evidence synthesis (see Chapters 2 and 3) (21, 22), (ii) Australian telehealth policy review (see Chapter 4), and (iii) empirical insights from earlier thesis chapters (case studies and equity framework development) (see Chapter 5). The final instrument included 24 attributes mapped a priori to nine equity-relevant domains: Digital Infrastructure and Access; Economic Affordability; User Digital Literacy and Capacity; Cultural Adaptation and Social Inclusion; Service Quality and Clinical Outcomes; Data Security and Privacy Protection; Stakeholder Engagement and Governance; Sustainability and Policy Support; and Healthcare System Integration. Attributes were written as short, respondent-facing statements describing desirable service features. Accordingly, the attribute set focused on aspects of telehealth service design that consumers could reasonably evaluate from their own experience and perspective, and did not include objective clinical effectiveness or safety outcomes that would require clinical expertise or outcome data. As a result, the Chapter 5 domain label "Service Quality and Clinical Outcomes" is only partially represented in the BWS instrument, capturing consumer-facing quality perceptions and care processes (e.g., perceived clinician

quality and access to prescriptions/referrals) rather than system-level clinical endpoints.

Domain mapping was used for descriptive organisation and interpretation only; we did not compute domain-level importance scores or make cross-domain comparisons.

For model identification, attribute A16 (“The quality of the doctor providing the service is high”) was specified as the reference (utility fixed to zero; $\beta_{16} = 0$), and all other attribute coefficients were estimated relative to this baseline (20).

6.3.4.2 Experimental design and choice tasks

We implemented Case 1 BWS (object-case), also known as MaxDiff (20, 23). Respondents completed a blocked experimental design comprising multiple choice tasks. In each task, respondents were shown three attributes and asked to select: (i) the attribute that was MOST important, and (ii) the attribute that was LEAST important when considering whether to use telehealth services.

A D-efficient, near-balanced incomplete block design was generated in SAS v9.4 (SAS Institute Inc., Cary, NC, USA). The design comprised 96 choice sets with three attributes per set and was blocked into eight versions of 12 tasks to reduce respondent burden. Respondents were randomly assigned to one of the eight blocks.

6.3.4.3 Data preparation and coding

BWS responses were transformed into long-format choice data suitable for multinomial logit estimation under a standard sequential best-worst (“exploded”) likelihood, where each task contributes two linked choices: a “best” choice among the displayed attributes followed by a “worst” choice among the remaining attributes after the best selection is removed (20, 23).

The long-format dataset included respondent identifiers to enable a panel specification (repeated tasks per respondent).

6.3.5 Statistical analysis

6.3.5.1 Descriptive analysis

Descriptive analyses summarised socio-demographic characteristics and key measures overall and by geographic group. Categorical variables were summarised using frequencies and percentages; continuous variables were summarised using appropriate measures of central tendency and dispersion. Between-group differences were assessed using χ^2 tests for categorical variables and t-tests/ANOVA (or Wilcoxon/Kruskal-Wallis tests where distributions were non-normal) for continuous variables, as appropriate.

6.3.5.2 Multivariable regression of access barriers and willingness

We estimated multivariable logistic regression models for: (i) internet access problems, (ii) low digital confidence, and (iii) unwillingness to use telehealth across each clinical scenario (24). All regression models were pre-specified and implemented as follows:

- **Common covariate set:** Geographic location (Geo3: Major city, Regional city/large town, Rural/remote area), age group, gender, and household income were included in all models. For regression, household income was collapsed to <AUD 60,000 vs ≥AUD 60,000 (reference). Gender was coded as male vs female (reference); other categories were treated as missing for regression due to small cell sizes.
- **Additional covariates:** Education and disability/long-term condition status were included in all fully adjusted models presented in this chapter. Education was collapsed to university degree (yes/no; reference = university degree), and disability/long-term condition was coded yes/no (reference = no).
- **Consistency across scenarios:** For scenario-based willingness analyses, the same covariate specification was applied to every scenario to enable interpretable comparisons of adjusted associations across scenarios.
- **Missing data handling:** Complete-case analysis was applied separately for each model after implementing pre-specified missing-data rules for outcomes and covariates.

- **Diagnostics:** Multicollinearity was assessed using variance inflation factors (VIFs) (25).
- **Model specification:** Unless otherwise stated, covariates were entered simultaneously in a single fully adjusted model for each outcome. Analytic samples (including complete-case regression sample sizes) are described in Section 6.3.2.
- **Reporting and interpretation:** Results are reported as adjusted odds ratios (aORs) with 95% confidence intervals. For all models, aORs > 1 indicate higher odds of the coded outcome (barrier present or unwillingness, as defined above).

6.3.5.3 BWS multinomial logit modelling and geographic heterogeneity

Analytical framework

BWS preferences were analysed within the random utility maximisation framework (26). For respondent n and attribute j presented in a task, latent utility was defined as:

$$U_{nj} = V_{nj} + \varepsilon_{nj},$$

where V_{nj} is the systematic component and ε_{nj} is an i.i.d. Type I extreme value error term.

Under these assumptions, choice probabilities follow a multinomial logit form (27).

Model specification

Preference parameters were estimated using a sequential (exploded) multinomial logit (MNL) model for Case 1 (MaxDiff), implemented with a panel specification to account for repeated tasks per respondent. In the pooled (constant) specification, attribute utilities were parameterised as:

$$V_{nj} = \beta_j,$$

with one attribute fixed as the reference for identification ($\beta_{16} = 0$).

To test geographic heterogeneity, we estimated an attribute specific interaction model using Geo3, with Major city as the reference category:

$$V_{nj} = \beta_j + \delta_{j,\text{Regional}} \cdot I(\text{Geo3}_n = \text{Regional}) + \delta_{j,\text{RuralRemote}} \cdot I(\text{Geo3}_n = \text{RuralRemote}),$$

where $I(\cdot)$ is an indicator function that equals 1 if the condition holds and 0 otherwise, and δ terms capture deviations in attribute utility for Regional and Rural remote respondents relative to the Major city baseline (20). A Geo2 model (Major city vs Non major city) was estimated as a sensitivity analysis and reported in Table A 13 a-c.

Model comparison and inference

Model fit across the Constant, Geo2, and Geo3 specifications was compared using log-

likelihood and information criteria (AIC/BIC), and nested model comparisons used likelihood-ratio tests (27). Geographic differences in individual attributes were evaluated using Wald tests on the interaction terms. Estimation was conducted in R using the Apollo package (28).

6.3.6 Ethics

Ethical approval was granted by The University of Sydney Human Research Ethics Committee (Project identifier: 2025/HE000929). This project meets the requirements of the National Statement on Ethical Conduct in Human Research. Informed consent was obtained online via an initial consent screen; participants indicated consent by selecting “I agree” and proceeding, and those who did not consent were exited from the survey. Participants could discontinue the survey at any time prior to submission. The survey was anonymous and no direct identifiers were collected. Data were stored securely in accordance with institutional data governance and Australian privacy requirements.

6.4 Results

6.4.1 Sample Characteristics and Model Inclusion

6.4.1.1 Recruitment, data quality screening, and analytic cohorts

A total of 3,783 panel members provided consent and started the Qualtrics survey (28 October to 24 November 2025). Quality control criteria were applied sequentially to the remaining records after each step; therefore, the exclusion counts are step-specific and sum to the total excluded:

1. Automated/fraudulent responses removed using Qualtrics reCAPTCHA (score <0.5):
n=91 excluded
2. Speeders removed using the pre-specified duration rule (completion time \leq one-third of the sample median): n=681 excluded
3. Low completion removed using a progress threshold (Progress $<86\%$): n=12 excluded
4. Incomplete BWS removed because respondents did not complete all 12 BWS choice tasks: n=117 excluded

After exclusions, the final BWS-complete analytic cohort was $N=2,882$ ($3,783 - 91 - 681 - 12 - 117 = 2,882$). This cohort was used for (i) sample description (Table 6.1), and (ii) BWS modelling (all respondents completed all 12 tasks).

Although Table 6.1 reports all valid response categories (including “Prefer not to answer”),

regression analyses used complete-case samples after treating non-informative categories (e.g., “Prefer not to answer”, “Other/Prefer not” where applicable) as missing for modelling.

This creates smaller, analysis-specific Ns in Sections 6.4.2-6.4.3.3, as detailed below.

Age was analysed using four pre-specified groups (18-34, 35-54, 55-74, 75+) to support interpretable life-stage contrasts and alignment with common population-health reporting strata. The 75+ group was retained as a distinct category rather than being combined with 55-74, to avoid obscuring potential threshold effects in later life when digital capability, comorbidity, and support needs may change more sharply. We recognise that heterogeneity may still exist within the 75+ group; further stratification was not undertaken due to sample size considerations.

For BWS modelling, the final sample generated 34,584 choice tasks (2,882 respondents × 12 tasks). Using sequential best-then-worst (“exploded”) encoding, each task contributes two linked choices, yielding 69,168 long-format choice observations (best and worst choices) for multinomial logit estimation.

6.4.1.2 Geographic Distribution

Geographic residence was analysed using a pre-specified three-level classification (Geo3) consisting of Major city, Regional city/large town, and Rural/remote area, selected to reflect distinct service contexts and infrastructure constraints across metropolitan, regional, and

rural/remote settings. Respondents were distributed as follows: Major city n=1,599 (55.5%), Regional city/large town n=891 (30.9%), and Rural/remote area n=392 (13.6%) (Table 6.1).

6.4.1.3 Sociodemographic and equity-relevant characteristics

Table 6.1 summarises the demographic and socioeconomic profile of the analytic sample overall and by geography. Respondents in Regional city/large town and Rural/remote areas were older than those in Major cities (35.3% aged ≥ 55 years in Major cities versus 47.4% in Regional city/large town and 46.7% in Rural/remote areas). The proportion of women also increased with remoteness (57.0% in Major cities, 62.5% in Regional city/large town, and 76.0% in Rural/remote areas).

Education and income showed a clear urban-rural gradient: Major city respondents were more likely to report a bachelor's degree or higher (51.6% versus 28.8% in Regional city/large town and 26.2% in Rural/remote area) and household income $\geq \$120,000$ (39.7% versus 23.7% Regional city/large town and 19.1% Rural/remote area). Language other than English at home was concentrated in Major cities (10.4%) and uncommon in Regional city/large town and Rural/remote area groups ($\leq 1.6\%$), consistent with settlement patterns.

Equity-relevant access indicators also varied. Internet access problems in the past three months were more frequently reported in Rural/remote areas (69.9%) than in Regional city/large town (58.0%) and Major city areas (54.3%) (Table 6.1). In contrast, digital

confidence and mean eHealth literacy (eHEALS) showed only modest geographic variation.

These patterns motivated subsequent multivariable analyses to distinguish unadjusted differences from adjusted differences remaining after accounting for sociodemographic composition.

Table 6.1 Sample characteristics by geographic location (N=2,882)

Characteristic	Overall N=2,882	Major city N=1,599	Regional city/large town N=891	Rural/remote N=392
Age band				
18-34	567 (19.7%)	349 (21.8%)	143 (16.0%)	75 (19.1%)
35-54	1,143 (39.7%)	684 (42.8%)	326 (36.6%)	133 (33.9%)
55-74	955 (33.1%)	464 (29.0%)	341 (38.3%)	150 (38.3%)
75+	215 (7.5%)	101 (6.3%)	81 (9.1%)	33 (8.4%)
Prefer not to answer	2 (0.1%)	1 (0.1%)	0 (0.0%)	1 (0.3%)
Gender				
Female	1,766 (61.3%)	911 (57.0%)	557 (62.5%)	298 (76.0%)
Male	1,112 (38.6%)	685 (42.8%)	334 (37.5%)	93 (23.7%)
Other/Prefer not	4 (0.1%)	3 (0.2%)	0 (0.0%)	1 (0.3%)
Language at home (LOTE = language other than English)				
English only	2,696 (93.5%)	1,433 (89.6%)	877 (98.4%)	386 (98.5%)
LOTE	186 (6.5%)	166 (10.4%)	14 (1.6%)	6 (1.5%)
Education				

Characteristic	Overall N=2,882	Major city N=1,599	Regional city/large town N=891	Rural/remote N=392
Less than Year 12 or equivalent	402 (13.9%)	170 (10.6%)	143 (16.0%)	89 (22.7%)
Completed Year 12 or equivalent	396 (13.7%)	197 (12.3%)	133 (14.9%)	66 (16.8%)
Trade or technical certificate or diploma	899 (31.2%)	407 (25.5%)	358 (40.2%)	134 (34.2%)
Bachelor's degree	851 (29.5%)	596 (37.3%)	180 (20.2%)	75 (19.1%)
Postgraduate/ higher degree	334 (11.6%)	229 (14.3%)	77 (8.6%)	28 (7.1%)
Household income				
Less than \$30,000	282 (9.8%)	114 (7.1%)	106 (11.9%)	62 (15.8%)
\$30,000-\$59,999	529 (18.4%)	212 (13.3%)	209 (23.5%)	108 (27.6%)
\$60,000-\$89,999	456 (15.8%)	240 (15.0%)	158 (17.7%)	58 (14.8%)
\$90,000-\$119,999	481 (16.7%)	286 (17.9%)	139 (15.6%)	56 (14.3%)
\$120,000 or more	921 (32.0%)	635 (39.7%)	211 (23.7%)	75 (19.1%)
Prefer not to answer	213 (7.4%)	112 (7.0%)	68 (7.6%)	33 (8.4%)
People in household				
1	593 (20.6%)	300 (18.8%)	213 (23.9%)	80 (20.4%)
2	1,020 (35.4%)	515 (32.2%)	348 (39.1%)	157 (40.1%)
3	529 (18.4%)	323 (20.2%)	145 (16.3%)	61 (15.6%)
4	488 (16.9%)	311 (19.4%)	115 (12.9%)	62 (15.8%)
5 or more	252 (8.7%)	150 (9.4%)	70 (7.9%)	32 (8.2%)
eHEALS total score (digital health literacy), mean (SD)	31.49 (5.74)	31.74 (5.54)	31.44 (5.75)	30.58 (6.40)
Digital technology confidence				

Characteristic	Overall N=2,882	Major city N=1,599	Regional city/large town N=891	Rural/remote N=392
Not confident	85 (2.9%)	39 (2.4%)	25 (2.8%)	21 (5.4%)
Somewhat confident	776 (26.9%)	363 (22.7%)	291 (32.7%)	122 (31.1%)
Confident	1,050 (36.4%)	602 (37.6%)	303 (34.0%)	145 (37.0%)
Very confident	971 (33.7%)	595 (37.2%)	272 (30.5%)	104 (26.5%)
Internet access problems (past 3 months)				
Never	1,223 (42.4%)	731 (45.7%)	374 (42.0%)	118 (30.1%)
Any problems (rarely/sometimes/often/always)	1,659 (57.6%)	868 (54.3%)	517 (58.0%)	274 (69.9%)
Previous telehealth use				
Yes	2,094 (72.7%)	1,175 (73.5%)	638 (71.6%)	281 (71.7%)
No	765 (26.5%)	412 (25.8%)	245 (27.5%)	108 (27.6%)
Don't Know	23 (0.8%)	12 (0.8%)	8 (0.9%)	3 (0.8%)
Self-rated health				
Excellent	293 (10.2%)	191 (11.9%)	68 (7.6%)	34 (8.7%)
Very Good	929 (32.2%)	568 (35.5%)	247 (27.7%)	114 (29.1%)
Good	1,062 (36.8%)	559 (35.0%)	356 (40.0%)	147 (37.5%)
Fair	490 (17.0%)	237 (14.8%)	179 (20.1%)	74 (18.9%)
Poor	108 (3.7%)	44 (2.8%)	41 (4.6%)	23 (5.9%)
Has regular GP				
Yes	2,399 (83.2%)	1,324 (82.8%)	760 (85.3%)	315 (80.4%)
No	436 (15.1%)	253 (15.8%)	116 (13.0%)	67 (17.1%)

Characteristic	Overall N=2,882	Major city N=1,599	Regional city/large town N=891	Rural/remote N=392
Not sure	44 (1.5%)	21 (1.3%)	13 (1.5%)	10 (2.6%)
Missing	3 (0.1%)	1 (0.1%)	2 (0.2%)	0 (0.0%)
Travel time to GP (current)				
Less than 30 minutes	2,277 (79.0%)	1,248 (78.0%)	757 (85.0%)	272 (69.4%)
30-60 minutes	500 (17.3%)	301 (18.8%)	106 (11.9%)	93 (23.7%)
More than 1 hour but less than 2 hours	75 (2.6%)	42 (2.6%)	18 (2.0%)	15 (3.8%)
More than 2 hours	27 (0.9%)	7 (0.4%)	8 (0.9%)	12 (3.1%)
Missing	3 (0.1%)	1 (0.1%)	2 (0.2%)	0 (0.0%)
Has disability or long-term condition				
Yes	980 (34.0%)	436 (27.3%)	362 (40.6%)	182 (46.4%)
No	1,902 (66.0%)	1,163 (72.7%)	529 (59.4%)	210 (53.6%)
Among those with disability: disability makes accessing healthcare harder				
Yes	201 (20.5%)	93 (21.3%)	57 (15.7%)	51 (28.0%)
No	779 (79.5%)	343 (78.7%)	305 (84.3%)	131 (72.0%)
Difficulty seeing/hearing even with aids				
Yes	451 (15.6%)	232 (14.5%)	150 (16.8%)	69 (17.6%)
No	2,431 (84.4%)	1,367 (85.5%)	741 (83.2%)	323 (82.4%)

6.4.2 Digital access barriers

Analyses of digital access barriers were conducted in the complete-case regression sample (N=2,667; Table 6.2). Unadjusted prevalence by geography and age is provided in Table A 14 a, and crude versus adjusted estimates for key predictors are summarised in Table A 15.

6.4.2.1 Internet access problems

Unadjusted prevalence of internet access problems was highest in Rural/remote areas (69.9%), followed by Regional city/large town (58.0%) and Major city respondents (54.3%) (Table 6.1). In the complete-case regression sample (N=2,667), unadjusted prevalence estimates showed the same pattern by geography (Table A 14 a). In fully adjusted models, Rural/remote area respondents had higher odds of reporting internet access problems compared with Major city respondents (aOR 1.88; 95% CI 1.45-2.44; $p < 0.001$), while Regional city/large town respondents did not differ materially from Major city respondents (aOR 1.05; 95% CI 0.87-1.25; $p = 0.60$) (Table 6.2). Compared with 18-34 years, older age groups had lower odds of reporting internet access problems (55-74: aOR 0.46; 95% CI 0.37-0.59; $p < 0.001$; 75+: aOR 0.32; 95% CI 0.22-0.45; $p < 0.001$). Crude odds ratios showed the same direction (55-74: crude OR 0.54; 95% CI 0.43-0.67; 75+: crude OR 0.39; 95% CI 0.28-0.55). Cross tabulation of response categories by age group indicated that the proportion reporting “Never” increased steadily with age (18-34: 34.5%; 75+: 57.4%), while the

proportion reporting “Sometimes”, “Often”, or “Always” decreased (18-34: 29.3%; 75+: 12.6%) (Table A 14 b). A sensitivity analysis using an alternative dichotomisation (Never or Rarely versus Sometimes, Often, or Always) yielded stronger age associations in the same direction (75+: aOR 0.27; 95% CI 0.16-0.43). Taken together, these patterns are consistent with differential internet use frequency by age: respondents who use the internet less frequently may have fewer opportunities to encounter or report access difficulties, meaning this item may understate connectivity constraints among older adults. Lower household income and disability or long-term condition were also associated with higher odds of internet access problems (Table 6.2).

6.4.2.2 Low digital confidence

Unadjusted prevalence of low digital confidence increased steeply with age and was higher outside Major cities (Major city 24.0%, Regional city/large town 34.6%, Rural/remote 35.8%; Table A 14 a). After adjustment, geography was not a statistically meaningful predictor of low digital confidence (Regional city/large town: aOR 1.17; 95% CI 0.95-1.43; $p=0.14$; Rural/remote area: aOR 1.11; 95% CI 0.85-1.46; $p=0.40$) (Table 6.2), indicating that unadjusted geographic differences were largely explained by sociodemographic composition. A strong age gradient remained: compared with 18-34 years, the odds of low digital confidence were higher for 35-54 (aOR 1.76; 95% CI 1.32-2.39; $p<0.001$), 55-74 (aOR 3.53; 95% CI 2.64-4.78; $p<0.001$), and 75+ (aOR 5.81; 95% CI 3.90-8.72; $p<0.001$) (Table 6.2).

Low income and not having a university degree were also independently associated with higher odds of low digital confidence (Table 6.2).

Table 6.2 Multivariable logistic regression for digital access barriers (N = 2,667)

Characteristic	Internet access problems			Low digital confidence		
	aOR	95% CI	p-value	aOR	95% CI	p-value
Geographic location (ref: Major city)						
Regional	1.05	0.87-1.25	0.60	1.17	0.95-1.43	0.14
Rural/Remote	1.88	1.45-2.44	<0.001	1.11	0.85-1.46	0.40
Age group (ref: 18-34)						
35-54	0.82	0.65-1.01	0.069	1.76	1.32-2.39	<0.001
55-74	0.46	0.37-0.59	<0.001	3.53	2.64-4.78	<0.001
75+	0.32	0.22-0.45	<0.001	5.81	3.90-8.72	<0.001
Gender (ref: Woman/female)						
Man/male	0.88	0.75-1.04	0.13	0.81	0.67-0.97	0.027
Education (ref: University degree)						
No university degree	1.13	0.95-1.35	0.20	2.0	1.63-2.47	<0.001

Characteristic	Internet access problems			Low digital confidence		
	aOR	95% CI	p-value	aOR	95% CI	p-value
Household income (ref: >=\$60,000/year)						
<\$60,000/year	1.23	1.01-1.50	0.036	1.93	1.58-2.37	<0.001
Disability/long-term condition (ref: No)						
Yes	1.29	1.08-1.53	0.005	1.15	0.95-1.39	0.20

Abbreviations: CI = confidence interval; aOR = adjusted odds ratio.

Note: Odds ratios are from multivariable logistic regression models adjusted for geographic location, age group, gender, household income, education, and disability/long-term condition. For both outcomes, the event was coded as 1 (internet access problems / low digital confidence); therefore, aOR>1 indicates higher odds of reporting the outcome. Internet access problems were dichotomised as any problems (rarely/sometimes/often/always) versus never. Digital technology confidence was dichotomised as low confidence (not confident/somewhat confident) versus high confidence (confident/very confident).

6.4.3 Willingness to use telehealth across clinical scenarios

Willingness responses are summarised descriptively in Figure 6.1 (N=2,879), while adjusted associations were modelled using a binary unwillingness outcome (Unlikely/Very unlikely = 1) and are reported in Table 6.3 and 6.4. Supplementary age-stratified patterns and crude estimates are provided in Tables A 16 to A 18.

6.4.3.1 Unadjusted willingness patterns

Willingness varied by scenario (Figure 6.1), with lower willingness, reflected in higher proportions of “Unlikely” and “Very unlikely” responses, for scenarios involving interpreters, unfamiliar providers, or uncertain appropriateness. Unadjusted age gradients were evident across most scenarios, with the largest contrasts observed for respondents aged 75 and above (Tables A16–A18). Unadjusted geographic differences were smaller and scenario-dependent (Figure 6.1). For adjusted analyses, responses were dichotomised to model unwillingness (Unlikely/Very unlikely = 1) in Table 6.3 and Table 6.4.

