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GENERAL ANAESTHESIA FOR CHILD DENTAL PATIENTS AT WESTMEAD HOSPITAL

PAUL BUSH
BDS (Dhaka University, Bangladesh)

A Thesis Submitted in Partial Requirement
for the Degree of
MASTER OF DENTAL SCIENCE (PUBLIC HEALTH DENTISTRY)

Public Health Dentistry
Faculty of Dentistry
University of Sydney
1995
Summary

The Paediatric Dental Unit at Westmead Hospital has the facility for using the Dental Operating Suite on Wednesdays for any elective general anaesthetic procedures, and urgent emergency procedures.

The Head of the Paediatric Dental Unit, is extremely careful to use general anaesthesia and it is treated as a final solution for treating child dental problems. In most instances, a caring attitude in association with a period of familiarisation will, more often than not, allow the child to be treated conservatively.

The anaesthetic service supplied by the Westmead Anaesthetic Department is comprised of three main anaesthetists. All of these anaesthetists are paediatrically trained and have extensive experience and commitment to paediatric anaesthesia.

All anaesthetists are periodically involved in education tasks. These activities include education of patients, medical trainers and other professionals. A major shift of the focus of medical education toward preventive medicine in a community setting could have significant effects on the resources available for anaesthesia education.

The regulation attending the Dentist Act was updated in 1989. A dentist must not carry out any procedures forming part of the practice of dentistry on a patient to whom a general anaesthetic has been administered unless the general anaesthetic has been administered by a registered medical practitioner.
The American Society of Anaesthesiologists (ASA) has evaluated paediatric and adult closed claims with respect to mechanism of injury, outcome, the cost, and the role of the judged to be substandard.

From a total of 2400 claims, 238 (10%) were in the paediatric age group (15 years and younger). In particular respiratory events were more common among paediatric claims, 43% versus 30% in the adult claims. The mortality rate was greater in paediatric claims, 50% compared to 35% in adult claims. A higher prevalence of patients injury was caused by inadequate ventilation in paediatric claims, 20% verses 9% in adult claims.

The Australian Incident Monitoring Study (AIMS) analysed anaesthetic incidents in infants and children with those of adults. Of the 2000 cases 1790 (90%) involved adults, 151 (7%) children and 56 (3%) infants.

Mortality associated with general anaesthesia was discussed in NSW. The Special Committee Investigating Deaths Under Anaesthesia (SCIDUA) reviewed 1503 deaths in some 3.5 million surgical procedures. In 60% of the cases, patients death was considered to be inevitable and in 4% fortuitous.

Information for this thesis was gathered by the writer from some private and government dental practices which use general anaesthesia. The information was collected by means of a questionnaire with the anaesthetist and observation of the dental practices.
The writer visited the following three government practices, the Adamstown Dental Clinic at Newcastle, the Community Dental Health Unit at Westmead Hospital, and the Paediatric Dentistry Unit at Westmead Hospital, Westmead. Three private clinics were also visited at Bondi Junction, Double Bay and Waterloo. The reason for these visits was to get an overview of the use of general anaesthetic for child dental patients.

From the total of 6 dental practices, 2240 patients were treated with general anaesthesia over a period of 1 year. From the 3 government practices a total of 1940 patients were treated with general anaesthesia whereas, in the private practices 300 patients were treated with general anaesthesia.
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Acknowledgment

I would like to express my sincere gratitude and appreciation to A/Professor P D Barnard, Head of Public Health Dentistry in the University of Sydney. I feel deeply indebted for his help, encouragement, guidance, and valuable assistance throughout the course and preparation of my thesis. One thing that I will carry around for the rest of my life is my undying respect for Professor Barnard.

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My special thanks go to a great person with a great personality, Dr. Richard Widmer, Head of the Paediatric Dentistry Unit at Westmead Hospital. I would also like to thank Dr. Angus Cameron and all the staff of the Dental Clinical School for helping me gather information for my thesis.