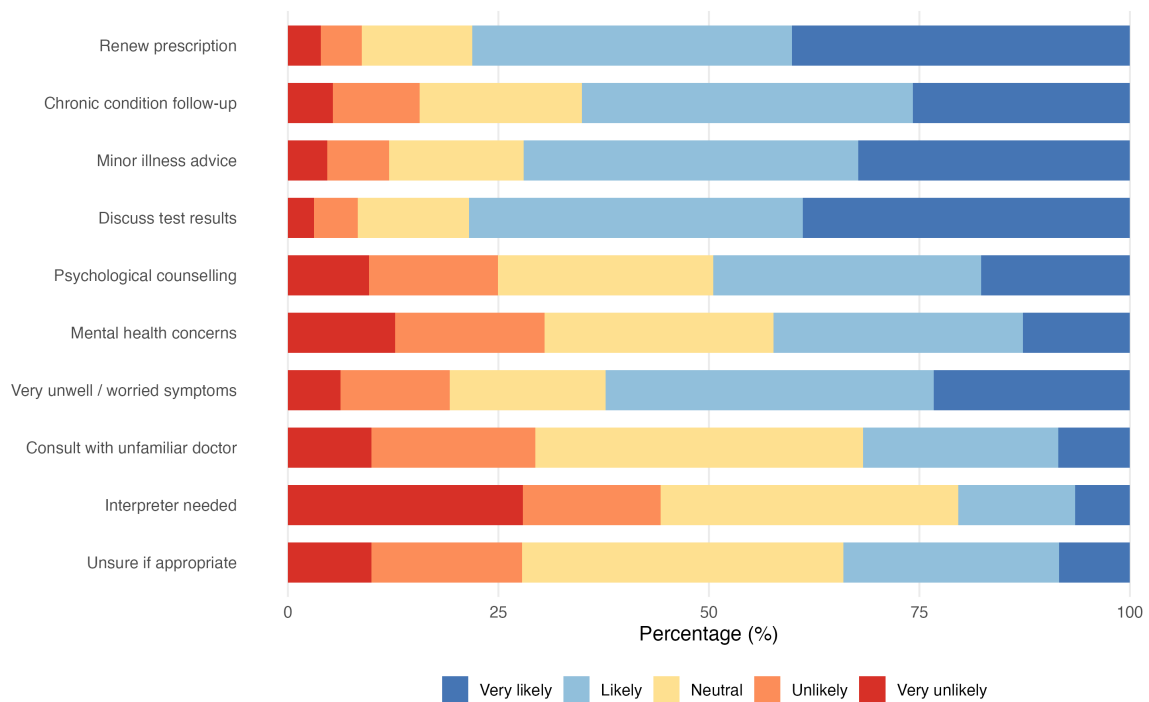


Figure 6.1 Willingness to use telehealth across clinical scenarios (N=2,879).

6.4.3.2 Adjusted associations: geographic residence and age

Adjusted geographic effects were modest and scenario-specific (Table 6.3). All Geo3 contrasts were estimated within the same fully adjusted models, enabling direct comparison of Regional city/large town and Rural/remote effects against the Major city reference. Regional city/large town residence was associated with higher odds of unwillingness for selected scenarios (e.g., interpreter required; chronic condition follow-up; feeling very unwell), whereas Rural/remote residence was similar to Major city for most scenarios and was associated with lower odds of unwillingness for a small number of scenarios (e.g., consulting a doctor not previously met; psychological counselling).

Age was the most consistent predictor across scenarios (Table 6.4). Compared with 18-34 years, older age groups, particularly those aged 75+, had markedly higher odds of unwillingness in most scenarios, with the largest effects observed for mental health/counselling scenarios and when an interpreter was required (Table 6.4).

The attenuation from crude to adjusted estimates for geography, contrasted with the persistence of age effects after adjustment, suggests that much of the unadjusted geographic variation was explained by covariate differences, whereas age-related differences remained robust (Tables A 17 to A 18).

Table 6.3 Unwillingness to use telehealth across scenarios: adjusted odds ratios for geographic residence (Geo3)

Scenario	Regional city or large town aOR (95% CI), reference Major city	Regional city or large town Wald test p value	Rural or remote aOR (95% CI), reference Major city	Rural or remote Wald test p value
Renew prescription	1.21 (0.90, 1.63)	0.213	0.86 (0.55, 1.33)	0.496
Chronic condition follow-up	1.33 (1.05, 1.68)	0.019	0.94 (0.67, 1.32)	0.712
Psychological counselling	1.08 (0.88, 1.32)	0.483	0.73 (0.54, 0.98)	0.039
Minor illness advice	1.28 (0.99, 1.67)	0.063	1.07 (0.74, 1.55)	0.712
Discuss test results	1.34 (0.98, 1.84)	0.063	1.12 (0.73, 1.73)	0.599
Very	1.32 (1.06, 1.63)	0.012	0.76 (0.55, 1.06)	0.104

Scenario	Regional city or large town aOR (95% CI), reference Major city	Regional city or large town Wald test p value	Rural or remote aOR (95% CI), reference Major city	Rural or remote Wald test p value
unwell/worried symptoms				
Not familiar doctor	0.86 (0.70, 1.04)	0.117	0.68 (0.52, 0.90)	0.007
Interpreter needed	1.34 (1.12, 1.60)	0.001	0.98 (0.77, 1.25)	0.868
Mental health concerns	1.18 (0.97, 1.43)	0.101	0.86 (0.65, 1.13)	0.275
Unsure telehealth appropriate	1.24 (1.02, 1.51)	0.032	0.90 (0.68, 1.18)	0.451

Note: Outcome coded 1 equals unwilling (Unlikely or Very unlikely) versus 0 equals willing (Neutral, Likely, or Very likely). aOR greater than 1 indicates higher odds of being unwilling. Fully adjusted logistic regression models included Geo3, age group, gender, household income, education, and disability or long-term condition. Models were estimated on a common complete case sample (N=2,664 per scenario). Wald test p values evaluate the Geo3 contrasts (Regional city or large town versus Major city; Rural or remote versus Major city) within the fully adjusted models.

Table 6.4 Unwillingness to use telehealth across scenarios: adjusted odds ratios for age group

Scenario	35-54 aOR (95% CI), reference 18-34 years	35-54 Wald test p value	55-74 aOR (95% CI), reference 18-34 years	55-74 Wald test p value	75+ aOR (95% CI), reference 18-34 years	75+ Wald test p value
Renew prescription	0.99 (0.63, 1.56)	0.969	1.99 (1.28, 3.09)	0.002	3.34 (1.95, 5.73)	<0.001
Chronic condition follow-up	0.96 (0.70, 1.32)	0.819	1.70 (1.24, 2.33)	<0.001	1.77 (1.12, 2.78)	0.014
Psychological	0.98 (0.74, 1.29)	0.899	2.37 (1.80, 3.13)	<0.001	5.96 (4.06, 8.63)	<0.001

Scenario	35-54 aOR (95% CI), reference 18-34 years	35-54 Wald test p value	55-74 aOR (95% CI), reference 18-34 years	55-74 Wald test p value	75+ aOR (95% CI), reference 18-34 years	75+ Wald test p value
counselling	1.30)		3.13)		8.74)	
Minor illness advice	1.15 (0.78, 1.70)	0.489	2.01 (1.37, 2.95)	<0.001	2.57 (1.57, 4.20)	<0.001
Discuss test results	0.59 (0.39, 0.88)	0.010	0.93 (0.63, 1.38)	0.721	1.15 (0.66, 1.99)	0.618
Very unwell/worried symptoms	1.00 (0.75, 1.33)	0.998	1.59 (1.19, 2.13)	0.002	2.22 (1.48, 3.33)	<0.001
Not familiar doctor	0.95 (0.74, 1.21)	0.685	1.76 (1.36, 2.26)	<0.001	2.57 (1.78, 3.70)	<0.001
Interpreter needed	1.30 (1.04, 1.62)	0.019	2.19 (1.73, 2.76)	<0.001	3.62 (2.52, 5.21)	<0.001
Mental health concerns	1.14 (0.88, 1.47)	0.323	2.73 (2.10, 3.55)	<0.001	6.62 (4.53, 9.66)	<0.001
Unsure telehealth appropriate	1.17 (0.92, 1.51)	0.204	1.88 (1.45, 2.43)	<0.001	3.23 (2.22, 4.69)	<0.001

Note: Outcome coded 1 equals unwilling (Unlikely or Very unlikely) versus 0 equals willing (Neutral, Likely, or Very likely). aOR greater than 1 indicates higher odds of being unwilling. Fully adjusted logistic regression models included Geo3, age group, gender, household income, education, and disability or long-term condition. Age group reference category was 18 to 34 years. Models were estimated on a common complete case sample (N=2,664 per scenario). Wald test p values evaluate the age group contrasts versus the reference group within the fully adjusted models.

6.4.4 Best-Worst Scaling preferences for telehealth service attributes

All BWS models were estimated on the same BWS-complete sample (N = 2,882), using

identical attribute coding; models differed only in how geographic heterogeneity was specified (Constant vs Geo2 vs Geo3).

6.4.4.1 Model comparison and selected specification

Table 6.5 compares three multinomial logit BWS specifications: a Constant pooled model, a Geo2 model contrasting Major city versus combined Regional city or large town plus Rural or remote residence, and a Geo3 model distinguishing Major city, Regional city or large town, and Rural or remote. Relative to the Constant model, allowing geographic heterogeneity improved model fit (Geo2 versus Constant likelihood ratio test, $p < 0.001$). Extending Geo2 to Geo3 yielded a further modest improvement in fit (Geo3 versus Geo2, $p = 0.009$), supporting retention of a three-category geography structure for the primary analysis. While information criteria provided mixed support, with AIC marginally favouring Geo2 and BIC favouring the more parsimonious Constant model, Geo3 was retained as the primary specification because it aligns with the study's pre-specified three context residence grouping and enables separation of regional and rural or remote preference patterns rather than combining them into a single category.

Table 6.5 BWS model comparison

Model	N	Parameters	Log-likelihood	AIC	BIC	Pseudo-R ²	Delta LL vs previous	LR chi square	df	Likelihood Ratio Test P-value
Constant	34,584	23	-54,135.6	108,317.1	108,511.5	0.1264				
Geo2	34,584	46	-54,082.3	108,256.5	108,645.3	0.1272	53.28	106.57	23	<0.001
Geo3	34,584	69	-54,061.2	108,260.4	108,843.6	0.1276	21.04	42.09	23	0.009

Note: N_tasks denotes the number of choice tasks (2,882 respondents x 12 tasks), which equals 34,584. Models were estimated on 69,168 exploded choice observations (best and worst choices), corresponding to 34,584 tasks. Parameters comprise 23 attribute coefficients (one attribute set as the reference) plus interaction terms for geographic groups. Log-likelihood values are from panel multinomial logit models estimated in Apollo. AIC = -2LL + 2k; BIC = -2LL + k x ln(N_tasks). Pseudo R² is calculated as 1 - (LL_model / LL_null). Likelihood ratio tests compare nested models using LR chi square = -2(LL_restricted - LL_full). Likelihood ratio test p values correspond to the LR chi square statistics.

6.4.4.2 Overall attribute importance

Overall BWS results highlighted clear priorities at the attribute level (Table 6.6). The highest weighted attribute was “the doctor or health professional I speak to is high quality” (share 12.1%), followed by “I can get a prescription or referral if needed” (9.4%) and “I get advice or treatment quickly” (7.5%). Attributes relating to continuity and trust were also highly weighted, including “the service is from an organisation I trust” (7.2%) and “I can talk to my usual doctor or health professional” (6.5%). In contrast, attributes relating to technical convenience, for example not needing downloads, and feedback mechanisms contributed smaller shares overall, although some attributes showed geographic variation in subsequent analyses.

Table 6.6 Overall attribute importance (constant model), all attributes

Attr ID	Domain	Attribute	Estimate (β)	Share (%)
A16	Service Quality and Clinical Outcomes	The quality of the doctor providing the service is high	0	12.14
A15	Service Quality and Clinical Outcomes	I can get a prescription or referral during the consultation	-0.25	9.43
A13	Service Quality and Clinical Outcomes	I can get timely medical advice without long waiting times	-0.49	7.46
A21	Sustainability & Policy Support	The organisation providing the	-0.53	7.18

Attr ID	Domain	Attribute	Estimate (β)	Share (%)
		service is trustworthy and reputable		
A12	Service Quality and Clinical Outcomes	I can talk to my regular or usual doctor	-0.63	6.46
A17	Economic Affordability	The consultation is completely free for me	-0.74	5.81
A7	Service Quality and Clinical Outcomes	I can choose a time for the appointment that works for me	-0.74	5.81
A19	Data Security and Privacy Protection	I feel sure that my personal information is safe and private	-0.81	5.4
A22	Healthcare System Integration	If I need to, I can switch to in-person care (that is, seeing a health professional face to face at a doctor's surgery or hospital) easily	-0.85	5.18
A14	Service Quality and Clinical Outcomes	I can get follow-up care, like another appointment, if I need it	-0.94	4.74
A2	Digital Infrastructure and Access	I can use the service on any basic device (e.g., phone, tablet)	-1.3	3.29
A24	Healthcare System Integration	My doctor can ask other health	-1.36	3.11

Attr ID	Domain	Attribute	Estimate (β)	Share (%)
		workers, like a nurse or specialist, to join my consultation if needed		
A8	Economic Affordability	I don't need to pay extra for equipment or software	-1.41	2.98
A18	Data Security and Privacy Protection	I know who can see or use my health information	-1.42	2.94
A23	Healthcare System Integration	My health records are automatically shared with other care providers to avoid repetition	-1.42	2.94
A5	User Digital Literacy and Capacity	The service is easy for me to use, even if I'm not good with technology	-1.53	2.63
A3	Digital Infrastructure and Access	I don't need to download or install anything hard to use the service	-1.71	2.19
A1	Digital Infrastructure and Access	I can use the service even with slow or unstable internet	-1.8	2.01
A6	User Digital Literacy and Capacity	I can get help if I have trouble connecting or using the platform	-1.87	1.88
A11	Cultural Adaptation and Social	My family member or carer can join	-1.97	1.69

Attr ID	Domain	Attribute	Estimate (β)	Share (%)
	Inclusion	the consultation if I want them to		
A4	Digital Infrastructure and Access	I can use the service even if I don't have a quiet or private room	-2.17	1.39
A9	Cultural Adaptation and Social Inclusion	I can use the service in my preferred language	-2.21	1.33
A10	Cultural Adaptation and Social Inclusion	I feel my culture is respected by the doctor or provider	-2.4	1.11
A20	Stakeholder Engagement and Governance	I can share my feedback or suggestions about the service	-2.6	0.9

Note: Share (%) values sum to 100 across all attributes. Estimates (β) are from the Constant (pooled) panel multinomial logit BWS model with one reference attribute fixed to 0.

6.4.4.3 Geographic heterogeneity (Geo3)

At the attribute level, the Geo3 interaction model identified six statistically significant deviations for Regional city or large town respondents relative to Major city respondents, and no statistically significant deviations for Rural or remote respondents (Figure 6.2; Table 6.7). Specifically, Regional city or large town respondents had lower relative utility than Major city respondents for the following attributes, as indicated by negative Geo3 interaction terms: not needing to download or install anything, being able to use telehealth without needing a

quiet or private room, being able to choose an appointment time that works for them, not needing to pay extra for equipment or software, feeling that culture is respected by the doctor or provider, and being able to share feedback or suggestions about the service (Table 6.7). No Rural or remote versus Major city contrasts reached statistical significance at $p < 0.05$. Taken together, these results suggest that, conditional on the full attribute set in the Geo3 specification, Rural or remote preferences were not detectably different from Major city preferences in this sample. Full Geo3 interaction results for all attributes are provided in Table A 19.

Table 6.7 Statistically significant Geo3 interaction deviations in attribute utility (reference: Major city)

Equity domain	Attribute	Delta (Regional vs Major)	SE (Regional)	p (Regional)	Delta (Rural or remote vs Major)	SE (Rural/remote)	p (Rural/remote)
Digital Infrastructure and Access	I don't need to download or install anything hard to use the service	-0.228	0.106	0.031	0.147	0.133	0.272
Digital Infrastructure and Access	I can use the service even if I don't have a quiet or private room	-0.265	0.107	0.013	-0.059	0.138	0.669
Service Quality and Clinical Outcomes	I can choose a time for the appointment that works for me	-0.219	0.103	0.034	-0.006	0.135	0.967
Economic Affordability	I don't need to pay extra for equipment or software	-0.300	0.098	0.002	0.002	0.127	0.989

Equity domain	Attribute	Delta (Regional vs Major)	SE (Regional)	p (Regional)	Delta (Rural or remote vs Major)	SE (Rural/remote)	p (Rural/remote)
Cultural Adaptation and Social Inclusion	I feel my culture is respected by the doctor or provider	-0.452	0.111	<0.001	-0.122	0.147	0.406
Stakeholder Engagement and Governance	I can share my feedback or suggestions about the service	-0.287	0.112	0.010	-0.034	0.150	0.823

Note: Delta values are Geo3 interaction terms (difference in attribute utility relative to Major city). Negative Delta indicates lower relative preference weight compared with Major city respondents, conditional on the full attribute set in the Geo3 model. p values are Wald test p values for the corresponding interaction terms. Only statistically significant Regional deviations ($p < 0.05$) are shown. No Rural or remote versus Major city contrasts reached statistical significance at the 0.05 level. Full Geo3 interaction results for all attributes are provided in Table A 19.

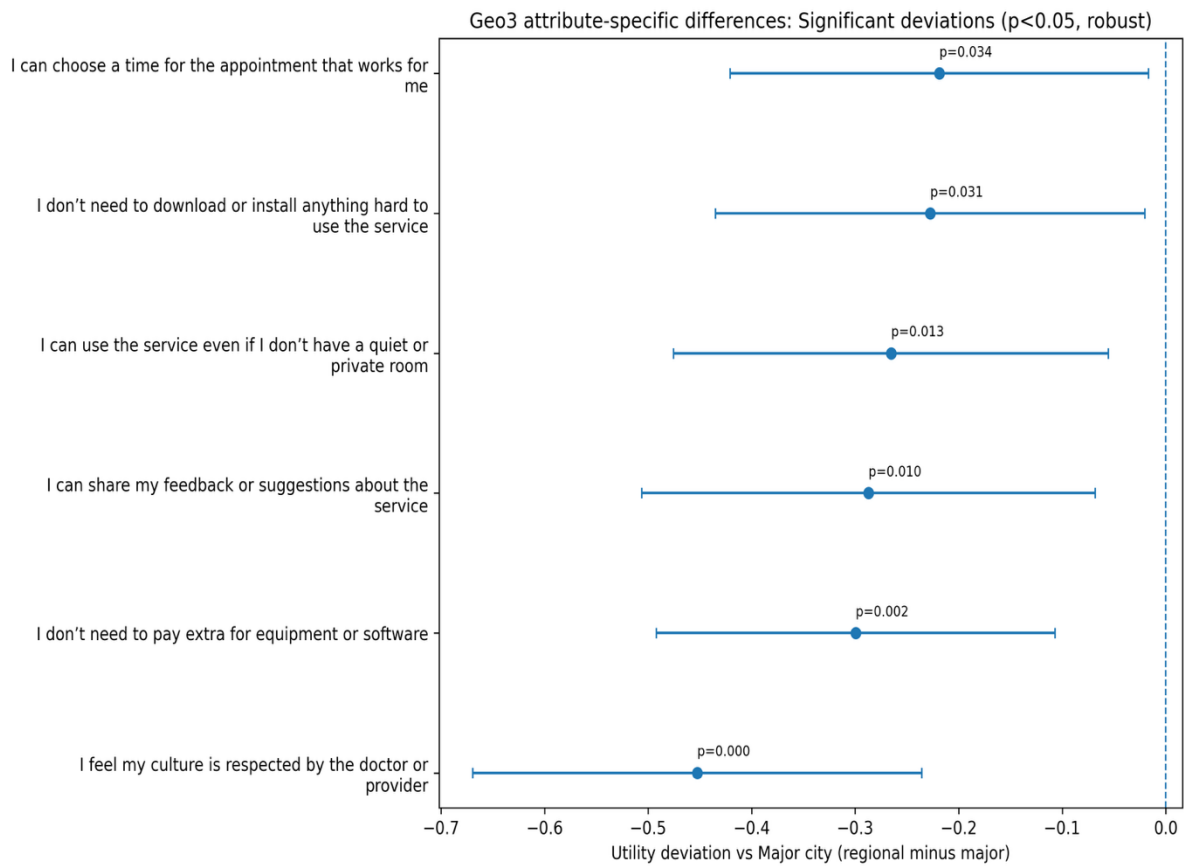


Figure 6.2 Geo3 attribute-specific differences: significant deviations for Regional vs Major city (robust $p < 0.05$)

As a sensitivity check, the Geo2 specification (Major city versus Regional city or large town and Rural or remote combined) yielded substantively similar conclusions, with limited geographic heterogeneity and the same set of priority attributes remaining highly weighted overall. Geo2 results are provided in Tables A 13a-c.

6.5 Discussion

This chapter quantified consumer-facing equity priorities for telehealth and examined how willingness to use telehealth varies across population groups and clinical scenarios. Three consistent messages emerge. First, age was the clearest and most consistent predictor of variation in telehealth willingness across scenarios, with older adults, especially those aged 55 years and above, showing markedly lower willingness after adjustment for sociodemographic covariates (Table 6.4). Second, geographic differences in willingness were smaller and more scenario-specific, suggesting that, among digitally reachable respondents, generational differences were more prominent than geographic ones in shaping telehealth willingness (Table 6.3). Third, when respondents were required to make explicit trade-offs in Best-Worst Scaling, attributes related to service quality and clinical outcomes were consistently the most highly weighted, led by “the quality of the doctor or health professional I speak to is high”, “I can get a prescription or referral if needed”, and “I get advice or treatment quickly” (Table 6.6). Attributes relating to integration, infrastructure, affordability, privacy, and sustainability also contributed non-trivial importance shares, indicating that consumers valued these features, but ranked them below the highest-priority clinical care attributes in the overall preference ordering (Table 6.6).

6.5.1 Interpreting willingness patterns: age effects outweigh geography

Across ten scenario-based models, age gradients were strong and consistent. Compared with the 18 to 34 years reference group, older cohorts showed lower willingness to use telehealth across multiple scenarios, and these effects persisted after adjustment for gender, education, income, disability or long-term conditions, and geography (Table 6.4). This pattern aligns with extensive evidence on generational digital divides and the persistence of capability barriers among older adults even where basic access exists (14, 29). In this study, the persistence of age effects after adjustment indicates that age is associated with barriers not fully explained by measured socioeconomic position alone, which may include lower confidence with digital interaction, stronger preference for established in-person care routines, higher perceived clinical risk of remote care, and greater concern about communication clarity in virtual encounters (30, 31).

Geographic residence showed smaller and less consistent effects than age. Regional city/large town respondents displayed lower willingness in selected scenarios, particularly those involving clinical complexity, uncertainty, or communication barriers such as chronic condition follow-up, being very unwell, or interpreter-needed consultations (Table 6.3). In adjusted models, Rural/remote residence was similar to Major city for most scenarios, with differences observed only in a small number of contexts, including psychological counselling and consultations with an unfamiliar doctor (Table 6.3). One plausible interpretation is pragmatic acceptance: where local services are limited, telehealth may be perceived as a

necessary route to access, particularly for mental health and specialist care (11, 32). At the same time, the overall modest geographic differences should be interpreted cautiously because the sample was recruited via an online panel, which is likely to under-represent people with very limited digital access or capability, since participation required sufficient connectivity and digital literacy to enrol and complete the survey (33). Within the digitally reachable population, age appears to be the primary stratifier of telehealth willingness.

Although recent migration patterns mean that language diversity is increasingly present in regional and rural Australian communities, average exposure to language interpretation needs may still differ across geographic settings, and these baseline differences may partly shape scenario-specific willingness for interpreter-required consultations rather than reflecting differences in the underlying value placed on culturally safe care.

6.5.2 What consumers value in telehealth: BWS shows clinical quality first

BWS provides structured evidence on consumer priorities under explicit trade-offs among telehealth service attributes. At the attribute level, the highest weighted items consistently reflected a clinical quality and completeness narrative, led by “the quality of the doctor or health professional I speak to is high”, “I can get a prescription or referral if needed”, and “I get advice or treatment quickly”, alongside trust in the organisation and continuity with a usual clinician (Table 6.6). This pattern suggests that consumers do not primarily evaluate

telehealth as a technology platform. Instead, they evaluate it as a mode of clinical care whose legitimacy depends on perceived competence, clinical completeness, continuity, and trust (34-36).

Attributes relating to integration, infrastructure, affordability, privacy, and sustainability also carried meaningful importance shares in the overall ranking (Table 6.6). However, they tended to rank below the top clinical care attributes, indicating that platform availability is necessary but may be insufficient for adoption if services are perceived as fragmented, discontinuous, or unable to deliver complete care pathways. This is consistent with stated preference research showing that clinical quality and relational continuity often outweigh convenience attributes when people evaluate models of care, including digital modalities (37, 38).

6.5.3 Geographic heterogeneity in BWS preferences: statistically detectable but limited in practice

Model comparison indicated improved fit when geographic heterogeneity was introduced, with likelihood ratio tests favouring the Geo2 and Geo3 specifications over the pooled Constant model (Table 6.5). However, interpretation should prioritise the magnitude and practical relevance of differences rather than statistical detectability alone, particularly given the large number of choice tasks contributing to the likelihood (39, 40).

At the attribute level, the Geo3 model identified six statistically significant deviations for Regional city or large town respondents relative to Major city respondents (Table 6.7; Figure 6.2). These deviations were concentrated in enabling features, including technical setup and accommodation, cost related considerations, cultural respect, and opportunities to provide feedback. In contrast, no Rural or remote versus Major city interaction terms reached statistical significance at $p < 0.05$ (Table 6.7; Table A 19). This pattern is consistent with broadly similar preference structures across geographies within the digitally reachable sample, while also recognising that smaller subgroup sizes and within group heterogeneity, particularly for Rural or remote respondents, may reduce the ability to detect modest differences (8, 41).

The Geo2 sensitivity analysis (Major city versus Regional city or large town and Rural or remote combined) yielded substantively similar conclusions (Tables A13a to A13c), providing additional reassurance that the finding of limited geographic preference heterogeneity is not driven by the specific three category geographic classification.

Overall, these results suggest a useful policy distinction: core clinical care expectations are broadly shared across geography, while any detectable heterogeneity tends to cluster in enabling features rather than in the highest weighted clinical quality attributes. This supports an approach in which universal service standards are maintained for clinical quality, safety, and integration, while enabling supports are adapted to local constraints.

6.5.4 Reconciling lower BWS weights with equity importance: salience versus constraint

Several equity relevant attributes, including those relating to cultural respect and language support, digital literacy and user support, and opportunities for feedback and engagement, received lower average importance shares than the highest weighted clinical care attributes (Table 6.6). This should not be interpreted as evidence that these equity dimensions are unimportant. Two considerations are critical. First, because the sample is online panel based, respondents already met minimum thresholds of digital access and capability. For populations facing binding access constraints, such as people without reliable broadband, those without suitable devices, or those with very low digital literacy, enabling features may function as prerequisites rather than optional improvements and would likely attract substantially higher relative importance if these groups were adequately represented (42).

Second, some equity relevant features, particularly governance, engagement mechanisms, and security safeguards, may be perceived as background expectations rather than foreground service attributes. Respondents may assume minimum standards are in place and therefore allocate their limited best selections to more tangible clinical and relational features. For this interpretation, the BWS results are best viewed as priorities among digitally reachable consumers under an idealised trade off task, not as a comprehensive ranking of equity needs for all populations.

6.5.5 Implications for equitable telehealth design and policy

Three implications follow directly from the combined willingness and BWS evidence.

First, perceived clinical quality and care pathway completeness should be treated as the foundation of equitable telehealth, not an optional enhancement. In this chapter, “clinical quality and completeness” refers to the highest weighted attributes relating to (i) clinician quality, (ii) access to clinically necessary outputs such as prescriptions or referrals, (iii) timely advice or treatment, and (iv) continuity and trust (Table 6.6). Services should therefore prioritise high quality clinical delivery supported by clear clinical governance, and ensure that telehealth can deliver core care functions, including prescribing, referrals, and follow-up pathways, rather than operating as an isolated or fragmented encounter. Integration into existing care pathways and appropriate information sharing to support continuity are central to acceptance and trust (34, 36, 43).

Second, age tailored support is likely to yield substantial equity gains. Given the strength and consistency of age effects across scenarios, interventions such as assisted telehealth models, digital navigators, simplified interfaces, caregiver inclusive workflows, and multimodal options including telephone where clinically appropriate should be prioritised (44, 45). These strategies address capability and confidence barriers that persist even when infrastructure exists.

Third, preference similarity across geography is an opportunity for standardisation of core

service expectations, but it is not evidence that one model fits all. The Geo3 results suggest that the highest priority attributes are broadly shared across groups, while any detectable heterogeneity clusters in enabling features (Table 6.7; Table A 19). At the same time, infrastructure investment and locally adapted enabling supports remain essential where access constraints are binding, particularly in rural and remote areas where internet problems were more common (Table 6.2). A differentiated approach is therefore warranted: standardise core service quality, safety, and integration expectations while targeting enabling supports to contexts and groups with structural disadvantages (18, 46).

6.5.6 Strengths and limitations

This chapter is strengthened by combining scenario-based willingness models with BWS trade off evidence, allowing examination of both when telehealth is acceptable and what respondents prioritised under explicit attribute trade-offs in an idealised service framing. The large sample and careful data cleaning improve data quality and robustness for the planned comparisons.

Limitations should be acknowledged. The online panel frame is likely to under-represent people with very limited digital access or capability because participation required sufficient connectivity and digital literacy to enrol and complete the survey; this may underestimate the importance of enabling features for the most digitally excluded groups. Geographic

categories also aggregate within group heterogeneity, and finer measures of remoteness and service availability may reveal additional variation. Finally, stated preferences reflect hypothetical trade-offs elicited in a simplified choice context and may not fully capture real-world constraints and behavioural responses. These limitations mean the results should be interpreted as evidence on the digitally reachable population and as a complement to programme and policy analyses elsewhere in the thesis.

6.5.7 Future research directions

Future work should purposively recruit digitally excluded populations using non internet dependent modes, including telephone or community partnered approaches, to test whether priorities shift when access constraints are binding. Mixed methods studies are needed to explain mechanisms behind scenario specific reluctance, especially for clinically complex contexts and scenarios involving communication barriers. Longitudinal designs would help distinguish stable preferences from experience dependent attitudes as telehealth becomes more routine. Linking stated preferences to administrative utilisation data would test predictive validity and support stronger policy inference. Finally, implementation evaluations should test whether age tailored supports and integration focused redesign reduce observed inequities in willingness, uptake, and experience.

6.5.8 Integration with thesis contributions and the nine dimension equity framework

This thesis developed a nine-dimension equity framework to evaluate telehealth across digital infrastructure and access, economic affordability, user digital literacy and capacity, cultural adaptation and social inclusion, service quality and clinical outcomes, data security and privacy, stakeholder engagement and governance, sustainability and policy support, and healthcare system integration. The current chapter strengthens the thesis contribution in three ways.

First, it provides demand-side evidence relevant to the framework by quantifying which service attributes are most salient to consumers under explicit trade-offs. The highest weighted attributes emphasised clinician quality, ability to obtain prescriptions or referrals, timely advice or treatment, trust in the provider organisation, continuity with a usual clinician, and the ability to switch to in person care if needed (Table 6.6). These priorities show that equity in telehealth cannot be framed as access and infrastructure alone; consumers evaluate telehealth as a mode of clinical care that must deliver high-quality, complete, and connected care pathways.

Second, it clarifies that different equity dimensions operate through distinct mechanisms. In willingness models, age was the most consistent predictor across scenarios, consistent with capability and confidence barriers and acceptability concerns (Table 6.4). Geographic residence showed smaller and more scenario specific differences, and in BWS modelling any detectable preference heterogeneity was limited and concentrated in enabling attributes rather

than the highest weighted clinical care attributes (Table 6.7). This mapping supports interpreting equity gaps as multi mechanism rather than single cause, aligning targeted responses with the relevant framework dimensions.

Third, it provides empirical guidance on where standardisation and adaptation are appropriate. The overall pattern of attribute priorities was broadly shared across geographic groups, supporting universal minimum standards for clinical quality, safety, continuity, and integration. Where heterogeneity was detected, it clustered in enabling features including technical setup and accommodation, affordability related features, cultural respect, and opportunities to provide feedback (Table 6.7). Together with earlier chapters, this chapter triangulates frameworks, policies, programmes, and population preferences to strengthen the thesis argument that equitable telehealth requires a comprehensive multidimensional approach.

6.6 Conclusion

This chapter examined geographic and demographic variation in telehealth willingness and consumer preferences for equity-relevant service attributes in New South Wales. Three conclusions are most important. First, age was a clearer and more consistent predictor of telehealth willingness than geography across the clinical scenarios examined, indicating that telehealth acceptability is shaped strongly by life stage and digital capability rather than by

place of residence alone. Second, Rural or remote respondents had higher odds of internet access problems, but geographic differences in digital confidence were largely explained after adjustment for sociodemographic factors, suggesting that structural access barriers and user capability should not be treated as the same problem. Third, Best-Worst Scaling showed broad agreement across geographic groups on the importance of core clinical care attributes, particularly perceived clinician quality, access to prescriptions or referrals, and timely care, while also identifying a more limited set of geography-related differences in enabling features and service design priorities.

Taken together, these findings suggest that equitable telehealth should combine universal expectations for service quality and clinical effectiveness with targeted supports that address structural and capability-related barriers. Telehealth services should therefore be designed not only to be technically available, but also to be usable, trustworthy, and adaptable across different populations and clinical situations. This includes attention to infrastructure reliability, affordability, digital support, communication needs, and the ability to move between remote and in-person care when required.

This chapter contributes user-level evidence to the wider thesis by showing that preference heterogeneity exists, but is more nuanced than a simple metropolitan versus rural divide. The findings support flexible telehealth models that maintain high-quality core care standards while incorporating locally responsive enabling supports for groups facing greater structural disadvantage. In this way, the chapter complements the policy and programme analyses

presented earlier in the thesis and reinforces the need for telehealth equity strategies that integrate service design, implementation, and user experience.

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Chapter 7 Discussion and Conclusion

7.1 Introduction

This thesis began with a fundamental question: how can health equity considerations be systematically assessed and enhanced in telehealth programmes, particularly those addressing rural-urban health inequalities in Australia? This question emerged from a critical observation. While telehealth has been widely promoted as a solution to geographic barriers in healthcare access, substantial uncertainty remains about whether, and under what conditions, telehealth reduces or potentially exacerbates health inequalities between metropolitan and non-metropolitan populations (1, 2).

The COVID-19 pandemic dramatically accelerated telehealth adoption in Australia, with remote consultations rising from less than 2% of general practice encounters in 2019 to over 40% during pandemic peaks (3, 4). This rapid transformation created both unprecedented opportunities and urgent challenges for health equity. On one hand, telehealth can reduce travel burden and improve timeliness of access for people in rural and remote areas, where access to services is more limited and health outcomes are poorer (5). On the other hand, the digital shift risked creating new forms of exclusion for populations already experiencing disadvantage: those without reliable internet connectivity, those lacking digital literacy or confidence, culturally and linguistically diverse communities requiring language support, and Aboriginal and Torres Strait Islander peoples seeking culturally safe care (6, 7).

Addressing this tension required moving beyond simplistic narratives of telehealth as inherently democratising or inherently exclusionary. Instead, this research adopted a systematic, multi-method approach to understand how equity considerations are conceptualised, operationalised, and experienced across various levels of the Australian healthcare system, spanning academic literature and theoretical frameworks, policy documents and programme implementation, and end-user preferences and priorities. This thesis brought together five complementary evidence streams: a systematic review examining how existing telehealth literature addresses multiple dimensions of healthcare access (Chapter 2), a systematic evaluation of health equity frameworks for their applicability to digital health contexts (Chapter 3), a comprehensive policy review assessing how Australian governments integrate equity considerations into telehealth strategies (Chapter 4), comparative case studies of two contrasting telehealth programmes examining equity implementation in practice (Chapter 5), and a large-scale stated-preference experiment using Best-Worst Scaling (BWS; Case 1, object-case/maximum-difference scaling) to quantify user priorities for telehealth service attributes across geographic populations (Chapter 6) (8, 9).

This chapter synthesises findings from these diverse evidence streams to answer the overarching research question and its subsidiary objectives. The discussion proceeds through five sections. Section 7.2 integrates findings across all empirical chapters, identifying convergent themes and complementary insights that together construct a comprehensive understanding of equity challenges and opportunities in Australian telehealth. Section 7.3 translates these integrated findings into actionable implications for policy makers, service

providers, researchers, and consumer advocates. Section 7.4 articulates the theoretical contributions this research makes to health equity scholarship and telehealth implementation science. Section 7.5 acknowledges the methodological, conceptual, and contextual limitations that bound the study's claims and interpretations. Section 7.6 identifies priority directions for future research that build upon this foundation. Finally, Section 7.7 offers concluding reflections on the broader significance of this work for advancing health equity in an increasingly digital healthcare landscape.

7.2 Integration of Findings Across Chapters

The five empirical chapters of this thesis generated a multi-layered evidence base on equity in Australian telehealth. Rather than summarising each chapter sequentially, this section integrates findings thematically to identify patterns, tensions, and opportunities that become most visible when evidence streams are considered together.

Before examining specific findings, it is important to clarify how the access frameworks used across this thesis relate to one another. The 6A framework, building on Pechansky and Thomas's conceptualisation of access and Saurman's extension to include awareness, provides a structured lens for describing where inequities arise along the access pathway and in observed access outcomes (10, 11). By contrast, the nine-dimension telehealth equity framework developed and operationalised in this thesis focuses on upstream determinants

that shape whether equitable access can be achieved and sustained, including digital infrastructure and access, economic affordability, digital literacy and capability, cultural adaptation and social inclusion, service quality and clinical outcomes, data security and privacy, stakeholder engagement and governance, sustainability and policy support, and health-system integration. Accordingly, this section synthesises evidence primarily through the nine-dimension framework as an integrative lens, while retaining 6A terminology where it helps describe access outcomes (Table 7.1).

Five major themes emerge from this synthesis: the systematic neglect of awareness as a dimension of healthcare access; the structural nature of digital divides and their resistance to purely technological solutions; persistent policy-practice gaps despite strong equity rhetoric; the tension between efficiency imperatives and culturally safe care; and the importance of attending to user preference heterogeneity rather than assuming universal needs.

Table 7.1 Cross-chapter evidence mapped across policy, programme, and user layers.

Equity dimension (nine-dimension framework)	Policy layer (Chapter 4)	Programme layer (Chapter 5)	User layer (Chapter 6)
Digital infrastructure and access	Connectivity is recognised as an enabler, but translation into measurable service standards and equity monitoring is uneven.	VRGS reduces patient technology requirements via nurse-facilitated models; RPA Virtual uses platform support roles; implementation varies by pathway.	Connectivity problems are more common in rural and remote areas; reliability and access attributes are prioritised where barriers are experienced.
Economic affordability	Affordability is referenced but funding	Equity supports (interpreters, navigation,	Affordability-related attributes showed

Equity dimension (nine-dimension framework)	Policy layer (Chapter 4)	Programme layer (Chapter 5)	User layer (Chapter 6)
	levers (out-of-pocket protections, subsidies) are often under-specified.	facilitation) require resourcing beyond baseline funding; approaches vary across programmes.	geographic variation, with Regional respondents showing significant preference deviations for cost-related features; affordability also interacts with income and disadvantage.
Digital literacy and capability	Digital literacy is acknowledged, but responsibility is often shifted to consumers rather than embedded as ongoing support.	Patient-end support is embedded unevenly; VRGS facilitation lowers digital capability burden, while some RPA pathways assume higher independent capability.	Preference heterogeneity indicates strong value placed on ease of use and assistance, especially among lower capability groups.
Cultural adaptation and social inclusion	Equity rhetoric includes cultural safety and inclusion, but actionable guidance and monitoring are limited.	Cultural safety and inclusion are variably operationalised; interpreter access and culturally adapted pathways are inconsistently embedded or reported.	Trust, communication, and culturally responsive care attributes matter, particularly for vulnerable groups; one-size-fits-all models perform poorly.
Service quality and clinical outcomes	Quality is emphasised, but equity-relevant outcomes (for example, differential effectiveness) are rarely measured routinely.	Both programmes pursue quality; however, equity-stratified outcomes are not routinely reported in public materials and are context dependent.	Users prioritise core quality attributes (clinical competence, continuity) alongside access, with differences by geography and need.
Data security and privacy	Privacy is mentioned, but systematic governance, consent processes, and equity impacts are underdeveloped.	Data governance varies; privacy and data handling practices shape trust and uptake, but are not consistently	Privacy and confidentiality are salient to user preferences and influence willingness to

Equity dimension (nine-dimension framework)	Policy layer (Chapter 4)	Programme layer (Chapter 5)	User layer (Chapter 6)
		foregrounded as equity determinants.	engage in telehealth.
Stakeholder engagement and governance	Consultation is referenced, but ongoing governance and accountability mechanisms for equity are often unclear.	Governance structures differ; stakeholder engagement is more explicit in VRGS partnerships, while RPA governance aligns with tertiary settings and hospital systems.	Preference heterogeneity implies governance must incorporate diverse consumer priorities rather than assume universal needs.
Sustainability and policy support	Sustainability is frequently asserted, but long-term funding, workforce capacity, and evaluation resourcing are inconsistently addressed.	Programme sustainability depends on funding, workforce models, and institutional support; equity-supporting components are vulnerable.	Users value reliability and continuity; sustainability underpins trust and willingness to engage over time.
Health system integration	Integration is a recurring policy goal, but operational pathways and interoperability remain uneven.	Integration varies; VRGS aims to bridge rural services, while RPA interfaces with hospital systems; integration gaps affect continuity and equity.	Users prefer coordinated, seamless care; fragmented systems reduce perceived value of telehealth.

7.2.1 The Systematic Awareness Deficit: A Cascading Failure Across Evidence Layers

One of the most striking patterns emerging from cross-chapter analysis is the systematic neglect of awareness, which includes knowing that telehealth services exist, understanding how to access them, and having confidence that such services are appropriate and available

for people like oneself. This deficit cascades across each level of evidence examined in this thesis, from academic research through policy design to programme implementation, reflecting an implicit assumption that service availability alone is sufficient to generate uptake.

At the literature layer (Chapter 2), awareness was the least examined 6A dimension. Among 42 included reviews, 38.0% did not address awareness at all, and only 4.8% achieved good coverage among those that did. This gap is consequential because awareness operates as a precondition for all other access dimensions. Populations unaware of telehealth services cannot meaningfully engage with whether those services are accessible, affordable, or acceptable.

At the theory layer (Chapter 3), even telehealth relevant equity frameworks rarely operationalised awareness as a measurable dimension. Although communication and health literacy were sometimes acknowledged as equity determinants, few frameworks translated these concepts into indicators for monitoring whether target populations know services exist. This matters because frameworks guide evaluation practice, and what is not measured is unlikely to be systematically improved.

At the policy layer (Chapter 4), Australian strategies similarly emphasised infrastructure investment and clinical safety, while proactive outreach and community education were underdeveloped. Medicare Benefits Schedule telehealth items created financial access pathways, but there were limited awareness raising activities to ensure eligible populations,

including older Australians, culturally and linguistically diverse communities, and people in remote areas, knew of their availability.

At the practice layer (Chapter 5), neither RPA Virtual Hospital nor VRGS reported systematic awareness campaigns or community engagement as core equity infrastructure during initial implementation. Where outreach mechanisms emerged, these tended to be reactive responses to low uptake in specific populations rather than proactive elements designed into programme architecture.

Finally, the user preference layer (Chapter 6) did not include awareness as an explicit attribute in the Best Worst Scaling instrument. This can be interpreted as a methodological constraint: preferences were elicited conditional on respondents already recognising telehealth as an option, and therefore could not capture the perspectives of individuals unaware of telehealth services. Together, these findings raise the possibility of a cycle in which limited research attention to awareness may contribute to weak metrics, weak policy prioritisation, limited programme investment in community education, and persistent utilisation disparities. For populations experiencing structural disadvantage, passive availability of telehealth options may be insufficient, and proactive, sustained, and culturally adapted awareness raising may be an important precondition for meaningful access.

7.2.2 Digital Divides as Structural Barriers: Beyond Infrastructure to Capability and Trust

A second major theme concerns the multi-dimensional nature of digital divides and their resistance to simplistic technological solutions. The evidence synthesised in this thesis suggests that the digital divide spans at least three interrelated dimensions: infrastructure access, digital capability, and digital trust.

The infrastructure dimension is well documented. Chapter 2 identified connectivity as a recurring barrier in rural telehealth implementation (12-14). Chapter 6 provided quantitative evidence, with Rural/Remote residents having higher odds of reporting internet access problems than Major city residents after adjustment (aOR 1.88; 95% CI 1.45 to 2.44; $p < 0.001$) (Table 6.2), consistent with broader digital inclusion evidence of persistent infrastructure gaps despite National Broadband Network rollout (15).

However, the capability dimension revealed a different pattern. Chapter 6 found that low digital confidence was not independently associated with geography after adjustment, while age was the dominant predictor. Adults aged 75 and above had substantially higher odds of low confidence than those aged 18 to 34 (aOR 5.81; 95% CI 3.90 to 8.72; $p < 0.001$) (Table 6.2). Education and income were also independently associated, suggesting that apparent rural-urban capability gaps may be partly attributable to demographic composition rather than geography per se. This finding is important because it shifts the interpretation of digital inequity away from a purely place-based account. It suggests that capability interventions may need to prioritise older adults and socioeconomically disadvantaged groups across

settings, while recognising that these groups are disproportionately represented in non-metropolitan areas.

Chapter 5 illustrated how capability barriers can be mitigated through assisted models. VRGS used nurse-facilitated bedside telehealth, reducing the need for patients to manage devices or interfaces, but increasing workload and resource requirements for rural staff. RPA Virtual implemented a Digital Patient Navigator role to support platform set-up and troubleshooting. Together, these examples indicate that addressing capability gaps requires workforce investment, not only technology provision.

The trust dimension was most evident in Chapter 6's scenario-based willingness analysis. Respondents were more willing to use telehealth for administrative and routine care than for complex scenarios involving interpreters, unfamiliar providers, or uncertain appropriateness, suggesting that uptake may depend on trust as well as technical capability (16, 17). Chapter 3 and Chapter 4 also highlighted cultural safety and community trust as under-addressed, and Chapter 5 showed that availability of supports does not necessarily translate into equitable engagement.

Overall, the synthesis indicates that framing the digital divide as primarily technical is insufficient. Consistent with broader digital inclusion and telehealth equity literature, infrastructure, capability, and trust operate as interdependent rather than separable barriers. This thesis therefore suggests that responses limited to connectivity or device provision are unlikely to be sufficient on their own. More equitable telehealth will require coordinated

investment in infrastructure, assisted-use models, culturally safe trust-building, and service pathways that recognise digital exclusion as a structural rather than purely individual problem.

7.2.3 Policy-Practice Gaps: Strong Rhetoric, Weak Implementation Mechanisms

A third prominent theme concerns the persistent gap between policy rhetoric on health equity and the operational mechanisms required to implement equity commitments in practice.

Across chapters, this gap appears in three forms: equity framed as aspiration without accountability, siloed rather than integrated approaches, and the absence of routine equity monitoring systems.

Chapter 4 showed extensive equity rhetoric across Australian telehealth strategies, yet limited translation into operational specifications, funding conditions, or accountability frameworks (17, 18). Monitoring and evaluation was the weakest policy domain: no policy achieved the highest score, and almost half scored only 1 or 2 (Chapter 4, Table 4.4). Few policies specified mechanisms to link ongoing funding to demonstrable equity outcomes or to require consistent equity-related performance reporting.

Chapter 5 indicated that this policy gap carries through to programme evaluation. Both RPA Virtual and VRGS reported favourable performance indicators and routinely monitored quality and activity, but neither consistently reported equity-stratified outcomes in publicly

available evaluation materials. For example, VRGS documented substantial Aboriginal service use without reporting stratified experience or outcomes, while RPA Virtual reported comprehensive interpreter pathways despite lower engagement among non-English speaking patients, particularly those aged 50 and above. These patterns suggest that equity is often treated as a design input, such as making supports available, rather than as a monitored output assessing whether disparities in access, experience, and outcomes are reduced over time.