I would like to thank Dr. R Holland, Dr. N Street, Dr. D Polyblank, Dr. M Walker, Dr. P King, Dr. B Turner, Dr. G Manning, and Dr. J Murray for allowing me into their clinics to observe their procedures regarding general anaesthesia and also in the collection of information for my thesis.

Finally, my warmest love and thanks goes to my family, especially my wife Mary for constant help and support, and also my sons Peter and John for their help and understanding, their sacrifices, and great moral support all the time.
Dedication

to

My Parents and Family

Also

My Wife Mary and my Sons Peter and John

For their support and help as a family
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1 Introduction

1.1 Aim

For children attending for dental care it may necessary, as a last resort, for a general anaesthetic to be administered to enable treatment to be carried out.

The aim of this thesis is to present a summary of information on general anaesthesia used for child dental patients a Westmead Hospital. Safety and mortality rates associated with general anaesthesia in NSW, relevant education and legislation, and information about procedures used are reviewed.

The writer has visited some government and private practices which use general anaesthesia for child dental patients. The aim of these visits was to determine an overview of general anaesthetic procedures used at Westmead Hospital and some other government and private practices. The government practices visited were Adamstown Dental Clinic at Newcastle, Paediatric Dentistry Unit and Community Dental Health Unit at Westmead Hospital. The private practices visited were Double Bay Dental Clinic, Bondi Junction Dental Clinic and Waterloo Dental Clinic. A total of 2240 patients were treated with general anaesthesia over a period of 1 year. From the government practices a total of 1940 patients were treated with general anaesthesia whereas in private practices 300 patients were treated with general anaesthesia. The Paediatric Dental Unit performs about 1200 operations per year with general anaesthesia on children whereas the other practices combined only treat 740 child patients per year (Appendix A1).

1.2 Dental Administration Services of Westmead Hospital Dental Clinical School

Dental administration of the Dental Clinical School is located at level 2, Block A at Westmead Hospital, at Westmead in Sydney.
1.2.1 Director of Dental Services

The Director of Dental Services is responsible to the General Manager for the management and administration of the dental services of the Dental Clinical School. The Director of Dental Services is also responsible to ensure that patients receive appropriate dental treatment and that high quality of care is provided to the patients.

1.2.2 Deputy Director of Dental Services

The Deputy Director of Dental Services assists the Director of Dental Services with general administration of the Dental Clinical School. The Deputy Director of Dental Services is responsible for the rostering of house dental officers, quality assurance, co-ordination of dental services and laboratory support facilities.
1.2.3 Clinical Departments of Dental Clinical School at Westmead Hospital.

The departmental structure of the Dental Clinical School consists of 4 departments and 14 units.

Table 1.
Department Structure of Dental Clinical School.
Source: Dental Clinical School, Westmead Hospital (1993).

<table>
<thead>
<tr>
<th>DEPARTMENTS</th>
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<td>Primary Oral Care</td>
</tr>
<tr>
<td></td>
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</tr>
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<td></td>
<td>Oral Radiology</td>
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<tr>
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</tr>
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<td>Oral and Maxillo-Facial Surgery</td>
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<td></td>
<td>Orthodontics</td>
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<td></td>
<td>Community Dental Health</td>
</tr>
<tr>
<td></td>
<td>Dental Assistant Utilisation</td>
</tr>
<tr>
<td>School of Dental Therapy</td>
<td>Parramatta School Clinic</td>
</tr>
<tr>
<td>Area Clinics</td>
<td>Merrylands Community Health Centre</td>
</tr>
<tr>
<td></td>
<td>Castle Hill School Clinic</td>
</tr>
</tbody>
</table>
1.2.4 Head of Paediatric Dentistry Unit

The Head of the Paediatric Dentistry Unit undertakes certain administrative duties on behalf of the Director of Dental Services and the director of the relevant department. The Head of the unit is responsible for recommendations for staffing and to ensure children receive appropriate dental treatment.

1.2.5 Head of Community Dental Health Unit

The Head of CDHU co-ordinates the activities of the unit which aims to improve the dental health status of adults with disabilities. The Head of the unit is responsible for administering the unit on behalf of the Director of Dental Services.

1.2.6 Dental Officers

Dental Officers appointed (full time) are graded as follows:

- Dental Officer
- Senior Dental Officer
- Dental Resident
- Dental Registrar
- Senior Registrar

Dental Officers are rostered to the Unit/Department of the Dental Clinical School by the Deputy Director of the Dental Clinical School. Senior Dental Officers, Residents and Registrars are appointed to the Unit/Department by the Director of Dental Services upon recommendation of the Director of the relevant department of the Dental Clinical School.
1.2.7 Dental Laboratory Staff

Technical dental services are provided by the technicians of the Dental Staff Laboratory under the laboratory manager.

1.2.8 Dental Nursing Services

The Senior Nurse Manager is responsible to the Director of Dental Services, at Westmead Hospital for nursing staff.
2 Dental Anaesthesia

Dentists abound in the history of anaesthesia, so do surgeons, obstetricians, and nurses. Each of this group has contributed to a great extent of the establishment of anaesthesia, and none have done more than dentists. The very first successful public demonstration of anaesthesia was by a dentist William T.G Morton of Boston who convinced a sceptical audience of previously disillusioned Massachusetts surgeons that it was possible to alleviate, even abolish, the pain of surgery by inhaling ether. Subsequently a number of dentists made contributions to anaesthesia, foremost amongst them Jay Heidbrink and Charles K. Teter, both of them prominent in the development of Nitrous Oxide apparatus (Grainger 1970).

Figure 1.
Teter Apparatus with Vapour Warmer.
Source: Grainger (1970).
Alfred Coleman, was a pioneer of Chloroform anaesthesia and T.W Evans the American
dentist practicing in Paris, was a notable contributor to the advancement of anaesthesia.
Junker was a German who practiced in England, who went to Japan at the invitation of the
Japanese government to establish medical training there along Western lines, and returned to
the UK in retirement. Junker produced a device by which it was possible to limit the quantity
reaching the patient, independent of patients own respiratory effort. In any case, he began
a series of developments (eg. vaporisers) which were to culminate in the sophisticated,
calibrated, accurate apparatus of today (Figure 1).

2.1 General Anaesthesia at Westmead Hospital Paediatric Dentistry Unit
The need for general anaesthesia (GA) represents the final solution to a child's dental
treatment. The decision to arrange general anaesthesia is not taken lightly. The dentist must
be certain about the need for the dental work that is required. The child must have a sensible
treatment plan arranged. It includes home care instructions, dietitians referral, use of home
fluoride and regular visits to the dentist. After seeing the child several times, if the dentist
feels that the child needs dental treatment but is unmanageable, GA should be considered.
2.1.1 Paediatric dentistry for children.

1. The use of Emla cream on the hand of all children, as a local anaesthesia agent. This is very helpful for placing the small butterfly cannula in the hand and lessening the anxiety the children get when they feel this being done. The Emla is very effective at deadening the skin as long as it has a good 45 minutes to work.

Figure 2.
Emla Cream Instructions for Application.

EMLA™ cream 5%
— instructions for application

1. Press out a sufficient quantity of cream (about 2 g or 1/2 tube) at the site of the procedure.

2. Take one of the enclosed occlusive dressings and remove the centre cut-out piece.

3. Peel the paper liner from the paper framed dressing.

4. Cover the EMLA cream so that you get a thick layer underneath. Do not spread out the cream. Smooth down the dressing edges carefully to avoid leakage.

5. Remove the paper frame. The time of application can easily be marked directly on the occlusive dressing. NB EMLA must be applied at least 1 hour before the start of the procedure and may be left on for several hours without loss of effect.