The gap is reinforced by fragmented governance. Chapter 4 highlighted that digital health, cultural safety, and social inclusion were addressed through separate policy streams with limited integration. The nine-dimension equity framework developed in Chapter 5 responds to this fragmentation by enabling integrated assessment across infrastructure, affordability, capability support, cultural adaptation, quality and care processes, privacy, governance, sustainability, and system integration. That both programmes plateaued at score 3 across multiple dimensions suggests recurring system-level constraints, particularly limited routine monitoring, equity-stratified reporting, and policy-mandated sustainability guarantees (Chapter 5, Table 5.3).

The synthesis therefore points to a need for operationalised equity that moves beyond aspirational statements to concrete implementation mechanisms. Evidence from this thesis most directly supports strengthening equity-stratified monitoring requirements and embedding accountability for equity outcomes (19). It also supports more integrated equity assessment when telehealth policies or programmes undergo major modification (20). Other

scholars have proposed complementary approaches, including equity-weighted funding formulas and national equity reporting standards specifying minimum metrics across population groups (21, 22); the evidence in this thesis is consistent with such proposals, but their detailed design and implementation require further empirical testing.

7.2.4 The Efficiency-Culture Tension: Beyond False Trade-offs to Complementary Design

A fourth major theme concerns the apparent tension between efficiency imperatives and cultural safety requirements in telehealth design. This tension manifested differently across the case study programmes and user preference patterns, but the integrated evidence suggests that efficiency and cultural safety can be complementary when approached through deliberate service design.

Chapter 5's case studies exemplified this tension through contrasting programme models. The Virtual Rural Generalist Service demonstrated strong efficiency performance, with activity unit costs approximately 40% lower than comparators (A\$1,047 vs A\$1,753), ED encounter costs 44% lower (A\$134 vs A\$239), and a 58% reduction in locum dependence compared with pre-VRGS baselines. These efficiencies were supported by centralised specialist coverage across multiple small hospitals, standardised clinical protocols, and streamlined documentation integrated into existing electronic medical records. However, publicly available evaluation materials did not report interpreter services, multilingual patient

resources, or formal Aboriginal governance structures embedded in day-to-day operations during the initial implementation period reviewed. This suggests that the programme's early emphasis on clinical coverage and cost containment, while addressing critical needs in resource constrained rural districts, was not matched by equally visible cultural equity infrastructure in routine reporting.

Conversely, RPA Virtual invested substantially in cultural equity infrastructure from inception, including Aboriginal Cultural Support Teams and care navigators, interpreter pathways, translated materials, consumer and Aboriginal governance committees, and digital navigation support. These supports strengthened culturally safe engagement with diverse metropolitan populations. However, economic evaluation results indicated heterogeneous benefit cost ratios across service models, with some falling below 1.0 at lower activity volumes, alongside documentation suggesting that efficiency improved as models matured and volumes increased. This pattern suggests that achieving cultural safety alongside efficiency may require upfront investment and sufficient scale to spread fixed equity infrastructure costs across larger patient volumes.

This aligns with Chapter 4's policy analysis, which found that telehealth strategies strongly emphasised cost effectiveness and sustainability while often treating cultural safety, language access, and community engagement as secondary considerations. Chapter 3's framework review similarly indicated that economic evaluation in telehealth commonly focuses on system efficiency metrics but less often incorporates equity relevant distributional impacts

unless explicitly using equity informative approaches (23, 24).

Chapter 6 provided complementary insights into how different populations prioritise enabling features that support culturally safe access. In Best Worst Scaling, all geographic groups placed high weight on perceived clinician quality and data security attributes. Regional city or large town respondents showed statistically significant differences relative to Major city respondents concentrated in enabling features such as technical set up, affordability, cultural respect, and feedback mechanisms (Table 6.7), while no statistically significant attribute level deviations were detected for Rural or remote respondents. These differences were matters of degree rather than fundamental conflicts, and no group systematically prioritised efficiency over cultural safety or vice versa. Interpretation should also consider sample limitations.

Because Chapter 6 used an online commercial panel and did not collect Aboriginal and Torres Strait Islander status, representation of Aboriginal and Torres Strait Islander peoples cannot be assessed. Findings therefore should not be interpreted as representative of Aboriginal and Torres Strait Islander communities' priorities.

Overall, framing efficiency and cultural equity as inherent trade-offs risks creating a false dichotomy. Several design strategies can pursue both objectives simultaneously, including modular service architecture that combines an efficient standardised core with culturally tailored components that can be activated based on patient needs, tiered service models that provide efficient baseline access while offering enhanced support for first encounters or complex scenarios, and shared equity infrastructure such as interpreter services and digital

navigation support operating across multiple programmes. Learning oriented feedback loops that monitor equity stratified utilisation and experience measures and iteratively adapt service protocols may further support this alignment (25).

Finally, the apparent efficiency and cultural safety tension may partly reflect measurement practices that undervalue equity. Standard cost effectiveness metrics capture readily quantifiable benefits but may fail to reflect distributional impacts and equity relevant benefits unless explicitly incorporated through equity informative methods (23, 24). Evidence also indicates that language barriers and lack of language concordant care are associated with poorer care quality and outcomes, and that professional interpreter services can improve care processes and outcomes, suggesting that investments in language support and culturally responsive delivery can generate value that conventional metrics may not fully capture (26, 27).

7.2.5 User Preference Heterogeneity: Beyond One-Size-Fits-All Telehealth Design

The final major integrative theme concerns substantial heterogeneity in user preferences, needs, and priorities across population groups. This heterogeneity challenges universal telehealth designs and supports flexible, adaptable service models that accommodate diverse circumstances and values.

Chapter 6 provided the most direct evidence of preference heterogeneity. Across all

geographic groups, there was broad agreement on the high importance of core clinical care attributes, led by perceived clinician quality, access to prescriptions or referrals, and timely care, alongside data security and trust (Table 6.6). At the same time, six statistically significant preference deviations were identified for Regional city or large town respondents relative to Major city respondents. These deviations clustered in enabling features, including technical set-up and accommodation, affordability related considerations, cultural respect, and feedback mechanisms (Table 6.7). No individual attribute level deviations reached statistical significance for Rural or remote respondents relative to Major city respondents, although directional patterns suggested somewhat higher valuation of infrastructure and affordability attributes in this group.

These patterns are consistent with Chapter 6's structural barrier analysis. Rural or remote residents had higher odds of reporting internet access problems compared with Major city residents (aOR 1.88), which is consistent with greater salience of infrastructure reliability and accessibility in this group. By contrast, digital confidence did not differ by geography after adjustment and was more strongly patterned by age, education, and income (Table 6.2).

Together, these results suggest that stated preferences may reflect lived exposure to constraints, and that enabling features become most salient where barriers are most directly experienced. At the same time, the capability findings should be interpreted cautiously: apparent rural-urban differences in digital capability in this sample may be partly attributable to demographic composition rather than geography alone. This suggests that capability-related interventions may need to prioritise older adults and socioeconomically disadvantaged

groups across settings, while recognising that these groups are disproportionately represented in some non-metropolitan populations.

Scenario-specific willingness analysis further reinforced context-dependent heterogeneity.

Descriptively, willingness was higher for administrative and routine care scenarios and lower for complex scenarios involving interpreters, unfamiliar providers, or uncertain

appropriateness (Figure 6.1). In adjusted models, Regional city or large town respondents

showed lower willingness for interpreter-requiring scenarios than Major city respondents,

whereas Rural or remote respondents did not differ significantly from Major city respondents

for this scenario (Table 6.3). This pattern may partly reflect differences in baseline exposure

to language diversity across settings, among other factors, rather than differences in the

underlying importance of culturally safe care. This interpretation is consistent with

established settlement patterns, although it is acknowledged that regional areas are

increasingly diverse and that language other than English representation may vary across

specific localities and over time. It is also important to distinguish language interpretation

needs from culturally safe communication needs. For Aboriginal and Torres Strait Islander

peoples, equitable telehealth may depend more on cultural safety, trust-building, and

culturally responsive communication processes than on interpreter provision alone, implying

different service design responses beyond standard language pathways (28-32).

These empirical findings align with the framework insights synthesised in Chapter 3. Digital

health equity literature emphasises that technology access, capability, and adoption vary

across population groups, and that equity-oriented design should anticipate heterogeneity rather than assume a single modal user (1, 2). Chapter 5's case studies illustrate two practical responses. VRGS implemented a standardised model across multiple rural hospitals to secure baseline access, safety, and workforce coverage in constrained settings. RPA Virtual implemented differentiated pathways and dedicated supports, including interpreter services, Aboriginal support roles, and digital navigation, reflecting greater heterogeneity in metropolitan populations. However, residual engagement disparities among older non-English speaking patients indicate that even extensive adaptations may not eliminate inequities without sustained outreach, monitoring, and iterative redesign. These findings also suggest that equitable telehealth should not be understood as a stand-alone digital transaction, but as a service model that needs to be integrated into existing care pathways and supported by workforce arrangements that enable patients to move between remote and in-person care when needed.

The synthesis suggests that addressing heterogeneity requires moving beyond both universal standardisation, which can exclude users whose needs deviate from the modal pathway, and complete individualisation, which is often operationally unsustainable. Instead, the integrated evidence points to several design principles. Services should be designed for diversity from inception rather than retrofitting equity features after implementation (1, 2, 33). Systems should support user agency in access mode selection, for example by offering telephone alongside video, synchronous alongside asynchronous options, and self-directed alongside assisted pathways. A progressive enhancement approach may be particularly useful, with a

universally accessible baseline model complemented by proactively offered supports such as language services, cultural liaison, digital navigation, and accessibility accommodations for groups more likely to benefit, consistent with proportionate universalism (34). These design choices should be informed through co-design with target communities to clarify what constitutes appropriate telehealth use, which trust-building mechanisms are required, and where remote delivery is not acceptable (35). Finally, equity-stratified outcomes should be monitored routinely, and emerging disparities used to trigger service adaptation, recognising that heterogeneous needs cannot be fully anticipated at the design stage (21, 25).

Critically, preference heterogeneity in Chapter 6 does not imply fixed group traits in which some populations prefer telehealth and others prefer in-person care. Willingness varied by clinical scenario, provider relationship, communication requirements, and perceived appropriateness. This context dependency supports flexible systems that can accommodate varying needs across care contexts, clinical complexity, and individual circumstances.

7.3 Implications for Policy and Practice

The integrated findings synthesised in Section 7.2 carry substantive implications for those responsible for shaping, implementing, and evaluating telehealth in Australia. This section considers implications at two levels: the governance and policy settings that create enabling or constraining conditions for equitable telehealth, and the operational practices through

which services can embed equity in day-to-day delivery. The intent is not to provide a prescriptive blueprint, but to draw out directions that appear well supported by evidence generated across this programme of research, while recognising that implementation necessarily involves contextual judgement, resource constraints, and competing priorities.

7.3.1 Governance, Funding, and Accountability

A consistent finding across Chapters 3, 4, and 5 is that equity commitments in Australian telehealth policy are largely aspirational rather than operational. Equity is well articulated in strategic documents but is often inadequately embedded in funding mechanisms, monitoring requirements, and accountability structures. Translating rhetoric into practice would require movement on at least three interconnected fronts.

First, minimum equity standards aligned with the nine-dimension framework developed in Chapter 5 could provide a practical reference point for programme design, commissioning, and evaluation. Embedding such standards within existing quality and accreditation frameworks, and developing them cooperatively with affected communities and providers, would be one approach to shifting equity from optional best practice to a consistent system expectation (36). The feasibility of these standards and the sequencing of their introduction would require careful piloting and negotiation across jurisdictions.

Second, current funding arrangements can create structural incentives that work against

equity. As Chapter 5 demonstrated through RPAV and VRGS cases, programmes serving geographically dispersed or culturally diverse populations often incur higher per patient costs for equity enabling components, including nurse facilitation, interpreter infrastructure, cultural liaison, and digital navigation. Standard activity-based payments calibrated to average costs may be insufficient to resource these additional requirements. Equity adjusted funding approaches, in which payment better reflects patient complexity and the equity infrastructure required for safe and appropriate care, have precedents in other health system contexts and merit consideration for telehealth (22, 37). Such adjustments would need to be built on empirical cost evidence, piloted carefully, and evaluated to minimise unintended incentives.

Third, without routine equity stratified monitoring, disparities remain invisible and improvement cannot be tracked. Chapter 4's policy analysis found that monitoring and evaluation was the weakest policy dimension, with no policy achieving the highest score. Seven of fifteen policies scored 1 to 2, and the remaining eight scored 3 but not beyond (Chapter 4, Table 4.4). Chapter 5 similarly found that neither case study programme routinely published equity stratified outcome data despite substantial operational data collection. A minimum dataset spanning access, utilisation, experience, and clinical outcomes, stratified by Aboriginal and Torres Strait Islander status, language background, geographic remoteness, age, disability, and socioeconomic position, would allow equity claims to be tested rather than asserted (19, 21). The appropriate form and governance of such reporting, including how Aboriginal and Torres Strait Islander data sovereignty principles such as the CARE principles

should be embedded, should be co designed with communities rather than specified top down (38). A phased approach, beginning with larger established programmes before extending requirements more broadly, is likely to be more feasible than system wide simultaneous rollout.

Underpinning all three directions is the need for better cross portfolio policy integration. Chapter 4 identified structural fragmentation in which digital health, rural health, Aboriginal and Torres Strait Islander health, culturally and linguistically diverse health, disability, and aged care policy streams each address equity partially but without shared frameworks or coordination mechanisms. An integrated policy approach would not require a single omnibus document so much as deliberate cross departmental coordination, shared equity metrics, and governance that prevents siloed decision making.

7.3.2 Cultural Safety, Language Access, and Proactive Engagement

The infrastructure utilisation paradox documented in Chapter 5, where RPA Virtual's comprehensive cultural supports coexisted with lower engagement among non-English-speaking patients, particularly those aged 50 and over, highlights a distinction with implications for both policy and service design. Equity infrastructure, such as interpreters being available and cultural governance being established, is not equivalent to equity outcomes, such as interpreter services being activated when needed, governance meaningfully influencing decisions, and disparities in access and experience being reduced.

Moving from availability to realisation therefore requires a shift from passive accommodation to proactive engagement.

For Aboriginal and Torres Strait Islander peoples, this distinction is particularly significant.

Culturally safe telehealth depends less on language interpretation in a conventional sense than on culturally safe communication, trust-building, and relationally grounded care, which implies service design responses beyond standard language pathways (28-32). Practical implications include embedding Aboriginal Health Worker roles and cultural liaison capacity within telehealth teams as core staffing, strengthening Aboriginal governance with genuine decision-making authority over service design and evaluation, and investing in sustained community engagement that builds trust through demonstrable responsiveness over time.

Evidence on what works in telehealth-specific contexts remains developing, and Aboriginal and Torres Strait Islander-led research and evaluation should be prioritised to guide implementation and accountability (39, 40).

For culturally and linguistically diverse populations, the evidence supports proactive and systematic language support rather than relying on patients to request interpreting.

Implementation studies show that interventions such as routine language identification, active offers of professional interpreting, and workflow prompts can increase uptake of professional interpreters, although effects vary across settings and strategies (41). This aligns with broader evidence that lack of professional interpreting is associated with poorer quality of care, and that professional interpreters can improve communication, satisfaction, and clinical processes

and outcomes (26, 27). In practice, this points to system-level approaches, such as embedding interpreter prompts in booking workflows, providing translated information as a default where relevant, and training administrative and clinical staff to anticipate language needs.

Telehealth may amplify communication challenges in interpreted consultations, so culturally safe care must extend to the clinical interaction itself, not only to pre-consultation logistics.

Chapter 6's scenario-specific willingness data suggest that proactive engagement about when telehealth is clinically appropriate, and for whom, may matter alongside infrastructure.

Awareness deficits identified across Chapters 2, 4, and 5 are consistent with the possibility that outreach delivered through trusted community channels, in appropriate languages, and embedded within existing touchpoints such as pharmacy, community health, and primary care may be needed to support informed choices about service use. Evidence on effective approaches in telehealth settings remains limited, and further evaluation is warranted.

7.3.3 Service-Level Equity Practice

While the preceding discussion focuses on governance and system-level conditions, equity in telehealth is enacted or undermined through day-to-day service decisions. Chapters 5 and 6 suggest several practical directions for service providers implementing or expanding telehealth programmes.

The nine-dimension framework developed in Chapter 5 can be used as a structured self-

assessment tool across programme design, implementation, and evaluation. Applied prospectively, it can make equity requirements explicit and prompt planning for dimensions that might otherwise be treated as optional enhancements. Applied retrospectively, it can identify gaps in documentation and evidence, distinguishing confirmed absence of equity components from under-reporting of activities that may occur but are not systematically measured or described. The approach demonstrated in Chapter 5, combining document analysis with structured stakeholder input and transparent scoring, can be adapted to the resource constraints of smaller services while retaining its core logic.

The contrasting models of RPAV and VRGS demonstrate that there is no single correct approach to operationalising equity across telehealth settings. VRGS's nurse-facilitated bedside model reduced patient-facing digital capability barriers by shifting technology requirements to trained staff, supporting access coverage and affordability in resource-constrained rural settings. RPA Virtual's investment in layered cultural infrastructure, including interpreter pathways, Aboriginal support roles, and digital navigation, supported engagement with linguistically diverse metropolitan populations. Across both contexts, workforce development for equity-relevant roles, including clinical facilitation, digital navigation, cultural liaison, and Aboriginal health practice, requires protected time, training, and recognition as core professional activity rather than an additional burden.

Chapter 6's preference heterogeneity findings reinforce that populations hold meaningfully different priorities shaped by the barriers they experience. In descriptive patterns, Rural and

remote residents showed directionally higher valuation of affordability and service availability attributes, consistent with higher reported rates of internet access difficulty, although no individual attribute-level deviations reached statistical significance for this group (Table 6.7). Older adults and those with lower digital confidence valued technical support and ease-of-use attributes. These patterns suggest that universal service designs may under-serve populations whose needs differ from modal assumptions, and that flexible, modular approaches that can activate enhanced supports for patients likely to need them may better accommodate heterogeneity without requiring fully parallel systems.

7.4 Theoretical Contributions

Beyond its practical implications for policy and service delivery, this research makes substantive theoretical contributions to health equity scholarship, telehealth implementation science, and digital health evaluation. These contributions advance understanding in four interconnected domains: the framing of equity in digital health contexts, the development of assessment frameworks tailored to telehealth, methodological approaches to equity evaluation, and integration of perspectives that have often been treated separately.

7.4.1 Advancing Health Equity Theory for Digital Health Contexts

This thesis extends health equity concepts that were developed primarily for physical

healthcare delivery into digital health environments. It shows that equity requires reconceptualisation when care shifts from co located to distributed delivery, from face-to-face encounters to mediated interactions, and from physical service environments to digital platforms with variable accessibility barriers (1, 2, 42).

The thesis advances the notion of digital determinants of health equity as a distinct set of factors that should be integrated with established social determinants of health frameworks (42-44). Social determinants such as income, education, employment, housing, and geography shape health outcomes and access broadly. In digital care, these determinants continue to matter, but they also operate through additional pathways that influence whether a person can realistically use telehealth. For example, lower income may constrain device ownership, data plan affordability, and access to private space for consultations. Geographic remoteness may shape access not only through distance, but also through connectivity reliability, limited technical support, and potential disconnection from locally embedded care relationships.

Building on digital exclusion theory, this thesis conceptualises digital determinants across three interrelated dimensions: structural digital access, functional digital capability, and relational digital trust (42, 45, 46). Structural access concerns infrastructure availability, device ownership, and connectivity reliability. Functional capability concerns technical skills, platform navigation, troubleshooting competence, and digital health literacy. Relational trust concerns confidence in security and privacy, belief in the clinical appropriateness of remote

care, and perceived cultural safety of mediated interactions. These dimensions interact rather than operate independently. Structural access without capability can produce frustrated non-use. Capability without trust can lead to reluctant or selective engagement. Trust without structural access can generate unmet demand. Equity frameworks that focus on a single dimension while neglecting others will therefore under represent the complexity of digital health inequities (42, 45, 46).

The thesis also advances theory on equity paradoxes in digital health innovation, where interventions designed to improve equity can fail to reduce disparities, or can generate new inequities, despite addressing visible barriers (1, 2). The RPA Virtual case study illustrates this pattern. Comprehensive cultural infrastructure, including interpreter pathways, cultural liaison capacity, and governance mechanisms, coexisted with lower engagement among some target populations, particularly older non-English-speaking adults. This infrastructure utilisation paradox challenges linear intervention outcome assumptions and underscores that equity enabling inputs do not automatically translate into equitable outcomes. Plausible mechanisms include awareness barriers, activation gaps when services rely on patient initiated requests, trust deficits shaped by prior experiences with mainstream services, and compound barriers where age, language, digital capability, and socioeconomic constraints interact in ways that single component interventions do not fully address.

Recognising these paradoxes requires a conceptual shift from availability focused equity, ensuring services exist, to realisation focused equity, ensuring intended beneficiaries receive

and benefit from services. This shift has clear implications for evaluation. Equity cannot be assessed solely through programme design features or resource inputs. It must also be evaluated using disaggregated evidence on utilisation, experience, and outcomes to determine whether disparities narrow over time. The framework developed in this thesis operationalises this shift by distinguishing evidence of equity infrastructure presence, evidence of infrastructure activation in practice, and evidence of equity outcomes across population groups.

7.4.2 Developing Comprehensive Telehealth Equity Assessment Frameworks

A central theoretical contribution of this thesis is the development and demonstration of a nine-dimension equity evaluation framework tailored to telehealth contexts. Building on Penchansky and Thomas's foundational access framework and Saurman's extension incorporating awareness (10, 11), this research extends prior models by: expanding the conceptual coverage to capture telehealth-specific determinants; specifying operational indicators and a transparent 0 to 4 scoring rubric to enable structured comparison; demonstrating real-world application through comparative case studies; and showing that the framework can surface actionable equity gaps even in established programmes.

The nine dimensions, digital infrastructure and access, economic affordability, user digital literacy and capacity, cultural adaptation and social inclusion, service quality and clinical

outcomes, data security and privacy protection, stakeholder engagement and collaborative governance, sustainability and policy support, and healthcare system integration, provide a theoretically grounded yet pragmatic conceptualisation of telehealth equity. Each dimension is justified through synthesis of access theory, social determinants of health and digital inclusion scholarship, and empirical evidence from telehealth implementation research and stakeholder input.

Critically, the framework treats equity as multidimensional and non-compensatory. Strength in one dimension cannot offset deficits in others, because exclusion from key groups undermines the equity purpose of telehealth even when performance is strong elsewhere. This position aligns with rights-based and justice-oriented approaches to health equity that emphasise minimum standards and distributional fairness rather than accepting inequity as an efficiency trade-off (23, 47).

The framework also advances equity evaluation by specifying how multiple evidence types should be integrated systematically. Chapter 5 combined documentary analysis with structured stakeholder verification and transparent cross-case synthesis. This approach recognises that no single evidence source is sufficient. Documents may omit sensitive gaps, stakeholder accounts may emphasise achievements, and external evaluations may lack implementation context. Triangulating evidence sources improves credibility and supports more defensible equity judgements than single-method assessment (48, 49).

Finally, the framework conceptualises equity as dynamic rather than static. The scoring rubric

enables tracking change over time and supports identification of whether equity performance improves, plateaus, or deteriorates as programmes mature, scale, or respond to policy shifts. The case studies illustrated temporal variation, including strengthening of cultural adaptation infrastructure in RPA Virtual between early proof-of-concept and scaled implementation, and sustained affordability performance in VRGS alongside scope for improvement in cultural and reporting dimensions as implementation matured. This temporal perspective challenges one-off equity assessments and reinforces that equity requires ongoing monitoring and iterative refinement.

7.4.3 Methodological Innovations in Equity Research

This thesis demonstrates the value of integrated mixed methods designs that combine complementary research traditions to generate comprehensive equity evidence (50). The programme of work deployed five methodologies, a review of reviews, framework synthesis, policy document analysis, comparative case studies, and stated-preference experiments, with each method addressing gaps left by the others. The sequential design enabled cumulative knowledge building from evidence mapping and theory appraisal, through policy operationalisation, to programme implementation and end-user priorities. This integration strengthens inference by combining breadth with contextual depth and by connecting governance intent with service delivery and user experience.