6. Remove the occlusive dressing, wipe off the EMLA cream, clean the entire area with alcohol and prepare the patient for the procedure. Duration of effective skin anaesthesia will be approximately 30 minutes after removal of the occlusive dressing.

Astra Pharmaceuticals Pty. Ltd.
10-14 Khartoum Rd, Nth, Ryde 2113
Australia
2. The Paediatric Dentistry Unit (PDU) allows the child's parent with the child in the pre-anaesthetic room of the operating suite. For most of the children under 6 years of age, the child sits on the parents lap facing the parent with their arm around the parent. Paediatric Dentists find this a very valuable technique to have the parent present during the induction of the anaesthesia.

3. The children don't always have to change out of their street clothes into the hospital garb, if it is proving to be an absolute upsetting situation. The PDU is flexible to accept the child's opinion to prevent the child getting upset.

4. The Pediatric Dentistry Unit stress that with all approaches to general anaesthesia, they are always flexible. If they can minimise the upset for the child before they go to sleep, they will minimise it when the child wakes up.

5. The Paediatric Dentistry Unit will use some pre-operative sedation in extreme cases. This is done after consultation with the paediatric anaesthetist, on appropriateness and for dosage reasons. The PDU tend to limit their anaesthesia from an hour to an hour and fifteen minutes and consequently their treatment planning is aimed at sensible retaining/restoration of teeth and extraction of teeth in other situations where it is appropriate.

6. General anaesthesia cases run from routine restorative, preventive, extraction to endodontics, to placement of orthodontic bands, and taking study models impressions. The latter operations are usually done for children with a disability where co-operation has not been absolutely ideal for some of the major events that are required to co-operate with.
7. In the recovery room, nurses get the parents to come in as soon as the child is fully conscious and they again have found that having one parent available in recovery is a great help with post-operative care.

8. Most patients having GA for bottle caries have in the past received appointments with the hospital dietitian for a follow up, subsequent to general anaesthetic.

2.1.2 Pre-operative Instruction

Fasting instructions must be given by the dentist. The anaesthetist must ensure that consent forms have been completed and the parents informed of the surgery, and that all of the patient's medical records are available in the operating room theatre.

Children 6 Years and Under

For a child under six years, there are to be no solid foods for six hours and no liquid for four hours prior to the operation.

Children 6 Years and Older

A child six years and older is to have no solids or liquids for six hours prior to their operation. It is very important for adherence to instructions, otherwise the anaesthetist may not go ahead with the anaesthetic because the patient is at a significant risk.
2.2 Categories of Anaesthetic Risk

Categories of anaesthetic risk defined by the American Society of Anaesthesiologists are shown in Table 2.

Table 2.
Categories of Anaesthetic Risk.

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
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<td>Class 1</td>
<td>Healthy patient</td>
</tr>
<tr>
<td>Class 2</td>
<td>Mild to moderate systemic disease without significant limitations</td>
</tr>
<tr>
<td>Class 3</td>
<td>Severe systemic disturbance with physical limitations</td>
</tr>
<tr>
<td>Class 4</td>
<td>Life threatening systemic disorder</td>
</tr>
<tr>
<td>Class 5</td>
<td>Moribund patient not expected to last more than 24 hours</td>
</tr>
<tr>
<td>Class E</td>
<td>Emergency patient</td>
</tr>
</tbody>
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Patients Class 3 or greater are not suitable for day stay general anaesthesia and require pre-operative admission.
3 Paediatric Dental Anaesthetic Service

Westmead Hospital opened in 1978, with 975 beds as a specialised tertiary referral hospital for the western metropolitan area of Sydney which has a population of about 2 million people and 15 local government areas. The hospital dental school opened in 1981. The Dental Clinical School is one of 2 clinical schools for the Faculty of Dentistry of the University of Sydney. General anaesthesia has been in practice since the opening of the Dental Clinical School in 1981.