The Best-Worst Scaling (BWS) study in Chapter 6 extends stated-preference approaches within telehealth equity evaluation by quantifying the relative importance of equity-relevant service attributes and testing heterogeneity across geographic populations. BWS offers methodological advantages over ratings and simple rankings. It elicits trade-offs directly, supports scale-free estimation of relative importance, and improves discrimination between attributes when many features are perceived as important (8). The attribute set developed in this thesis, 24 attributes mapped to nine domains, provides a replicable basis for future telehealth preference studies and for cross-setting comparison.

The case study component also advances equity evaluation methodology through structured application of a transparent scoring rubric, integration of multiple evidence sources, and visual comparative synthesis. While case study designs are common in implementation science, systematic equity scoring combined with explicit evidence trails and cross-case matrices is less routinely applied and improves transparency and comparability while retaining contextual interpretation (48, 51). This hybrid approach offers a practical model for equity evaluation that balances interpretability for policy and practice with methodological rigour.

7.4.4 Integrating Cross-Disciplinary Perspectives on Digital Health Equity

This research contributes to breaking down disciplinary silos that have historically

fragmented digital health equity scholarship. It integrates perspectives from public health, health services research, information systems, health policy, health economics, and critical social theory. Each discipline offers a valuable but partial account of telehealth equity, and synthesising them supports a more complete understanding of how digital technologies interact with structural disadvantage, service design, and health system governance (1, 2, 42).

For example, information systems scholarship on digital divides clarifies mechanisms of exclusion in access, skills, and patterns of use, but it can under-specify how these mechanisms translate into healthcare experiences and outcomes (45, 46). Public health research foregrounds inequities in outcomes and the social determinants shaping them, but it can treat technology as neutral infrastructure rather than as a socio-technical system that can reproduce inequities (1, 2). Health economics provides rigorous methods for evaluating efficiency, but conventional cost-effectiveness approaches do not automatically capture distributional impacts unless equity is explicitly incorporated (23, 24). Critical social theory draws attention to power, marginalisation, and structural inequality in health systems, but is not always linked to operational evaluation mechanisms that can be embedded in programme design and monitoring (52, 53).

This thesis demonstrates how integration can address these limitations. Digital divide theory helps specify who is excluded and through which pathways, health services research and implementation science clarify how service design shapes access and experience, public health frameworks situate these patterns within broader structural determinants, and

economic evaluation and policy analysis identify where governance and resource allocation can enable or constrain equity in practice (1, 2, 23, 24, 42, 45, 46). Together, these perspectives support a socio-technical account of telehealth equity that connects upstream determinants with downstream outcomes and provides clearer leverage points for evaluation and improvement.

The thesis also raises considerations relevant to Aboriginal and Torres Strait Islander digital health equity scholarship by foregrounding Indigenous data sovereignty and culturally safe governance as fundamental requirements for equitable digital health systems (28, 38, 39).

The thesis does not itself constitute Indigenous-led scholarship, and the substantive development of this field requires Aboriginal and Torres Strait Islander leadership, methodologies, and governance. While this thesis did not employ Indigenous research methodologies directly, it incorporates Indigenous priorities by treating Aboriginal and Torres Strait Islander governance as an explicit equity dimension, emphasising alignment with the CARE Principles (Collective benefit, Authority to control, Responsibility, Ethics) in data systems (38), and recognising that structural and historical factors, including ongoing impacts of colonisation within mainstream services, shape trust and engagement with telehealth (28, 39). Future work should build on this foundation through Indigenous-led research and genuine partnership with Aboriginal and Torres Strait Islander communities to ensure digital health innovations support, rather than undermine, self-determination (28, 39).

7.5 Limitations of the Study

While this research makes substantive contributions to understanding telehealth equity, several methodological, conceptual, and contextual limitations bound the scope and transferability of its findings. These limitations are grouped into five areas: methodological constraints across the empirical chapters, conceptual choices in how equity was framed and operationalised, data availability and quality constraints, contextual specificity of the Australian setting, and temporal limitations given the rapidly evolving telehealth landscape.

7.5.1 Methodological Limitations

Across Chapters 2 and 3, the systematic reviews were limited to English-language publications and had finite search end-dates, which means more recent work and evidence from non-Anglophone contexts may be under-represented. Grey literature coverage was necessarily incomplete, and publication bias may have favoured positive findings. The use of the 6A framework provided structure in Chapter 2 but may have imposed boundaries across overlapping dimensions and may not capture emergent equity considerations outside the framework.

Chapter 4 analysed publicly available written policy documents and therefore cannot assess implementation, resource allocation, or how stated commitments translated into operational practice. Interpretation of policy language requires judgement despite structured coding, and

internal government materials and confidential evaluations were not accessible.

Chapter 5 focused on two contrasting case study programmes, enabling depth and comparison but limiting diversity across other telehealth models and clinical settings.

Findings were constrained by available documentation, meaning dimensions that were more thoroughly documented could appear stronger than dimensions with less public reporting.

Stakeholder questionnaires provided valuable verification but could not fully substitute for deeper qualitative fieldwork such as observation or interviews. The scoring rubric required judgement, especially for borderline categories, and the review largely captured early implementation periods, so equity performance may have shifted as programmes matured.

Chapter 6 used a cross-sectional online survey recruited through a commercial panel, which raises representativeness concerns and may under-represent people with very limited digital access and capability. The Rural/remote subsample was relatively small, and subgroup response rates were not available. Because Aboriginal and Torres Strait Islander status was not collected in Chapter 6, representation of Aboriginal and Torres Strait Islander peoples cannot be assessed. Findings therefore should not be interpreted as representative of Aboriginal and Torres Strait Islander communities' priorities. The NSW-only sample limits transferability to other jurisdictions. As a stated-preference study, BWS and scenario items simplify decision contexts, and expressed preferences may diverge from real-world behaviour, particularly among respondents with limited telehealth experience.

7.5.2 Theoretical and Conceptual Limitations

The equity framing in this thesis reflects normative choices. The work primarily adopts a distributional lens focused on who accesses and benefits, with comparatively less emphasis on procedural and recognition dimensions of equity. Geographic categories (Major city, Regional, Rural/remote) necessarily simplify within-group heterogeneity. Similarly, analysing equity primarily through broad sociodemographic and geographic categories risks obscuring intersectionality, which could not be examined in depth with the available data and methods. The nine-dimension framework also separates analytically distinct domains that are interdependent in practice, including feedback loops between trust, capability, and utilisation.

7.5.3 Data Availability and Quality Constraints

A recurring limitation was data availability. Chapter 5 relied heavily on what programmes documented and released publicly, and neither programme provided the granularity of equity-stratified outcomes that would enable robust assessment of distributional effects across multiple subgroups. Chapter 6 could not link survey responses to administrative health records, limiting validation of self-reported measures and preventing analysis of clinical outcomes or longitudinal impacts. Self-reported survey data are subject to recall and social desirability biases.

7.5.4 Contextual Specificity and Generalisability

This research examined Australian policies, programmes, and populations. Australia's healthcare financing, broadband infrastructure, service geography, and Indigenous health governance context is likely to shape both telehealth implementation and equity considerations. Findings may be relevant to comparable high-income countries with dispersed populations but are not directly generalisable to health systems with different funding structures, governance arrangements, or population contexts. Within Australia, the NSW focus of Chapter 6 limits transferability to jurisdictions with different remoteness profiles and service systems.

7.5.5 Temporal Constraints and Rapid Change

The research period spanned rapid telehealth expansion during and after the COVID-19 pandemic. Pandemic-era utilisation, policy settings, and behavioural norms may not reflect future steady-state patterns. In addition, technological change is ongoing, and emerging modalities, including advanced remote monitoring and AI-enabled systems, may alter both telehealth capabilities and equity implications. Some findings may therefore require updating as policy, technology, and population digital capability evolve.

Despite these limitations, the thesis provides a rigorous and transparent multi-method assessment of telehealth equity. Findings should be interpreted with these constraints in mind

and can inform future research that expands to additional settings, incorporates Indigenous-led and community-controlled methods, links to longitudinal outcomes data, and evaluates equity impacts as telehealth continues to evolve.

7.6 Future Research Directions

The findings and limitations of this thesis point to three interconnected priorities for future research. These directions are not intended as an exhaustive agenda, but as areas where this programme of work has most clearly identified gaps and generated follow-up questions.

7.6.1 Methodological Advances

First, longitudinal and quasi-experimental designs are needed to assess how equity effects evolve as telehealth matures. Linked administrative data, such as MBS, PBS and hospital admissions, combined with repeated surveys, could test whether telehealth narrows disparities, maintains them, or creates new inequities over multi-year horizons. Where feasible, quasi-experimental designs comparing matched populations with differential telehealth exposure would strengthen causal inference. Equity stratification should be built into study design from inception rather than treated as an optional secondary analysis.

Second, the nine-dimension framework developed in Chapter 5 requires further testing and

refinement beyond the two-programme demonstration. Priority questions include whether dimensions perform consistently across clinical modalities and jurisdictions, the inter-rater reliability of the scoring rubric, and whether a shorter monitoring version can be developed without unacceptable loss of coverage. Further work could also assess whether any dimensions are empirically redundant or whether additional dimensions are needed in other system contexts.

Third, inclusive preference research is needed. Commercial online panel designs may under-represent groups most affected by digital exclusion, and Chapter 6 did not collect Aboriginal and Torres Strait Islander status, limiting assessment of inclusion. Future studies should test culturally appropriate approaches, including community-based participatory methods, deliberative formats, and Indigenous-led methodologies, to capture priorities that may not be well served by standard survey panels.

7.6.2 Targeted Empirical Studies Addressing Key Evidence Gaps

Three evidence gaps warrant dedicated research. First, awareness remains the least studied access dimension, and evidence across Chapters 2, 4 and 5 indicates it can operate as a precondition for downstream access and equity. Rigorous evaluation of awareness-raising strategies is needed, comparing channels, messages and target populations, with outcomes extending beyond awareness to utilisation and health outcomes.

Second, the infrastructure utilisation paradox identified in Chapter 5, where comprehensive supports coexisted with lower engagement among some target populations, warrants qualitative and participatory research to clarify trust, activation barriers and the conditions under which supports are used in practice. This is particularly important where culturally safe governance, self-determination and data sovereignty are central to equitable service design.

Third, telehealth economic evaluation in this thesis highlighted the limits of relying on average efficiency metrics alone. Future work could apply distributional approaches to examine how costs and benefits are distributed across population subgroups, alongside broader accounting of patient-borne costs such as travel, time, and employment disruption. This would generate more policy-relevant evidence for equity-oriented resource allocation, particularly for rural populations and those facing transport barriers.

7.6.3 Implementation and Aboriginal and Torres Strait Islander-Led Research

Implementation studies are needed to test the policy and service directions proposed in Section 7.3 under real-world constraints. Priorities include comparing proactive versus passive cultural and language support models; piloting equity-adjusted funding mechanisms; assessing digital navigator interventions with adequate statistical power for priority sub-populations; and examining which governance structures are most effective at embedding Aboriginal and Torres Strait Islander authority over service design and evaluation across contexts. Implementation science frameworks that attend to contextual enablers and barriers,

strategies for embedding change, and mechanisms through which interventions produce effects provide useful tools for this work.

For Aboriginal and Torres Strait Islander peoples, a distinct and dedicated research stream is essential. Priority areas include Indigenous data sovereignty in telehealth, culturally safe governance with genuine decision-making authority, impacts on holistic wellbeing beyond biomedical outcomes, and the conditions under which telehealth supports rather than undermines the autonomy of Aboriginal Community Controlled Health Organisations. This research should be Aboriginal and Torres Strait Islander-led, governed by community priorities, and resourced through dedicated funding mechanisms.

7.7 Conclusion

This thesis began with a deceptively simple question: can telehealth reduce health inequalities between metropolitan and non-metropolitan Australians. The evidence assembled across five empirical chapters indicates that telehealth has substantial potential to reduce geographic barriers to care, but equity impacts are contingent on policy choices, programme design, implementation quality, community engagement, and whether equity is treated as a monitored and resourced objective rather than an aspiration.

The thesis makes three substantive contributions. First, it provides multi-level empirical evidence on equity considerations across telehealth literature, frameworks, policies,

programmes and user populations, identifying both promising developments and systematic gaps. Second, it develops practical tools to support equity evaluation, including a nine-dimension framework operationalised through a transparent 0 to 4 scoring rubric and a stated-preference instrument for eliciting user priorities at scale. Third, it offers an integrated account of how equity gaps can cascade across evidence, frameworks, policy and practice, clarifying why problems persist and where leverage points for improvement may exist.

The pandemic created momentum for telehealth transformation that presents both opportunity and risk. The opportunity lies in embedding equity standards, monitoring infrastructure and community governance while systems remain adaptable. The risk is that telehealth becomes entrenched without equity foundations, with efficiency pressures crowding out cultural safety, outreach and accountability. This thesis supports a conditional but affirmative answer to its central question: telehealth can reduce health inequalities, but only if equity is made a genuine, monitored and resourced objective. The pathways are available, and the remaining task is implementation.

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Appendix A: Supplementary materials

This chapter contains supplemental tables and figures referenced in Chapters 2-6.

Chapter 2 supplementary materials

Table A 1: Detailed search strategy used in the systematic review of telehealth accessibility

Search Group	Concept	Search Strategy	Description
Telehealth	1.Telehealth terminologies	telehealth/ or telemedicine/ or ... or video consultation/	Different forms of telehealth
	2.eHealth & mHealth variants	(ehealth or e health or mhealth or ... tele ICU).tw,kw.	Additional keyword-based search for telehealth terms
	3.Remote patient monitoring	Remote patient monitoring.tw,kw.	Searching for remote patient monitoring
	4.Web-based health platforms	((webcast* or webina* or ... adj3 health*).tw,kw.	Different forms of virtual health platforms
	5.Remote health operations	(remote* adj3 (health* or medicine* ... or care)).tw,kw.	Remote forms of health services
	6.Telehealth Composite	1 or 2 or 3 or 4 or 5	Combination of all

Search Group	Concept	Search Strategy	Description
			telehealth related search terms
Rural Context	7.Rural Population	Rural Population/	Rural population descriptor
	8. Rural Health	Rural Health/	Rural health descriptor
	9. Rural Health Services	Rural Health Services/	Rural health services descriptor
	10. Rural terminology	rural.mp.	General rural term
	11. Regional or remote health	(health* adj3 (regional or remote)).tw,kf.	Regional and remote health-related terms
	Rural Composite	7 or 8 or 9 or 10 or 11	Combination of all rural related search terms
Health Disparity	13. Health services accessibility	exp health services accessibility	Health services accessibility
	14. Health disparities	Health Status Disparities/ or Healthcare Disparities/	Health status and healthcare disparities

Search Group	Concept	Search Strategy	Description
			descriptors
	15. Health equity terms	(Health* adj5 (inequality or ... or barrier*)).tw,kw.	Health-related inequalities and disparities
	16.Health Disparity Composite	13 or 14 or 15	Combination of all health disparities related search terms
Final		6 And 12 And 16	Combination of telehealth, rural, and health disparities search terms

Table A 2: Quality ratings of included reviews in the systematic review of telehealth studies
(2012-2023)

Surname of the First author and year of publication	Search Strategy Reporting (Databases, dates, and search span specified? Yes/No)	Details of Quality Assessment of Primary Studies Provided (Did the review perform quality/risk-of-bias assessment? Yes/No)	Overall Quality Rating (Good/Fair/Poor)
Banbury (53) 2014	Yes	Yes	Good
Bradford (50) 2016	Yes	Yes	Good
Chesser (52) 2016	Yes	Yes	Good
Irving (42) 2018	Yes	Yes	Good
Thomas Craig (46) 2020	Yes	Yes	Good
Vimalananda (37) 2020	Yes	Yes	Good
Yang (54) 2021	Yes	Yes	Good
Emami (39) 2022	Yes	Yes	Good
Morris (32)	Yes	Yes	Good

Surname of the First author and year of publication	Search Strategy Reporting (Databases, dates, and search span specified? Yes/No)	Details of Quality Assessment of Primary Studies Provided (Did the review perform quality/risk-of-bias assessment? Yes/No)	Overall Quality Rating (Good/Fair/Poor)
2022			
Moreno-Chaparro (36) 2022	Yes	Yes	Good
Fitzpatrick (19) 2023	Yes	Yes	Good
Mseke (14) 2023	Yes	Yes	Good
Kruse (13) 2016	Yes	No	Fair
Kozera (27) 2016	Yes	No	Fair
Benavides-Vaello (47) 2013	Yes	No	Fair
Kulcsar (35) 2014	Yes	No	Fair
Estai (41) 2016	Yes	No	Fair
Su (18) 2016	Yes	No	Fair

Surname of the First author and year of publication	Search Strategy Reporting (Databases, dates, and search span specified? Yes/No)	Details of Quality Assessment of Primary Studies Provided (Did the review perform quality/risk-of-bias assessment? Yes/No)	Overall Quality Rating (Good/Fair/Poor)
McLendon (34) 2017	Yes	No	Fair
Alvarado (29) 2017	Yes	No	Fair
Coustasse (30) 2019	Yes	No	Fair
Schoen (12) 2019	Yes	No	Fair
Appuswamy (10) 2020	Yes	No	Fair
LeBlanc (15) 2020	Yes	NO	Fair
Hilty (33) 2020	Yes	No	Fair
Kichloo (17) 2020	Yes	No	Fair
Airola (45) 2021	Yes	No	Fair
Wood (44)	Yes	No	Fair

Surname of the First author and year of publication	Search Strategy Reporting (Databases, dates, and search span specified? Yes/No)	Details of Quality Assessment of Primary Studies Provided (Did the review perform quality/risk-of-bias assessment? Yes/No)	Overall Quality Rating (Good/Fair/Poor)
2021			
Sekhon (16) 2021	Yes	No	Fair
Stellefson (55) 2022	Yes	No	Fair
Barnes (48) 2022	Yes	No	Fair
Freire (56) 2023	Yes	No	Fair
Haimi (31) 2023	Yes	No	Fair
Kosowicz (43) 2023	Yes	No	Fair
Yue (57) 2023	Yes	No	Fair
Marcin (11) 2016	No	No	Poor
Maddukuri (58) 2021	No	No	Poor

Surname of the First author and year of publication	Search Strategy Reporting (Databases, dates, and search span specified? Yes/No)	Details of Quality Assessment of Primary Studies Provided (Did the review perform quality/risk-of-bias assessment? Yes/No)	Overall Quality Rating (Good/Fair/Poor)
Ahuja (40) 2022	No	No	Poor
Van Cleave (28) 2022	No	No	Poor
Kappel (48) 2022	No	No	Poor
Dolar-Szczasny (26) 2023	No	No	Poor
Dhediya (38) 2023	No	No	Poor

Table A 3: Characteristics of reviews included in the systematic analysis of telehealth studies

Characteristic	Category/Range	N=42	%
Publication Year			
	2012-2014	3	7.1%
	2015-2017	9	21.4%
	2018-2020	9	21.4%
	2021-2023	21	50.1%
Review Type			
	Systematic Review (and variations)	18	42.9%
	Literature review	10	23.8%
	Scoping review	5	11.9%
	Rapid review	4	9.5%
	Narrative review	3	7.1%
	Comprehensive review	2	4.8%
Country of the Corresponding Author			
	USA	21	50%
	Australia	8	19%
	Canada	6	14.3%
	Other countries	7	16.7%
Country or a Region of Interest			
	USA	10	23.8%
	Australia	4	9.5%

Characteristic	Category/Range	N=42	%
	Canada	2	4.8%
	Other countries	5	11.9%
	Not specified	21	50%
Disease of Interest			
	Chronic diseases	13	31%
	Other types of diseases	9	21.4%
	Reviews not focused on a particular disease	20	47.6%
Search Time Range			
	Yes	30	71.4%
	Not reported	12	28.6%
Number of Databases Searched			
	>1	33	78.6%
	=1	1	2.4%
	Not reported	8	19%
Included Grey Literature			
	Yes	3	7.1%
	No	31	73.8%
	Not reported	8	19.1%
Alignment with our PICO			
	Yes	40	95.2%
	No	2	4.8%

Characteristic	Category/Range	N=42	%
Study Quality Assessed by Review Authors			
	Yes	13	31%
	Not reported	29	69%

Table A 4: Detailed ratings for each dimension of healthcare access of included articles in systematic reviews (2012-2023)

Surname of the First author and year of publication	Quality of review	Number of included studies	Dimensions of access					
			Accessibility	Availability	Acceptability	Affordability	Adequacy	Awareness
Banbury (53) 2014	Good	19	Poor	Poor	Not covered	Poor	Poor	Poor
Bradford (50) 2016	Good	72	Poor	Not covered	Not covered	Poor	Poor	Poor
Chesser (52) 2016	Good	15	Poor	Not covered	Poor	Poor	Not covered	Poor
Irving (42) 2018	Good	39	Poor	Poor	Poor	Poor	Poor	Poor
Thomas Craig (46) 2020	Good	38	Poor	Poor	Fair	Not covered	Poor	Poor

Surname of the First author and year of publication	Quality of review	Number of included studies	Dimensions of access					
			Accessibility	Availability	Acceptability	Affordability	Adequacy	Awareness
Vimalananda (37) 2020	Good	63	Fair	Not covered	Good	Good	Poor	Not covered
Yang (54) 2021	Good	338	Poor	Poor	Good	Poor	Poor	Good
Morris (32) 2022	Good	54	Poor	Fair	Good	Not covered	Fair	Poor
Emami (39) 2022	Good	16	Not covered	Not covered	Fair	Fair	Fair	Not covered
Moreno-Chaparro (36) 2022	Good	9	Poor	Poor	Poor	Not covered	Poor	Poor
Mseke (14)	Good	4	Poor	Poor	Good	Fair	Fair	Poor

Surname of the First author and year of publication	Quality of review	Number of included studies	Dimensions of access					
			Accessibility	Availability	Acceptability	Affordability	Adequacy	Awareness
2023								
Fitzpatrick (19) 2023	Good	21	Poor	Poor	Poor	Fair	Poor	Not covered
Benavides-Vaello (47) 2013	Fair	38	Poor	Poor	Poor	Poor	Poor	Poor
Kulcsar (35) 2014	Fair	NR	Poor	Poor	Poor	Poor	Poor	Poor
Estai (41) 2016	Fair	NR	Poor	Poor	Poor	Fair	Poor	Not covered
Su (18) 2016	Fair	49	Not covered	Fair	Not covered	Poor	Not covered	Not covered

Surname of the First author and year of publication	Quality of review	Number of included studies	Dimensions of access					
			Accessibility	Availability	Acceptability	Affordability	Adequacy	Awareness
Kruse (13) 2016	Fair	48	Fair	Poor	Good	Good	Poor	Not covered
Kozera (27) 2016	Fair	NR	Fair	Poor	Good	Good	Fair	Poor
Alvarado (29) 2017	Fair	41	Good	Good	Good	Fair	Good	Not covered
McLendon (34) 2017	Fair	14	Poor	Poor	Fair	Fair	Poor	Poor
Coustasse (30) 2019	Fair	86	Poor	Fair	Fair	Poor	Poor	Poor
Schoen (12) 2019	Fair	7	Poor	Poor	Fair	Poor	Poor	Poor

Surname of the First author and year of publication	Quality of review	Number of included studies	Dimensions of access					
			Accessibility	Availability	Acceptability	Affordability	Adequacy	Awareness
Appuswamy (10) 2020	Fair	NR	Good	Not covered	Poor	Good	Not covered	Not covered
Kichloo (17) 2020	Fair	42	Poor	Poor	Fair	Good	Fair	Fair
LeBlanc (15) 2020	Fair	69	Poor	Poor	Poor	Poor	Poor	Poor
Hilty (33) 2020	Fair	44	Not covered	Not covered	Poor	Not covered	Not covered	Poor
Sekhon (16) 2021	Fair	12	Poor	Poor	Good	Not covered	Poor	Poor
Wood (44) 2021	Fair	28	Poor	Poor	Fair	Poor	Poor	Not covered

Surname of the First author and year of publication	Quality of review	Number of included studies	Dimensions of access					
			Accessibility	Availability	Acceptability	Affordability	Adequacy	Awareness
Airola (45) 2021	Fair	17	Poor	Poor	Poor	Poor	Fair	Not covered
Barnes (48) 2022	Fair	15	Poor	Poor	Poor	Poor	Poor	Not covered
Stellefson (55) 2022	Fair	11	Poor	Not covered	Not covered	Not covered	Poor	Poor
Kosowicz (43) 2023	Fair	45	Poor	Poor	Poor	Poor	Poor	Not covered
Haimi (31) 2023	Fair	NR	Poor	Fair	Good	Fair	Poor	Good
Yue (57) 2023	Fair	15	Poor	Not covered	Fair	Poor	Poor	Not covered

Surname of the First author and year of publication	Quality of review	Number of included studies	Dimensions of access					
			Accessibility	Availability	Acceptability	Affordability	Adequacy	Awareness
Freire (56) 2023	Fair	18	Poor	Poor	Poor	Poor	Poor	Poor
Marcin (11) 2016	Poor	NR	Poor	Poor	Fair	Fair	Good	Poor
Maddukuri (58) 2021	Poor	NR	Not covered	Poor	Poor	Not covered	Poor	Not covered
Van Cleave (28) 2022	Poor	NR	Fair	Poor	Poor	Poor	Poor	Poor
Ahuja (40) 2022	Poor	NR	Fair	Poor	Fair	Fair	Poor	Not covered
Kappel (48) 2022	Poor	NR	Poor	Poor	Poor	Poor	Poor	Poor

Surname of the First author and year of publication	Quality of review	Number of included studies	Dimensions of access					
			Accessibility	Availability	Acceptability	Affordability	Adequacy	Awareness
Dolar-Szczasny (26) 2023	Poor	NR	Good	Fair	Good	Good	Fair	Poor
Dhediya (38) 2023	Poor	NR	Poor	Poor	Fair	Fair	Poor	Not covered

Chapter 3 supplementary materials

Table A 5: Information sources and search log

Source	Platform / interface	Run(s)	Search date (month/year)	Records retrieved (combined across runs)	Notes
MEDLINE	Ovid	Initial + update	2 Jul 2024; 11 Nov 2024	332	Strategy in Table A 6
CINAHL	EBSCOhost	Initial + update	2 Jul 2024; 11 Nov 2024	232	Strategy in Table A 6
Scopus	Elsevier	Initial + update	2 Jul 2024; 11 Nov 2024	143	Strategy in Table A 6
Citation searching	Scopus / manual	Initial + update	NA	8	Yield added to full-text screening

Table A 6: Search strategies and full-text exclusion log

Part A: Search strategies for different databases

Database	Search Fields	Search String(s)	Search Run Dates	Limits
SCOPUS	Article title, Abstract, Keywords	(telehealth or telemedicine or “e-health” or ehealth or “digital health” or “video consult*” or “remote consult*”) AND ((framework* OR model* OR assess* OR evaluat*) W/5 (equity OR equal* OR inequalit* OR disparit*))	2 July 2024 (initial); 11 November 2024 (update)	English only
MEDLINE	Keyword	1. (telehealth.mp. or Telemedicine) 2. (telemedicine.mp.) 3. (e-health.mp.) 4. (ehealth.mp.) 5. (digital health.mp. or Digital Health/ or Mobile Applications) 6. (Remote Consultation/ or Remote Consult*.mp.) 7. (video consult*.mp.) 8. (virtual care.mp.) 9. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 10. ((equity or equal* or inequalit* or disparit*) adj5 (framework* or model* or assess* or evaluat*)).mp. 11. 9 AND 10	2 July 2024 (initial); 11 November 2024 (update)	English only
CINAHL	MH/TI/AB/Keywords	S1 (MH “Telehealth+”) OR “telehealth” S2 (MH “Telemedicine+”) OR “telemedicine” S3 TI (“e-health” OR ehealth OR “digital health”) OR AB (“e-health” OR ehealth OR “digital health”)	2 July 2024 (initial); 11 November 2024 (update)	English only

Database	Search Fields	Search String(s)	Search Run Dates	Limits
		<p>S4 (MH "Remote Consultation") OR "video consultation" OR (MH "Telephone Consultation (Iowa NIC)")</p> <p>S5 "virtual care"</p> <p>S6 "telecare"</p> <p>S7 S1 OR S2 OR S3 OR S4 OR S5 Or S6</p> <p>S8 (framework* OR model* OR assess* OR evaluat*) N5 (equity OR equal* OR inequalit* OR disparit*)</p> <p>S9 S7 AND S8</p>		

Part B: Full-text exclusion log (n = 10)

Full-text record	Reason for exclusion
Baquero, B., Gonzalez, C., Ramirez, M., Chavez Santos, E., & Ornelas, I. J. (2020). Understanding and Addressing Latinx COVID-19 Disparities in Washington State. <i>Health Education & Behavior</i> , 47(6), 845-849. https://doi.org/10.1177/1090198120963099	Lack of health equity discussion
Bitomsky, L., Pfitzer, E. C., Nißen, M., & Kowatsch, T. (2024). Advancing health equity and the role of digital health technologies: a scoping review protocol. <i>BMJ Open</i> , 14(10), e082336. https://doi.org/10.1136/bmjopen-2023-082336	Lack of health equity discussion (protocol only)
Blanc, J., Hahn, K., Oliveira, B., Phillips, R., Duthely, L. M., Francois, L., Carrasco, M., Moore, J., Sternberg, C. A., Jean-Louis, G., & Seixas, A. A. (2023). Bringing Health Care Equity to Diverse and Underserved Populations in Sleep Medicine and Research Through a Digital Health Equity Framework. <i>Sleep Medicine Clinics</i> , 18(3), 255-267. https://doi.org/10.1016/j.jsmc.2023.05.009	Focuses primarily on clinical/technical outcomes (not framework-focused for this review)
Hartwell, M., Lin, V., Gatewood, A., Sajjadi, N. B., Garrett, M., Reddy, A. K., Greiner, B., & Price, J. (2022). Health disparities, COVID-19, and maternal and childbirth outcomes: a meta-epidemiological study of equity reporting in systematic reviews. <i>Journal of Maternal-Fetal & Neonatal Medicine</i> , 35(25), 9622-9630. https://doi.org/10.1080/14767058.2022.2049750	Focuses primarily on clinical/technical outcomes
Steinman, L., Chavez Santos, E., Chadwick, K., Mayotte, C., Johnson, S. S., Kohn, M., Kelley, J., Denison, P., Montes, C., Spencer-Brown, L., & Lorig, K. (2024). Remote Evidence-Based Health Promotion Programmes During COVID: A National Evaluation of Reach and Implementation for Older Adult Health Equity. <i>Health Promotion Practice</i> , 25(3), 475-491. https://doi.org/10.1177/15248399231175843	Focuses primarily on clinical/technical outcomes
Ochtli, C., Gibran, N., Mandell, S., Pham, T., & Stewart, B. (2019). A Health Equity Framework for Telemedicine at a Regional Burn Center. <i>Journal of Burn Care & Research</i> , 40(Supplement_1), S14-S15. https://doi.org/10.1093/jbcr/irz013.021	Focuses primarily on clinical/technical outcomes
Partridge, S. R., Knight, A., Todd, A., McGill, B., Wardak, S., Alston, L., Livingstone, K. M., Singleton,	Focuses primarily on clinical/technical outcomes

Full-text record	Reason for exclusion
A., Thornton, L., Jia, S., Redfern, J., & Raeside, R. (2024). Addressing disparities: A systematic review of digital health equity for adolescent obesity prevention and management interventions. <i>Obesity Reviews</i> , 25(12), e13821. https://doi.org/10.1111/obr.13821	
Kaihlanen, A. M., Virtanen, L., Buchert, U., Safarov, N., Valkonen, P., Hietapakka, L., Hörhammer, I., Kujala, S., Kouvonen, A., & Heponiemi, T. (2022). Towards digital health equity - a qualitative study of the challenges experienced by vulnerable groups in using digital health services in the COVID-19 era. <i>BMC Health Services Research</i> , 22(1), 188. https://doi.org/10.1186/s12913-022-07584-4	Existing framework application only (no new/unique framework)
Nair, U. S., Kue, J., Athilingam, P., Rodríguez, C. S., & Menon, U. (2023). Application of the ConNECT Framework to achieve digital health equity. <i>Nursing Outlook</i> , 71(4), 101991. https://doi.org/10.1016/j.outlook.2023.101991	Existing framework application only (no new/unique framework)
Raza, M. M., Venkatesh, K. P., & Kvedar, J. C. (2023). Promoting racial equity in digital health: applying a cross-disciplinary equity framework. <i>NPJ Digital Medicine</i> , 6(1), 3. https://doi.org/10.1038/s41746-023-00747-5	Non-academic literature (Editorial)

Table A 7: Summary of health equity frameworks, with the main purpose and key elements as described by the framework authors

Reference(s)	Framework/Model Name	Main Purpose	Key Elements
Aday & Andersen, 1974 (17)	Aday and Andersen Model	This framework is primarily used to study the determinants of healthcare service utilization, focusing on why individuals use healthcare services and how the opportunities for different populations to access healthcare vary.	<p>(1) Health policy (financing, education, manpower, health care reorganization programmes)</p> <p>(2) Characteristics of the health care delivery system:</p> <ul style="list-style-type: none"> - Resources (volume and the distribution) - Organizations (entry, structure) <p>(3) Characteristics of the population at risk:</p> <ul style="list-style-type: none"> - Predisposing (age, sex, race, religion, and values concerning health and illness) - Enabling (income, insurance coverage, rural-urban character, region) - Need (perceived, evaluated) <p>(4) Utilization of health care services (type, sites, purpose, time interval)</p> <p>(5) Consumer satisfaction (convenience, costs, coordination, courtesy, information, quality)</p>
Kepper et al., 2024 (18)	A Model for Advancing Digital Health Access to Foster Health Equity	This model aims to advance health equity by identifying and addressing multilevel factors that drive inequities in access to and utilization of digital health tools.	<p>(1) Multilevel Access Dimensions:</p> <p>Adapted from Levesque et al.'s framework, the model focuses on approachability, acceptability, availability, affordability, and appropriateness of digital health tools to address access barriers comprehensively.</p> <p>(2) Design, Delivery, Dissemination, and Sustainability:</p> <ul style="list-style-type: none"> -Design: User-centered, participatory approaches to ensure inclusivity and cultural

Reference(s)	Framework/Model Name	Main Purpose	Key Elements
			<p>relevance.</p> <ul style="list-style-type: none"> -Delivery: Incorporating workflows, training, and technical support for seamless integration. -Dissemination: Targeted outreach to raise awareness among underserved populations. -Sustainability: Developing funding models and infrastructure to support long-term accessibility. <p>(3) Evaluation and Ethics:</p> <ul style="list-style-type: none"> -Emphasises ongoing evaluation of access metrics and ethical principles to ensure tools are effective, inclusive, and aligned with the needs of diverse communities.
World Health Organisation, 2010 (19)	Conceptual Framework for Action on the Social Determinants of Health	This framework offers a comprehensive approach to understanding and addressing the social determinants of health (SDoH) and their impact on health inequalities. The framework aims to elucidate the fundamental processes that lead to health inequalities through a “causal” perspective. As an “action-oriented” framework, it is designed to assist policymakers in identifying where to intervene in these	<p>(1) Socio-economic and political context, which are the backgrounds that generate social stratification and class divisions:</p> <ul style="list-style-type: none"> -Governance: Policies and governance structures that impact health outcomes. -Macroeconomic Policies: Economic policies affecting income distribution, employment, and social security. -Social Policies: Education, health, labour market, and housing policies. -Public Policies: Including both social and economic policies. -Culture and Societal Values: The broader social norms and cultural values that influence social determinants of health. -Epidemiological Conditions: particularly in the case of major epidemics such as HIV/AIDS, which exert a powerful influence on social structures and must be factored into global and national policy setting.

Reference(s)	Framework/Model Name	Main Purpose	Key Elements
		fundamental processes to most effectively combat health inequalities.	<p>(2) Structural determinants of health inequalities, which shape the conditions of inequality:</p> <ul style="list-style-type: none"> -Socioeconomic Position: The social and economic status of individuals, determined by factors such as income, education, occupation, gender, race/ethnicity, and social class. -Social Stratification: The division of society into hierarchical groups, affecting access to resources and opportunities. <p>(3) Intermediary determinants of health, formed by structural determinants such as housing, physical work environment, social support, stress, nutrition, and physical activity, shape individual health outcomes.:</p> <ul style="list-style-type: none"> -Material Circumstances: Living and working conditions, food availability, housing quality, and neighbourhood characteristics. -Behaviours and Biological Factors: Health-related behaviours (smoking, diet, physical activity) and biological/genetic factors. -Psychosocial Factors: Stress, social support, and coping mechanisms. -Health System: Accessibility, affordability, and quality of health care services.
<p>Levesque et al., 2013 (20)</p> <p>Pullyblank et al., 2023 (21)</p>	Conceptual Framework of Access to Health Care	This framework emphasises the complexities of access and identifies factors that can enhance or hinder access to health services. These dimensions originate from both the supply side (such as healthcare	<p>(1) Approachability (Perceived Ability): Recognises whether health services are known to exist, can be reached, and are open to all.</p> <p>(2) Acceptability (Seeking Ability): Relates to the match between how responsive health services are to the cultural and social expectations of individual users.</p> <p>(3) Availability and Accommodation (Reaching Ability): Ensures that services are available at appropriate times and supported by sufficient resources and staff.</p> <p>(4) Affordability (Paying Ability): Considers the economic capacity of individuals to</p>

Reference(s)	Framework/Model Name	Main Purpose	Key Elements
		systems and organizations) and the demand side (such as individuals, families, and communities), involving different processes that facilitate accessibility (such as healthcare needs, healthcare-seeking behaviour, and healthcare coverage).	<p>spend resources without causing hardship.</p> <p>(5) Appropriateness (Engaging Ability): Measures the fit between health services and client needs, ensuring that services are provided in a respectful and coordinated manner that is relevant to the health needs.</p>
Crawford & Serhal, 2020 (22)	Digital Health Equity Framework (DHEF)	This framework aims to address health equity in the design, implementation, and evaluation of digital health solutions. It focuses on identifying and mitigating digital determinants of health that may reinforce or exacerbate existing health inequities. It also integrates digital health equity considerations into health systems and provider practices to ensure inclusive access and equitable health outcomes.	<p>(1) Social Stratification:</p> <ul style="list-style-type: none"> -Incorporates the hierarchical allocation of resources and power based on intersectional factors like race, income, age, gender, and geography. -Links these factors to a person’s health risks and material circumstances. <p>(2) Digital Determinants of Health:</p> <ul style="list-style-type: none"> -Includes access to technology, digital health literacy, and psychosocial factors influencing the usage of digital health services. -Considers the impact of digital health access on intermediate health outcomes, such as beliefs, behaviours, and preexisting conditions. <p>(3) Systemic and Institutional Context:</p> <ul style="list-style-type: none"> -Highlights the role of institutions, policies, and health systems in shaping digital health outcomes. -Encourages the development of equitable health strategies and culturally safe environments. <p>(4) Ecological Approach:</p>

Reference(s)	Framework/Model Name	Main Purpose	Key Elements
			<ul style="list-style-type: none"> -Examines the interplay between individual behaviours, social circumstances, and broader systemic factors. -Advocates for integrating health equity into the digital health ecosystem from development to implementation. (5) Measurement and Evaluation: <ul style="list-style-type: none"> -Emphasises the need for systematic measurement of digital health equity outcomes. -Calls for the collection and analysis of health equity data to refine the framework and guide policy changes. (6) Person-Centered Care: <ul style="list-style-type: none"> -Ensures digital health solutions are adaptable to diverse needs and empower patient autonomy. -Encourages inclusion of vulnerable populations in the design and leadership of digital health innovations.
Groom et al., 2024 (33)	Digital Health Equity-focused Implementation Research Model (DH-EquIR)	To guide the planning, design, implementation, and evaluation of digital health interventions with a focus on promoting health equity. It aims to address systemic inequities by integrating equity-focused strategies across all stages of digital health implementation.	<ul style="list-style-type: none"> (1) Population Health Status and Determinants of Health: <ul style="list-style-type: none"> -Combines social determinants of health (SDOH) and digital determinants of health to assess population needs and inequities. (2) Planning the Program: <ul style="list-style-type: none"> -Identifies disadvantaged groups. -Quantifies current health inequities. -Develops equity-sensitive recommendations tailored to specific needs. (3) Designing the Program:

Reference(s)	Framework/Model Name	Main Purpose	Key Elements
			<ul style="list-style-type: none"> -Identifies key actors, including community members and facilitators. -Addresses barriers to equity-focused recommendations. -Incorporates culturally and contextually relevant design principles. <p>(4) Implementing the Program:</p> <ul style="list-style-type: none"> -Designs equity-focused communication strategies. -Defines resources and incentives for implementation. -Develops strategies to overcome identified barriers. <p>(5) Equity-Focused Implementation Outcomes:</p> <ul style="list-style-type: none"> -Measures sustainability, fidelity, and adoption rates. -Tracks the impact on targeted populations and evaluates success using defined equity metrics.
Antonio & Petrovskaya, 2019 (32)	eHealth Equity Framework (eHEF)	The Framework aims to integrate health equity considerations throughout the lifecycle of health information technologies (HITs), such as electronic health records and patient portals. It is designed to address inequities inadvertently perpetuated by eHealth solutions, ensuring that health equity remains a core goal in designing,	<p>(1) Socio-Techno-Economic-Political Context:</p> <ul style="list-style-type: none"> -Incorporates factors like governance, policy, cultural values, and existing technologies that influence health equity. -Highlights how existing technological infrastructure can both enable and constrain equitable access. <p>(2) Patients' Social Position and Characteristics:</p> <ul style="list-style-type: none"> -Accounts for education, occupation, income, gender, age, ethnicity, race, and geographic location as socially mediated determinants. -Emphasises intersectionality to address the complex ways social determinants affect

Reference(s)	Framework/Model Name	Main Purpose	Key Elements
		implementing, and evaluating digital health interventions.	<p>patient outcomes.</p> <p>(3) Intermediary Determinants of Health:</p> <ul style="list-style-type: none"> -Includes technology and healthcare access, material circumstances, and social capital. -Recognises the importance of multiple forms of literacy (health, digital, and media literacy) in effective technology use. <p>(4) Technology Integration:</p> <ul style="list-style-type: none"> -Incorporates technology into every stage of the framework, from pre-existing infrastructure to implementation and outcomes. -Acknowledges that technology can both exacerbate inequities and serve as a tool to address them. <p>(5) Life Course Perspective:</p> <ul style="list-style-type: none"> -Reflects the impact of socio-economic and political contexts throughout the lifecycle of health information technologies. <p>(6) Feedback Loops and Non-Linear Processes:</p> <ul style="list-style-type: none"> -Encourages an iterative approach to understanding and addressing inequities through continuous evaluation and adaptation.
Richardson et al., 2022 (25)	Framework for Digital Health Equity	The framework provides a detailed explanation of the key Digital Determinants of Health (DDoH) to support the work of industry professionals, healthcare system operators, and	<p>(1) At the individual level, the determinants include digital literacy, digital self-efficacy, technology acquisition, and attitudes towards technology use.</p> <p>(2) At the interpersonal level, the determinants encompass hidden technology biases, interdependencies, and the relationships between patients, technology professionals, and clinicians.</p> <p>(3) At the community level, the determinants cover community infrastructure, healthcare infrastructure, community technology standards, and community</p>

Reference(s)	Framework/Model Name	Main Purpose	Key Elements
		academic researchers in the creation of digital health tools. The DDoH is studied at the individual, interpersonal, community, and societal levels, discussing the root causes and the importance of a multi-level approach.	partnerships. (4) At the societal level , the determinants involve technology policies, data and design standards, social norms and ideologies, and algorithmic biases.
Woodward et al., 2019 (26) Woodward et al., 2021 (27) Norman et al., 2024 (28)	Health Equity Implementation Framework (HEIF)	The HEIF primarily focuses on integrating health equity principles into specific health programmes and policies. Its purpose is to identify the determinants of health equity so that interventions and implementation strategies can be adjusted or tailored to promote health equity. This framework aims to ensure that health interventions effectively reduce health disparities, especially among populations with lower socio-economic status or limited resources.	(1) Culturally related factors , such as mistrust in healthcare, demographic biases, or prejudices of recipients;(2) Clinical encounters or interactions between patients and providers; (3) Social contexts , including material infrastructure, economics, and the social and political forces at play.

Reference(s)	Framework/Model Name	Main Purpose	Key Elements
Dover & Belon, 2019 (29)	Health Equity Measurement Framework (HEMF)	The HEMF provides a comprehensive view of numerous social determinants of health (SDoH) and the drivers of healthcare utilization, along with guiding quantitative analysis for public health monitoring and policy making to address these disparities.	This framework encompasses socio-economic, cultural, and political contexts; health policy background; social stratification and status; material and social environments; environmental and biological factors; health-related behaviours and beliefs; stress; care quality; and healthcare utilization.
O'Neill et al., 2014 (30) Woolley et al., 2023 (31)	PROGRESS/PROGRESS-PLUS	PROGRESS-Plus is a framework used to identify and analyse health inequalities across various dimensions. It is designed to enhance understanding and reporting of equity issues in health research and interventions.	<ul style="list-style-type: none"> (1) Place of residence: Urban/rural location, region, country. (2) Race/ethnicity/culture/language: Different racial or ethnic groups, cultural practices, and language barriers. (3) Occupation: Type of employment, working conditions, and employment status. (4) Gender/sex: Differences based on gender and biological sex. (5) Religion: Religious beliefs and practices influencing health. (6) Education: Level of education attained and its impact on health literacy and behaviours. (7) Socioeconomic status: Income level, wealth, and social class. (8) Social capital: Social networks, community support, and social cohesion.

Reference(s)	Framework/Model Name	Main Purpose	Key Elements
			<p>The “PLUS” component captures additional factors that may be relevant in specific contexts:</p> <ul style="list-style-type: none"> (1) Personal characteristics: Age, disability, sexual orientation. (2) Features of relationships: Family structure, marital status. (3) Time-related factors: Life cycle, duration of exposure to certain conditions.
Szymczak et al., 2023 (23)	Process Model of Healthcare Access, Quality and Equity	This model illustrates the impact of telehealth on patient, population, and system outcomes, and is intended to be used to broadly guide research, practice, and policy concerning the equity impacts of healthcare service innovations.	<ul style="list-style-type: none"> (1) Patient Care Seeking, including: <ul style="list-style-type: none"> - Care Seeking: Identifying and perceiving health needs. - Care reaching: The ability to access healthcare services, which can be affected by geographic, financial, and other barriers. - Care Encounters: Interactions with healthcare providers and receiving care. - Health Outcomes: Results of medical interventions over a period. (2) Care Delivery Systems, which includes: <ul style="list-style-type: none"> - Representing System People: Healthcare professionals and support staff. - Processes: The procedures and protocols that govern how care is delivered, including the use of tools and technology. - Environment: The physical and organizational setting in which care is provided. (3) Systemic Commitment to Health Equity: <ul style="list-style-type: none"> -Anti-Oppression Frameworks: Initiatives and policies designed to address and dismantle oppressive practices within healthcare systems. This includes efforts to repair, remediate, restructure, and remove barriers to equitable care.

Reference(s)	Framework/Model Name	Main Purpose	Key Elements
			<p>-Feedback Loops: Mechanisms that allow the system to learn from the outcomes and adapt processes to improve both access and quality of care. These loops are critical for making ongoing adjustments that enhance system performance and patient outcomes.</p> <p>(4) Outcomes:</p> <p>-System Outcomes: Metrics such as quality, safety, efficiency, cost-effectiveness, healthcare worker morale, and trustworthiness of the healthcare system.</p> <p>-Patient Outcomes: Direct impacts on patients, including health outcomes, satisfaction with care, costs, and trust in the system.</p> <p>-Population Outcomes: Broader impacts on health equity, such as access and outcome disparities across different demographic groups (e.g., race, ethnicity, language, payer).</p>
Foley et al., 2021 (24)	Suggested Pathways of Access, Use and Benefit from Digital Health Services	This framework was developed to explore and enhance equity in access to, use of, and benefits derived from population-oriented digital health services.	<p>(1) Access:</p> <p>-Availability and affordability of technology.</p> <p>-Sociodemographic barriers like age, socioeconomic status, and education.</p> <p>-Technological literacy and infrastructure.</p> <p>(2) Use:</p> <p>-Trust in digital health services.</p> <p>-Confidence in navigating and using digital tools effectively.</p> <p>-Integration of digital services with face-to-face healthcare.</p> <p>(3) Benefit:</p> <p>-Improved health literacy and self-efficacy.</p>

Reference(s)	Framework/Model Name	Main Purpose	Key Elements
			<ul style="list-style-type: none"> -Complementarity between digital and face-to-face services. -Empowerment in health-related decision-making. (4) Social Determinants of Health: <ul style="list-style-type: none"> -Incorporates the broader social context affecting digital health equity, including geographic location, cultural background, and economic disparities. (5) Trust and Literacy: <ul style="list-style-type: none"> -Highlights the foundational role of trust in digital tools and services. -eHealth literacy as a critical mediator for effective use and benefit.

Table A 8: Quality and applicability assessment rubric, scoring template, and results for included frameworks

Part A: The rubric table (criterion × 0-3 anchors)

Criterion	0 (Not met)	1 (Partially met)	2 (Mostly met)	3 (Fully met)
Clarity of purpose	No clear aim/target context/intended users stated.	Purpose stated but vague; limited specification of population/setting or intended use.	Purpose and intended use described with minor ambiguity.	Explicit purpose, target context/population, and intended users/use-cases clearly stated.
Theoretical basis	No theory/conceptual foundations referenced.	Implicit or minimal theoretical grounding; cites concepts without explaining how they inform the framework	Relevant theory/evidence identified with partial integration.	Clear theoretical grounding and explicit explanation of how it informed development.
Comprehensiveness (telehealth-relevant equity domains)	Very limited domains; major determinants absent.	Some core domains included but multiple important domains are omitted.	Most key domains are covered with minor omissions/limited depth.	Comprehensive coverage including social and digital determinants relevant to telehealth/digital health.
Applicability to telehealth	No guidance for application/assessment in telehealth.	Mentions relevance but offers limited practical guidance.	Some practical guidance but limited operational detail.	Clear actionable guidance for telehealth application (steps, measurable constructs/indicators, implementation

Criterion	0 (Not met)	1 (Partially met)	2 (Mostly met)	3 (Fully met)
				considerations).

Part B: The blank scoring template

Criterion	Score (0-3)	Justification (brief, evidence-based)
Clarity of purpose		
Theoretical basis		
Comprehensiveness (telehealth-relevant equity domains)		
Applicability to telehealth		

Note: Scoring: 0-3 each, total 0-12; High 10-12 / Moderate 7-9 / Fair 4-6 / Low 0-3.

Part C: Quality and applicability assessment of included frameworks

Authors/Framework name	Clarity of Purpose	Theoretical Basis	Comprehensiveness	Applicability	Total Score (0-12)
Foley et al., 2021	1	3	1	2	7
Pullyblank et al., 2023 Access to health care model	3	2	3	3	11
Antonio & Petrovskaya, 2019 eHealth Equity Conceptual Framework	3	3	2	1	9
Richardson et al., 2022 Framework for digital health equity	3	2	2	3	10
Szymczak et al., 2023 Process model of healthcare access, quality and equity	2	3	3	3	11
WHO, 2010 A Conceptual Framework for Action on the Social Determinants of Health	2	3	2	1	8
Woodward et al., 2019 Health Equity Implementation Framework	3	3	3	2	11
Woodward et al., 2021 Health Equity Implementation Framework	3	3	2	2	10
Woolley et al., 2023 PROGRESS PLUS	2	2	1	2	7
Aday & Andersen, 1974	3	3	2	1	9
Dover & Belon, 2019	3	3	1	1	8

Authors/Framework name	Clarity of Purpose	Theoretical Basis	Comprehensiveness	Applicability	Total Score (0-12)
Health Equity Measurement Framework					
Crawford & Serhal, 2020 The Digital Health Equity Framework	1	2	1	3	7
Kepper et al., 2024 A model for advancing digital health access to foster health equity	2	3	2	3	10
Groom et al., 2024 Digital Health Equity-focused Implementation Research Model	3	3	2	3	11
Levesque et al., 2013 A conceptual framework of access to health care	3	3	2	2	10
Norman et al., 2023 Health Equity Implementation Framework	3	1	2	3	9
O'Neill et al., 2014 PROGRESS	3	1	1	1	6
Note: Frameworks related to digital health or eHealth are highlighted in bold.					

Table A 9: Common factors and key differences across health equity frameworks

Category	Factor	Description and the Impact of Factors on Health Equity	Frameworks/Models with the factor
Common Factors	Social Determinants of Health (SDoH)	Emphasise that broad social, economic, cultural, and political factors fundamentally shape health opportunities and outcomes. Addressing SDoH can reduce structural disparities and improve equitable health outcomes.	All frameworks
	Cultural and Linguistic Appropriateness/Cultural Competence	Stresses matching healthcare services with patients’ cultural, linguistic, and social contexts to build trust and engagement.	<ol style="list-style-type: none"> 1. Conceptual Framework for Action on the Social Determinants of Health 2. Framework for Digital Health Equity 3. HEIF 4. HEMF 5. PROGRESS-PLUS 6. Process Model of Healthcare Access, Quality and Equity 7. DHEF 8. DH-EquIR 9. eHEF 10. A Model for Advancing Digital Health Access to Foster Health Equity 11. Suggested Pathways of Access, Use and Benefit from Digital Health Services

Category	Factor	Description and the Impact of Factors on Health Equity	Frameworks/Models with the factor
	Access Dimensions	Includes availability, affordability, acceptability, approachability, and appropriateness of services.	<ol style="list-style-type: none"> 1. Aday and Andersen Model 2. A Model for Advancing Digital Health Access to Foster Health Equity 3. Conceptual Framework for Action on the Social Determinants of Health 4. Conceptual Framework of Access to Health Care 5. DHEF 6. Process Model of Healthcare Access, Quality and Equity 7. Suggested Pathways of Access, Use and Benefit from Digital Health Services
	DDoH (in Digital/ehealth Contexts)	Disparities in access to healthcare arise due to unequal access to digital technologies, such as devices, reliable internet connections, and the skills needed to use them effectively. Core factor leading to disparities in access to healthcare.	<ol style="list-style-type: none"> 1. DHEF 2. eHEF 3. Framework for Digital Health Equity 4. DH-EquIR 5. A Model for Advancing Digital Health Access to Foster Health Equity 6. Suggested Pathways of Access, Use and Benefit from Digital Health Services
	Policy and Governance	Identifies the influence of	<ol style="list-style-type: none"> 1. Aday and Andersen Model

Category	Factor	Description and the Impact of Factors on Health Equity	Frameworks/Models with the factor
	Interventions	policies, regulations, and resource allocation at systemic levels on health equity and telehealth access.	<ol style="list-style-type: none"> 2. Conceptual Framework for Action on the Social Determinants of Health 3. DHEF 4. eHEF 5. HEMF 6. Process Model of Healthcare Access, Quality and Equity
	Iterative Feedback and Continuous Evaluation	Emphasises ongoing monitoring, feedback loops, and adaptive approaches to continually address and improve health equity outcomes.	<ol style="list-style-type: none"> 1. Aday and Andersen Model 2. Process Model of Healthcare Access, Quality and Equity 3. eHEF 4. A Model for Advancing Digital Health Access to Foster Health Equity 5. DHEF 6. DH-EquIR
Differences	Algorithmic Bias & Advanced Digital Determinants	Highlights specific concerns about algorithmic fairness and data biases in digital tools. Addressing these factors could lead to more equitable data-driven interventions.	Framework for Digital Health Equity
	Life Course Perspective	Considers health equity across the lifespan. Measures how health equity evolves over time, influenced by age and	<ol style="list-style-type: none"> 1. eHEF 2. PROGRESS-PLUS

Category	Factor	Description and the Impact of Factors on Health Equity	Frameworks/Models with the factor
		life stages.	
	Person-Centered Design	Ensuring inclusivity and accessibility through user-centered approaches.	<ol style="list-style-type: none"> 1. DHEF 2. DH-EquIR 3. A Model for Advancing Digital Health Access to Foster Health Equity
	Precise Quantitative Digital Equity Metrics	Focuses on specialized measures for digital health equity. These metrics can improve the precision of interventions and allows tracking of progress toward more equitable digital health outcomes.	<ol style="list-style-type: none"> 1. DHEF 2. DH-EquIR 3. A Model for Advancing Digital Health Access to Foster Health Equity 4. Process Model of Healthcare Access, Quality and Equity

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Table A 10: Detailed search sources and terms

Source	Websites / Platforms	Search Terms	Notes
Federal Government	Australian Department of Health and Aged Care, Australian Digital Health Agency	telehealth, digital health, virtual care, telemedicine, policy, strategy, framework	Website search + Google (site:.gov.au); first 5 pages reviewed; 2019-2024
State/Territory	NSW Health, VIC Health, QLD Health, WA Health, SA Health, TAS Health, NT Health, ACT Health	Same as above	Website search + Google; first 5 pages reviewed; 2019-2024
Policy Commons	https://policycommons.net	(“telehealth” OR “digital health” OR “virtual care” OR “telemedicine”) AND Australia AND (policy OR strategy OR framework OR guideline)	Filter: 2019-2024, Australia only
Google	site:.gov.au	telehealth policy Australia; virtual care strategy; digital health framework NSW (and other states)	First 5 pages (~50 results per query) reviewed; 2019-2024
<p>Note: The search strategy included multiple terms (“telehealth,” “digital health,” and “virtual care”) to reflect the diversity of terminology used across Australian policy documents. For consistency, the manuscript uses “telehealth” as the standard term unless otherwise stated in the policy title or citation.</p>			

Table A 11: Seven policy/strategy documents excluded at full-text for “no substantive equity”
mention.

No.	Policy Document Title	Issuing Body	Year
1	Digital Health Strategy 2019-2029 (1)	ACT Health	2019
2	Digital Health Governance and Investment Framework Policy Directive (2)	South Australia	2020
3	Allied Health Digital Readiness Issues Paper (3)	Department of Health and Aged Care	2021
4	Digital Strategy for the Western Australian Government 2021-2025 (4)	Government of Western Australia	2021
5	Digital Health Strategic Vision for Queensland 2026 (5)	Queensland Health	2021
6	Digital Health Strategy (2021-2024) (6)	Western Australia Primary Health Alliance (WAPHA)	2021
7	MBS Review Advisory Committee: Telehealth Post-Implementation Review - Final Report (7)	Department of Health	2022

References:

1. ACT Health. Digital Health Strategy 2019-2029. 2019.
2. Government of South Australia. Digital Health Governance and Investment Framework Policy Directive. 2020.
3. Department of Health and Aged Care. Allied Health Digital Readiness 2021.

4. Government of Western Australia. Digital Strategy for the Western Australian Government 2021-2025. 2021.
5. Queensland Health. Digital Health Strategic Vision for Queensland 2026. 2021.
6. Western Australia Primary Health Alliance. Digital Health Strategy (2021-2024). 2021.
7. MBS Review Advisory Committee. Telehealth Post-Implementation Review - Final Report. 2022.

Chapter 5 supplementary materials

Table A 12: Official programme documents and peer-reviewed sources used for evidence

extraction and verification

No.	Programme	Title	Type	Publisher / Source	Year / Coverage
1	RPAV	RPA Virtual Hospital Year 2 Evaluation Report [20]	Evaluation report	Sydney Local Health District	2021-2022 (Feb 2021-Jan 2022)
2	RPAV	RPA Virtual Hospital-proof of concept trial Evaluation Report 2020-2021[21]	Evaluation report	Sydney Local Health District	2020-2021
3	RPAV	RPA Virtual Hospital - Economic Evaluation Report [24]	Economic evaluation report	Sydney Local Health District	2024
4	RPAV	The Virtual Care Experience of Patients Diagnosed With COVID-19 [26]	Peer-reviewed article	Journal of Patient Experience	2021
5	RPAV	rpavirtual: Key lessons in healthcare organisational resilience in the time of COVID-19 [23]	Peer-reviewed article	International Journal of Health Planning and Management	2022
6	RPAV	Association of	Peer-reviewed	Health Policy and	2025

No.	Programme	Title	Type	Publisher / Source	Year / Coverage
		demographic characteristics of COVID-19 patients with RPA Virtual Hospital service utilization in 2020-22 [27]	article	Technology	
7	RPAV	RPA Virtual Hospital Patient Reported Experience Measures (PREMs) [25]	Internal manuscript	RPAV / SLHD	2024
8	RPAV	RPA Virtual Hospital - Presentation (Key Milestones & Governance) [28]	Official presentation	Sydney Local Health District	2019-2021 (timeline)
9	VRGS	Spotlight on virtual care: Virtual Rural Generalist Service (VRGS) [10]	Programme profile (official)	NSW Agency for Clinical Innovation	2021
10	VRGS	Health service access and quality of care provided by the Western NSW Local Health District Virtual Rural Generalist Service: a retrospective analysis of linked administrative data [29]	Peer-reviewed article	Medical Journal of Australia (Supplement)	2024

No.	Programme	Title	Type	Publisher / Source	Year / Coverage
11	VRGS	Clinician experiences of a hybrid virtual medical service supporting rural and remote hospitals: a qualitative study [30]	Peer-reviewed article	Medical Journal of Australia (Supplement)	2024
12	VRGS	Patient and carer experiences of hospital-based hybrid virtual medical care: a qualitative study [31]	Peer-reviewed article	Medical Journal of Australia (Supplement)	2024
13	VRGS	An economic evaluation of the Virtual Rural Generalist Service versus usual care in Western New South Wales Local Health District [32]	Peer-reviewed article	Medical Journal of Australia (Supplement)	2024
14	VRGS	The Virtual Rural Generalist Service: a hybrid virtual model of care designed to improve health access and outcomes in rural and remote	Peer-reviewed article	Medical journal of Australia	2024

No.	Programme	Title	Type	Publisher / Source	Year / Coverage
		communities [33]			
15	VRGS	Virtual Rural Generalist Service Evaluation - Final Report [22]	Evaluation report (draft)	Western NSW Local Health District	FY2021/22 (draft)

Notes: Titles are taken from the cover page or first page of each document. 'Evaluation report (draft)' indicates an internal draft provided for context; published MJA Supplement papers were used for scoring when available.

Chapter 6 supplementary materials

Table A 13: BWS geo2 sensitivity analysis tables

Table A 13 a: Model fit summary (Constant vs Geo2)

Model	Log-likelihood	k (parameters)	AIC	BIC
Constant (no geography interactions)	-54,135.6	23	108,317.1	108,511.5
Geo2 (Non-major vs Major interactions)	-54,082.3	46	108,256.5	108,645.3

Note: Likelihood ratio test (Geo2 vs Constant): $\chi^2(23)=106.57, p<0.001$

Table A 13 b: Geo2 significant deviations (subset aligned to Geo2 figure)

Attr_ID	Domain	Attribute	Deviation (Non-major vs Major city)	Robust SE	95% CI	p
15	Service Quality and Clinical Outcomes	I can get a prescription or referral during the consultation	0.223	0.094	[0.038, 0.408]	0.018
4	Digital Infrastructure and Access	I can use the service even if I don't have a quiet or private room	-0.176	0.080	[-0.332, - 0.020]	0.027
20	Stakeholder Engagement and Governance	I can share my feedback or suggestions about the service	-0.195	0.085	[-0.361, - 0.030]	0.021
8	Economic Affordability	I don't need to pay extra for equipment or software	-0.177	0.085	[-0.344, - 0.011]	0.037
10	Cultural Adaptation and Social Inclusion	I feel my culture is respected by the doctor or provider	-0.376	0.084	[-0.541, - 0.211]	<0.001

Interpretation: positive deviation indicates higher relative importance in non-major areas compared with major cities; negative indicates lower.

Table A 13 c: Geo2 deviations (all attributes, for appendix completeness)

Attr_ID	Domain	Attribute	Deviation (Non-major vs Major city)	Robust SE	95% CI	p
2	Digital Infrastructure and Access	I can use the service on any basic device (e.g., phone, tablet)	0.093	0.079	[-0.062, 0.249]	0.238
3	Digital Infrastructure and Access	I don't need to download or install anything hard to use the service	-0.069	0.082	[-0.229, 0.092]	0.403
4	Digital Infrastructure and Access	I can use the service even if I don't have a quiet or private room	-0.176	0.080	[-0.332, -0.020]	0.027
5	User Digital Literacy and Capacity	The service is easy for me to use, even if I'm not good with technology	0.053	0.081	[-0.106, 0.213]	0.510
6	User Digital Literacy and Capacity	I can get help if I have trouble connecting or using the platform	-0.090	0.075	[-0.238, 0.057]	0.231
7	Economic Affordability	The consultation is	-0.106	0.092	[-0.286, 0.074]	0.250

Attr_ID	Domain	Attribute	Deviation (Non-major vs Major city)	Robust SE	95% CI	p
		completely free for me				
8	Economic Affordability	I don't need to pay extra for equipment or software	-0.177	0.085	[-0.344, - 0.011]	0.037
9	Cultural Adaptation and Social Inclusion	I can use the service in my preferred language	0.033	0.085	[-0.133, 0.199]	0.697
10	Cultural Adaptation and Social Inclusion	I feel my culture is respected by the doctor or provider	-0.376	0.084	[-0.541, - 0.211]	<0.001
11	Cultural Adaptation and Social Inclusion	My family member or carer can join the consultation if I want them to	-0.047	0.084	[-0.212, 0.118]	0.581
12	Service Quality and Clinical Outcomes	I can talk to my regular or usual doctor	0.040	0.093	[-0.142, 0.222]	0.667
13	Service Quality and Clinical Outcomes	I can get timely medical advice without long waiting times	0.193	0.087	[0.023, 0.362]	0.026

Attr_ID	Domain	Attribute	Deviation (Non-major vs Major city)	Robust SE	95% CI	p
14	Service Quality and Clinical Outcomes	I can get follow-up care, like another appointment, if I need it	0.039	0.082	[-0.121, 0.200]	0.630
15	Service Quality and Clinical Outcomes	I can get a prescription or referral during the consultation	0.223	0.094	[0.038, 0.408]	0.018
16	Service Quality and Clinical Outcomes	The quality of the doctor providing the service is high	0.048	0.092	[-0.132, 0.228]	0.601
17	Service Quality and Clinical Outcomes	I can choose a time for the appointment that works for me	0.035	0.088	[-0.138, 0.208]	0.690
18	Data Security and Privacy Protection	I know who can see or use my health information	0.081	0.081	[-0.078, 0.240]	0.318
19	Data Security and Privacy Protection	I feel sure that my personal information is safe and private	-0.048	0.086	[-0.216, 0.120]	0.576
20	Stakeholder Engagement and	I can share my feedback or suggestions	-0.195	0.085	[-0.361, -0.030]	0.021

Attr_ID	Domain	Attribute	Deviation (Non-major vs Major city)	Robust SE	95% CI	p
	Governance	about the service				
21	Sustainability & Policy Support	The organisation providing the service is trustworthy and reputable	0.120	0.086	[-0.048, 0.288]	0.162
22	Healthcare System Integration	If I need to, I can switch to in-person care (that is, seeing a health professional face to face at a doctor's surgery or hospital) easily	0.063	0.089	[-0.111, 0.237]	0.477
23	Healthcare System Integration	My health records are automatically shared with other care providers to avoid repetition	0.135	0.086	[-0.034, 0.303]	0.117
24	Healthcare System Integration	My doctor can ask other health workers, like a nurse or specialist, to join my	0.186	0.088	[0.014, 0.357]	0.034

Attr_ID	Domain	Attribute	Deviation (Non-major vs Major city)	Robust SE	95% CI	p
		consultation if needed				

Table A 14: Digital access barriers: unadjusted prevalence and response distributions

(analytic regression sample, N=2,667).

Table A 14 a: Unadjusted prevalence of digital access barriers by geography and age group

(analytic regression sample, N=2,667).

Stratum	Internet access problems (%)	Low digital confidence (%)
Geographic group		
Major city	54.6	24.0
Regional	55.9	34.6
Rural/Remote	70.1	35.8
Age group		
18-34	65.5	13.2
35-54	60.8	21.4
55-74	50.6	41.7
75+	42.6	55.8

Note: Percentages are calculated within each stratum. Outcomes were coded as 1=barrier present (internet access problems / low digital confidence).

Table A 14 b: Internet access problems in the past 3 months by age group (frequency distribution)

Age group	Never	Rarely	Sometimes	Often	Always	Any problem (Rarely to Always)
18 to 34	183 (34.5)	193 (36.3)	124 (23.4)	28 (5.3)	3 (0.6)	348 (65.5)
35 to 54	420 (39.2)	341 (31.8)	247 (23.0)	47 (4.4)	17 (1.6)	652 (60.8)
55 to 74	433 (49.4)	295 (33.7)	127 (14.5)	15 (1.7)	6 (0.7)	443 (50.6)
75 plus	109 (57.4)	57 (30.0)	17 (8.9)	5 (2.6)	2 (1.1)	81 (42.6)

Note: Values are shown as n (percent) within each age group. This item captures self-reported frequency of internet access problems in the past 3 months. The binary outcome used in regression was coded as any problem (Rarely, Sometimes, Often, Always) versus no problem (Never).

Table A 15: Digital access barriers: crude (unadjusted) and adjusted odds ratios (OR) for key predictors (N=2,667).

Predictor	Level	Internet problems: Crude OR (95% CI)	Internet problems: Adjusted OR (95% CI)	p (adj)	Low digital confidence: Crude OR (95% CI)	Low digital confidence: Adjusted OR (95% CI)	p (adj)
Geographic location (ref: Major city)	Regional	1.05 (0.89, 1.25)	1.05 (0.87, 1.25)	0.60	1.68 (1.39, 2.02)	1.17 (0.95, 1.43)	0.14
Geographic location (ref: Major city)	Rural/Remote	1.95 (1.52, 2.50)	1.88 (1.45, 2.44)	<0.001	1.76 (1.38, 2.25)	1.11 (0.85, 1.46)	0.40
Age group (ref: 18-34)	35-54	0.82 (0.66, 1.02)	0.82 (0.65, 1.01)	0.069	1.79 (1.34, 2.39)	1.76 (1.32, 2.39)	<0.001
Age group (ref: 18-34)	55-74	0.54 (0.43, 0.67)	0.46 (0.37, 0.59)	<0.001	4.69 (3.53, 6.24)	3.53 (2.64, 4.78)	<0.001
Age group (ref: 18-34)	75+	0.39 (0.28, 0.55)	0.32 (0.22, 0.45)	<0.001	8.29 (5.66, 12.14)	5.81 (3.90, 8.72)	<0.001

Note: Table A 15 reports crude and adjusted ORs for key predictors (age group and geographic location). Full multivariable results for all covariates are presented in Table 6.2. Adjusted ORs are from multivariable logistic regression models including geographic location, age group, gender, household income, education, and disability/long-term condition. Outcomes coded as 1=barrier present.

Table A 16: Raw unwillingness (%) by age group across scenarios

Scenario	18-34	35-54	55-74	75
Renewing a prescription	5.5	5.6	11.8	20.6
GP follow-up for a chronic condition	12.5	12.2	20.2	22.4
Mental health counselling	17.5	16.4	33.0	54.2
Advice for minor illness	7.4	8.8	16.1	22.9
Discussing test results	8.7	5.5	10.3	13.6
Feeling very unwell / worried symptoms	16.1	15.8	22.7	29.9
Seeing a doctor you are not familiar with	25.4	22.7	36.1	45.8
Needing an interpreter	34.1	39.0	51.7	65.9
Discussing sensitive mental health concerns	20.5	21.7	39.6	62.6
Unsure telehealth is appropriate	21.7	24.4	31.9	43.9

Unwillingness coded as 1 = Unlikely/Very unlikely; 0 = Neutral/Likely/Very likely. Values are row percentages within each age group for each scenario.

Table A 17: Unwillingness by age group: unadjusted vs fully adjusted odds ratios across scenarios

Scenario	Unadjusted: 35-54 vs 18-34	Adjusted: 35-54 vs 18-34	Unadjusted: 55-74 vs 18-34	Adjusted: 55-74 vs 18-34	Unadjusted: 75+ vs 18-34	Adjusted: 75+ vs 18-34
Renewing a prescription	1.02 (0.66, 1.59)	0.99 (0.63, 1.56)	2.32 (1.54, 3.50)	1.99 (1.28, 3.09)	4.47 (2.73, 7.30)	3.34 (1.95, 5.73)
GP follow-up for a chronic condition	0.97 (0.71, 1.31)	0.96 (0.70, 1.32)	1.77 (1.32, 2.37)	1.70 (1.24, 2.33)	2.02 (1.34, 3.03)	1.77 (1.12, 2.78)
Mental health counselling	0.92 (0.71, 1.21)	0.98 (0.74, 1.30)	2.33 (1.80, 3.00)	2.37 (1.80, 3.13)	5.58 (3.95, 7.89)	5.96 (4.06, 8.74)
Advice for minor illness	1.21 (0.83, 1.76)	1.15 (0.78, 1.70)	2.40 (1.68, 3.44)	2.01 (1.37, 2.95)	3.71 (2.37, 5.80)	2.57 (1.57, 4.20)
Discussing test results	0.62 (0.42, 0.91)	0.59 (0.39, 0.88)	1.21 (0.84, 1.73)	0.93 (0.63, 1.38)	1.65 (1.01, 2.70)	1.15 (0.66, 1.99)
Feeling very unwell / worried symptoms	0.98 (0.75, 1.29)	1.00 (0.75, 1.33)	1.54 (1.17, 2.01)	1.59 (1.19, 2.13)	2.23 (1.54, 3.22)	2.22 (1.48, 3.33)
Seeing a doctor you are not familiar with	0.86 (0.68, 1.09)	0.95 (0.74, 1.21)	1.65 (1.31, 2.08)	1.76 (1.36, 2.26)	2.48 (1.78, 3.44)	2.57 (1.78, 3.70)
Needing an interpreter	1.24 (1.00, 1.53)	1.30 (1.04, 1.62)	2.07 (1.67, 2.56)	2.19 (1.73, 2.76)	3.73 (2.68, 5.20)	3.62 (2.52, 5.21)
Discussing sensitive mental health concerns	1.07 (0.84, 1.38)	1.14 (0.88, 1.47)	2.55 (2.00, 3.24)	2.73 (2.10, 3.55)	6.50 (4.61, 9.17)	6.62 (4.53, 9.66)
Unsure telehealth is appropriate	1.16 (0.91, 1.48)	1.17 (0.92, 1.51)	1.68 (1.32, 2.15)	1.88 (1.45, 2.43)	2.82 (2.02, 3.95)	3.23 (2.22, 4.69)

Unadjusted models include age only. Fully adjusted models include geography (Geo3), age, gender

(male vs female), household income ($< \$60k$ vs $\geq \$60k$), education (no university degree vs university degree), and disability status (yes vs no). Reference categories: 18-34, Major city, female, $\geq \$60k$, university degree, no disability

Table A 18: Unwillingness by geography: unadjusted vs fully adjusted odds ratios across scenarios

Scenario	Unadjusted: Regional vs Major city	Adjusted: Regional vs Major city	Unadjusted: Rural/remote vs Major city	Adjusted: Rural/remote vs Major city
Renewing a prescription	1.50 (1.13, 1.98)	1.21 (0.90, 1.63)	1.08 (0.72, 1.61)	0.86 (0.55, 1.33)
GP follow-up for a chronic condition	1.41 (1.13, 1.76)	1.33 (1.05, 1.68)	1.08 (0.79, 1.48)	0.94 (0.67, 1.32)
Mental health counselling	1.18 (0.98, 1.43)	1.08 (0.88, 1.32)	0.89 (0.69, 1.16)	0.73 (0.54, 0.98)
Advice for minor illness	1.56 (1.22, 1.99)	1.28 (0.99, 1.67)	1.33 (0.95, 1.86)	1.07 (0.74, 1.55)
Discussing test results	1.50 (1.12, 2.00)	1.34 (0.98, 1.84)	1.29 (0.87, 1.92)	1.12 (0.73, 1.73)
Feeling very unwell / worried symptoms	1.35 (1.10, 1.65)	1.32 (1.06, 1.63)	0.82 (0.60, 1.11)	0.76 (0.55, 1.06)
Seeing a doctor you are not familiar with	1.00 (0.84, 1.20)	0.86 (0.70, 1.04)	0.82 (0.64, 1.06)	0.68 (0.52, 0.90)
Needing an interpreter	1.43 (1.22, 1.69)	1.34 (1.12, 1.60)	1.09 (0.87, 1.36)	0.98 (0.77, 1.25)
Discussing sensitive mental health concerns	1.23 (1.03, 1.47)	1.18 (0.97, 1.43)	0.97 (0.76, 1.24)	0.86 (0.65, 1.13)
Unsure telehealth is appropriate	1.25 (1.05, 1.50)	1.24 (1.02, 1.51)	0.90 (0.70, 1.17)	0.90 (0.68, 1.18)

Unadjusted models include Geo3 only. Fully adjusted models include Geo3, age, gender, income, education, and disability. Reference category for geography: Major city.

Table A 19: Geo3 interaction results by attribute (Regional vs Major city; Rural or remote vs Major city)

Comparison	Domain	Attribute	Estimate	Robust SE	95% CI	p
Regional vs Major city	Digital Infrastructure and Access	I can use the service even with slow or unstable internet	-0.152	0.101	-0.351 to 0.047	0.134
Regional vs Major city	Digital Infrastructure and Access	I can use the service on any basic device (e.g., phone, tablet)	-0.037	0.100	-0.232 to 0.159	0.712
Regional vs Major city	Digital Infrastructure and Access	I don't need to download or install anything hard to use the service	-0.228	0.106	-0.435 to -0.020	0.031
Regional vs Major city	Digital Infrastructure and Access	I can use the service even if I don't have a quiet or private room	-0.265	0.107	-0.475 to -0.055	0.013
Regional vs Major city	User Digital Literacy and Capacity	The service is easy for me to use, even if I'm not good with technology	-0.054	0.100	-0.250 to 0.141	0.586

Comparison	Domain	Attribute	Estimate	Robust SE	95% CI	p
Regional vs Major city	User Digital Literacy and Capacity	I can get help if I have trouble connecting or using the platform	-0.178	0.097	-0.369 to 0.013	0.068
Regional vs Major city	Service Quality and Clinical Outcomes	I can choose a time for the appointment that works for me	-0.219	0.103	-0.421 to -0.016	0.034
Regional vs Major city	Economic Affordability	I don't need to pay extra for equipment or software	-0.300	0.098	-0.492 to -0.107	0.002
Regional vs Major city	Cultural Adaptation and Social Inclusion	I can use the service in my preferred language	-0.093	0.107	-0.303 to 0.118	0.388
Regional vs Major city	Cultural Adaptation and Social Inclusion	I feel my culture is respected by the doctor or provider	-0.452	0.111	-0.669 to -0.235	0.000
Regional vs Major city	Cultural Adaptation and Social Inclusion	My family member or carer can join the consultation if I want them to	-0.163	0.105	-0.370 to 0.043	0.121

Comparison	Domain	Attribute	Estimate	Robust SE	95% CI	p
Regional vs Major city	Service Quality and Clinical Outcomes	I can talk to my regular or usual doctor	-0.025	0.098	-0.217 to 0.167	0.797
Regional vs Major city	Service Quality and Clinical Outcomes	I can get timely medical advice without long waiting times	0.140	0.090	-0.038 to 0.317	0.123
Regional vs Major city	Service Quality and Clinical Outcomes	I can get follow-up care, like another appointment, if I need it	-0.042	0.086	-0.211 to 0.127	0.625
Regional vs Major city	Service Quality and Clinical Outcomes	I can get a prescription or referral during the consultation	0.181	0.093	-0.001 to 0.364	0.052
Regional vs Major city	Economic Affordability	The consultation is completely free for me	0.001	0.089	-0.174 to 0.176	0.990

Comparison	Domain	Attribute	Estimate	Robust SE	95% CI	p
Regional vs Major city	Data Security and Privacy Protection	I know who can see or use my health information	-0.067	0.091	-0.245 to 0.111	0.462
Regional vs Major city	Data Security and Privacy Protection	I feel sure that my personal information is safe and private	-0.140	0.090	-0.316 to 0.036	0.119
Regional vs Major city	Stakeholder Engagement and Governance	I can share my feedback or suggestions about the service	-0.287	0.112	-0.506 to -0.068	0.010
Regional vs Major city	Sustainability & Policy Support	The organisation providing the service is trustworthy and reputable	0.030	0.084	-0.134 to 0.194	0.721
Regional vs Major city	Healthcare System Integration	If I need to, I can switch to in-person care (that is, seeing a health professional face to face at a doctor's surgery or hospital) easily	-0.022	0.088	-0.195 to 0.150	0.799

Comparison	Domain	Attribute	Estimate	Robust SE	95% CI	p
Regional vs Major city	Healthcare System Integration	My health records are automatically shared with other care providers to avoid repetition	-0.034	0.093	-0.216 to 0.148	0.717
Regional vs Major city	Healthcare System Integration	My doctor can ask other health workers, like a nurse or specialist, to join my consultation if needed	0.029	0.093	-0.153 to 0.211	0.756
Rural/Remote vs Major city	Digital Infrastructure and Access	I can use the service even with slow or unstable internet	0.148	0.131	-0.109 to 0.404	0.260
Rural/Remote vs Major city	Digital Infrastructure and Access	I can use the service on any basic device (e.g., phone, tablet)	0.171	0.133	-0.090 to 0.432	0.200
Rural/Remote vs Major city	Digital Infrastructure and Access	I don't need to download or install anything hard to use the service	0.147	0.133	-0.115 to 0.408	0.272

Comparison	Domain	Attribute	Estimate	Robust SE	95% CI	p
Rural/Remote vs Major city	Digital Infrastructure and Access	I can use the service even if I don't have a quiet or private room	-0.059	0.138	-0.329 to 0.211	0.669
Rural/Remote vs Major city	User Digital Literacy and Capacity	The service is easy for me to use, even if I'm not good with technology	0.135	0.135	-0.130 to 0.400	0.318
Rural/Remote vs Major city	User Digital Literacy and Capacity	I can get help if I have trouble connecting or using the platform	0.037	0.124	-0.207 to 0.281	0.766
Rural/Remote vs Major city	Service Quality and Clinical Outcomes	I can choose a time for the appointment that works for me	-0.006	0.135	-0.271 to 0.259	0.967
Rural/Remote vs Major city	Economic Affordability	I don't need to pay extra for equipment or software	0.002	0.127	-0.247 to 0.251	0.989
Rural/Remote vs Major city	Cultural Adaptation and Social Inclusion	I can use the service in my preferred language	0.216	0.142	-0.062 to 0.494	0.128

Comparison	Domain	Attribute	Estimate	Robust SE	95% CI	p
Rural/Remote vs Major city	Cultural Adaptation and Social Inclusion	I feel my culture is respected by the doctor or provider	-0.122	0.147	-0.411 to 0.166	0.406
Rural/Remote vs Major city	Cultural Adaptation and Social Inclusion	My family member or carer can join the consultation if I want them to	0.045	0.135	-0.219 to 0.310	0.736
Rural/Remote vs Major city	Service Quality and Clinical Outcomes	I can talk to my regular or usual doctor	0.034	0.121	-0.203 to 0.270	0.781
Rural/Remote vs Major city	Service Quality and Clinical Outcomes	I can get timely medical advice without long waiting times	0.131	0.111	-0.087 to 0.349	0.239
Rural/Remote vs Major city	Service Quality and Clinical Outcomes	I can get follow-up care, like another appointment, if I need it	0.081	0.114	-0.141 to 0.304	0.474

Comparison	Domain	Attribute	Estimate	Robust SE	95% CI	p
Rural/Remote vs Major city	Service Quality and Clinical Outcomes	I can get a prescription or referral during the consultation	0.111	0.120	-0.123 to 0.345	0.354
Rural/Remote vs Major city	Economic Affordability	The consultation is completely free for me	-0.044	0.119	-0.279 to 0.190	0.710
Rural/Remote vs Major city	Data Security and Privacy Protection	I know who can see or use my health information	0.196	0.126	-0.050 to 0.443	0.119
Rural/Remote vs Major city	Data Security and Privacy Protection	I feel sure that my personal information is safe and private	0.017	0.122	-0.223 to 0.256	0.890
Rural/Remote vs Major city	Stakeholder Engagement and Governance	I can share my feedback or suggestions about the service	-0.034	0.150	-0.327 to 0.260	0.823

Comparison	Domain	Attribute	Estimate	Robust SE	95% CI	p
Rural/Remote vs Major city	Sustainability & Policy Support	The organisation providing the service is trustworthy and reputable	0.142	0.108	-0.070 to 0.354	0.188
Rural/Remote vs Major city	Healthcare System Integration	If I need to, I can switch to in-person care (that is, seeing a health professional face to face at a doctor's surgery or hospital) easily	0.032	0.119	-0.200 to 0.264	0.787
Rural/Remote vs Major city	Healthcare System Integration	My health records are automatically shared with other care providers to avoid repetition	0.241	0.125	-0.003 to 0.486	0.053
Rural/Remote vs Major city	Healthcare System Integration	My doctor can ask other health workers, like a nurse or specialist, to join my consultation if needed	0.224	0.121	-0.014 to 0.461	0.065

Note: Estimates are Geo3 interaction terms (difference in attribute utility relative to Major city). Robust SE, 95% CI, and p values correspond to Wald tests for each interaction term in the Geo3 model.

Appendix B: Publications and statements of contribution

Chapter 2

Chapter 2 was published as follows:

Wang S, Von Huben A, Sivaprakash PP, Saurman E, Norris S, Wilson A. Addressing health service equity through telehealth: A systematic review of reviews. DIGITAL HEALTH. 2025;11. doi:10.1177/20552076251326233.

The co-authors made the following contributions to this manuscript (roles defined by CRediT (Contributor Roles Taxonomy), <https://credit.niso.org/>):

Wang S, Conceptualisation, Data curation, Formal Analysis, Investigation, Methodology, Project Administration, Validation, Visualisation, Writing - original draft, Writing - review and editing

Von Huben A, Supervision, Writing - review and editing

Sivaprakash PP, Investigation, Validation, Writing - review and editing

Saurman E, Writing - review and editing

Norris S, Conceptualisation, Supervision, Writing - review and editing

Wilson A, Conceptualisation, Investigation, Supervision, Writing - review and editing

Acknowledgments: We thank Ms. Bernie Carr, Academic Liaison Librarian, Fisher Library,

University of Sydney, for assisting with the search strategy.

Chapter 3

Chapter 3 was published as follows:

Wang S, Killedar A, Von Huben A, Norris S, Wilson A. Evaluation of health equity frameworks in telehealth and digital health: a systematic review and narrative synthesis.

Frontiers in Public Health. 2026;13:1690117. doi:10.3389/fpubh.2025.1690117.

The co-authors made the following contributions to this manuscript (roles defined by CRediT (Contributor Roles Taxonomy), <https://credit.niso.org/>):

Wang S, Conceptualisation, Data curation, Formal Analysis, Investigation, Methodology, Project Administration, Validation, Visualisation, Writing - original draft, Writing - review and editing

Killedar A, Formal Analysis, Validation, Supervision, Writing - review and editing

Von Huben A, Conceptualisation, Supervision, Writing - review and editing

Norris S, Conceptualisation, Investigation, Supervision, Writing - review and editing

Wilson A, Conceptualisation, Formal Analysis, Supervision, Writing - review and editing

Acknowledgments: We thank Ms. Bernie Carr, Academic Liaison Librarian, Fisher Library, University of Sydney, for assisting with the search strategy.

Chapter 4

Chapter 4 was published as follows:

Wang S, Killedar A, Norris S, Wilson A. Evaluating health equity in Australian telehealth policies: a policy review. *npj Digital Public Health*. 2026;1:4. doi:10.1038/s44482-025-00008-0.

The co-authors made the following contributions to this manuscript (roles defined by CRediT (Contributor Roles Taxonomy), <https://credit.niso.org/>):

Wang S, Conceptualisation, Data curation, Formal Analysis, Investigation, Methodology, Project Administration, Validation, Visualisation, Writing - original draft, Writing - review and editing

Killedar A, Conceptualisation, Supervision, Writing - review and editing

Norris S, Conceptualisation, Supervision, Writing - review and editing

Wilson A, Conceptualisation, Supervision, Writing - review and editing

Appendix C: Ethics Approval

HUMAN RESEARCH ETHICS APPROVAL

The University of Sydney confirms that this project meets the requirements of the National Statement on Ethical Conduct in Human Research.

Project identifier:	2024/HE001354
Project title:	Assessing the Impact of Telehealth Programs on Health Equity in Australia
Application version:	0.03
Chief Investigator:	Professor Donald Wilson
Project team:	Ms Amy Von Huben Ms Anagha Killedar Associate Professor Sarah Norris Ms Siyu Wang
Project start date:	31 Jan 2025
Project end date:	30 Jan 2029
Date of issue:	Friday, 31 January, 2025

Project summary

This research aims to evaluate how telehealth programs in Australia address health equity, focusing on the design, implementation, and outcomes of these programs. The study will involve a case series analysis of selected telehealth programs, supported by a desktop review of national and regional telehealth policies. Secondary data analysis will be conducted to quantify disparities in telehealth access and outcomes across diverse population groups. Participants will include key stakeholders, such as program managers, healthcare providers, and policy makers, who will be conducted questionnaires to gather qualitative insights. The expected outcomes of the research include identifying best practices for integrating health equity into telehealth, highlighting gaps in current practices, and providing evidence-based recommendations to enhance the equitable delivery of telehealth services in Australia.

Documents approved

Document type	File name	Document version	Application version
Recruitment or advertising material	Information sheet.docx	2	0.03
Recruitment or advertising material	Invitation email.docx	1	0.02
Participant Consent Form (PCF)	participant-consent-form (1).docx	2	0.03
Participant Information Statement (PIS)	participant-information-statement (2).docx	2	0.03
Application Attachment	project-description.docx	3	0.03
Survey or questionnaire	Questionnaire Questions.docx	1	0.01

Project description / Protocol	Research Protocol.docx	1	0.01
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Conditions of Approval

- Research must be conducted according to the approved proposal.
- An annual progress report must be submitted on or before the anniversary of approval and a final report on completion of the project.
- You must report as soon as practicable anything that might warrant review of ethical approval of the project including:
 - Serious or unexpected adverse events (which should be reported within 72 hours).
 - Unforeseen events that might affect continued ethical acceptability of the project.
- Any changes to the proposal must be approved prior to their implementation (except where an amendment is undertaken to eliminate *immediate* risk to participants).
- Researchers working on this project must be sufficiently qualified by education, training, and experience for their role, or adequately supervised. Changes to the project team must be reported and approved.
- Researchers must disclose any actual, potential of perceived conflicts of interest, including any financial or other interest or affiliation, as relevant to this project.
- Research data and primary materials must be retained and stored in accordance with relevant legislation and University guidelines.
- Ethics approval is dependent upon ongoing compliance of the research with the *National Statement on Ethical Conduct in Human Research*, the *Australian Code for the Responsible Conduct of Research*, applicable legal requirements, and with University policies, procedures, and governance requirements.
- If your research project is a clinical trial and is being sponsored by the University or is to be conducted on a University of Sydney site, you must comply with additional University governance requirements prior to commencing your Clinical Trial.
- The University may conduct audits on approved projects.
- The Chief Investigator has ultimate responsibility for the conduct of the research and is responsible for ensuring all others involved will conduct the research in accordance with the above.

Ethics Committee Representative

Chair
On behalf of the University of Sydney

The University of Sydney HRECs are constituted and operate in accordance with the National Statement on Ethical Conduct in Human Research and the Australian Code for the Responsible Conduct of Research (NHMRC). All personnel named on the project should be acquainted with these documents.

Research Integrity & Ethics Administration
Research Portfolio
Level 3, Michael Spence Building (F23)
The University of Sydney
NSW 2006 Australia

T +61 2 9036 9161
E human.ethics@sydney.edu.au
W intranet.sydney.edu.au/ethics

ABN 15 211 513 464
CRICOS 00026A

HUMAN RESEARCH ETHICS APPROVAL

The University of Sydney confirms that this project meets the requirements of the National Statement on Ethical Conduct in Human Research.

Project identifier:	2025/HE000929
Project title:	Understanding User Preferences for Virtual Care: A Best-Worst Scaling Survey to Inform Equitable Telehealth Design
Application version:	0.02
Chief Investigator:	Professor Andrew Wilson
Project team:	Ms Amy Von Huben Ms Anagha Killedar Associate Professor Sarah Norris Miss Siyu Wang
Project start date:	08 Oct 2025
Project end date:	07 Oct 2029
Date of issue:	Wednesday, 8 October, 2025

Project summary

This study will survey Australian adults to understand which features of telehealth services most influence their willingness to use them. Using a simple online choice activity, participants will select the most and least important features (e.g. cost, appointment time, language support). Results will guide the design of fairer, more user-friendly telehealth services across different population groups.

Note

- Please ensure there is a version number and date displayed on all participant-facing documents.

Conditions of Approval for Clinical Trials

This letter constitutes ethical approval only. This project cannot proceed at any site until the necessary research governance authorisation is obtained.

- If your study is sponsored by the University or is to be conducted on a University of Sydney site, you must comply with additional University governance requirements prior to commencing at each site. Please contact Research Portfolio Clinical Trials Support at clinical-trials.research@sydney.edu.au.

- Clinical Trials must be registered on a clinical trials registry that complies with the International Committee of Medical Journal Editors (ICMJE). For trials conducted in Australia or New Zealand registration should be on the Australian New Zealand Clinical Trial Registry before recruitment of the first subject (<http://www.anzctr.org.au/>).
- If your trial is to be conducted under the Clinical Trials Notification (CTN) or Clinical Trials Approval (CTA) schemes should not commence until it has been notified to the Therapeutic Goods Administration (TGA).

Conditions of Approval

- Research must be conducted according to the approved proposal.
- An annual progress report must be submitted on or before the anniversary of approval and a final report on completion of the project.
- You must report as soon as practicable anything that might warrant review of ethical approval of the project including:
 - Serious or unexpected adverse events (which should be reported within 72 hours).
 - Unforeseen events that might affect continued ethical acceptability of the project.
- Any changes to the proposal must be approved prior to their implementation (except where an amendment is undertaken to eliminate *immediate* risk to participants).
- Researchers working on this project must be sufficiently qualified by education, training, and experience for their role, or adequately supervised. Changes to the project team must be reported and approved.
- Researchers must disclose any actual, potential of perceived conflicts of interest, including any financial or other interest or affiliation, as relevant to this project.
- Research data and primary materials must be retained and stored in accordance with relevant legislation and University guidelines.
- Ethics approval is dependent upon ongoing compliance of the research with the *National Statement on Ethical Conduct in Human Research*, the *Australian Code for the Responsible Conduct of Research*, applicable legal requirements, and with University policies, procedures, and governance requirements.
- If your research project is a clinical trial and is being sponsored by the University or is to be conducted on a University of Sydney site, you must comply with additional University governance requirements prior to commencing your Clinical Trial.
- The University may conduct audits on approved projects.
- The Chief Investigator has ultimate responsibility for the conduct of the research and is responsible for ensuring all others involved will conduct the research in accordance with the above.

Ethics Committee Representative

Chair

On behalf of the University of Sydney

The University of Sydney HRECs are constituted and operate in accordance with the National Statement on Ethical Conduct in Human Research and the Australian Code for the Responsible Conduct of Research (NHMRC). All personnel named on the project should be acquainted with these documents.



THE UNIVERSITY OF
SYDNEY

Human Ethics Approval certificate

Research Integrity & Ethics Administration
Research Portfolio
Level 3, Michael Spence Building (F23)
The University of Sydney
NSW 2006 Australia

T +61 2 9036 9161
E human.ethics@sydney.edu.au
W intranet.sydney.edu.au/ethics

ABN 15 211 513 464
CRICOS 00026A