3.1 Brief History

When Westmead Hospital first started, many of the restorative dental procedures under general anaesthesia were undertaken in the dental chair. This was an unsatisfactory method as the anaesthetic help and monitoring was inadequate, the recovery of un-consciousness patients was difficult. In the mid-1980's all the paediatric dental general anaesthetic were moved to the Dental School operating theatres. Initially there were two paediatrics lists per week, this soon increased to two lists on Monday and then a further list on Wednesday was started in 1987. In early 1990 all the paediatric lists were moved to Wednesday. This allowed greater flexibility for the dentists in that patients could be moved from one list to another, if one list finished early or the other was running late. It also allows urgent patients seen in the clinics on that day to be treated on the first finished list. This is the present format for the paediatric dental service which is run out of 2 operating theatres.
3.2 Present Operating Lists

All routine paediatric dental treatment under general anaesthesia is carried out in the Westmead dental theatres. At present there are 4 lists per week. These 4 lists occur on the Wednesday of each week. An average of sixteen patients are cared for on the routine operating lists. There is an annual figure of about 800 patients.

3.3 Present Service

The anaesthetic service supplied by the Westmead Anaesthetics Department comprises of three main anaesthetists, Drs. Jane MacDonald, Neil Street and Michelle O'Brien. All of these anaesthetists are paediatrically trained, and have extensive experience and commitment to paediatric anaesthesia. As such there is no restriction on the type of patient that may be admitted for dental treatment in the Westmead Dental Operation Theatres. Many patients with complex syndromes, treated and untreated congenital heart disease, severe asthmatics and central nervous system disease are treated in safety. The majority of patients are day stays and as such are admitted on the day of the surgery, fasting orders have been arranged by the admissions office when they are booked. Those patients who need more extensive pre-operative assessment may be either admitted the day prior to surgery, or if the dentist is unsure if this is necessary, he or she may ask the anaesthetist to see the patient at the time when they are in hospital. This is usually arranged at the end of, or during, an operating list if the patient is already present in the hospital. This pre-operative assessment process is very economical for the patient, the anaesthetist and the hospital, as it often reduces the need for admission the day prior to their surgery and also familiarises all concerned.
3.4 After Hours Service

Should paediatric patients need dental work urgently, such as trauma or facial swelling, an emergency roster of paediatric anaesthetists is available at all times in the main theatres. The same level of anaesthetic expertise is available as is present in the dental theatres.

3.5 Typical Anaesthetic

As the majority of patients are day stays, they are assessed when they arrive by the anaesthetist that will be in charge of their anaesthetic. The admitting nursing sister will take a brief history and record the patients vital signs, Emla cream (a topical local anaesthetic cream) is applied to the back of the hand. The consent is checked for errors and confirmation that the correct operation is to be performed. A relevant history and examination is undertaken by the anaesthetist. The majority of paediatric patients are fit for anaesthesia without any further preparation apart from premedication. Occasionally a patient may be unfit for their procedure on that day and are discharged to be readmitted in the near future or when they have recovered from their illness. Some other patients will need minor preparation such as further anti-asthma medication.
3.6 Premedication in Children

In general all the patients are premeditated with a mixture of Paracetamol and Midazolam about 15 to 30 minutes prior to surgery. Premedication has been an evolutionary process. Until about 4 years ago all patients received rectal paracetamol prior to anaesthesia, as it is better absorbed and acts as a vehicle for the sedative, Midazolam. Any other pre-operative preparations such as ventolin in asthmatics is also given at this time. A parent is encouraged to accompany their child into the anaesthetic but to minimise the anguish that may occur with separation, after induction of anaesthesia he or she is escorted back to the waiting area, where they wait for their child's return to the recovery area.

3.7 Induction of Anaesthesia

Two basic methods of induction are used in paediatrics, the dental school being no different. First it is intravenous induction with either thiopentone or propofol. This is usually accomplished through the previously prepared site (with Emla cream), with a small cannula or scalp vein needle, this method is very rapid, but may cause slight discomfort. Second is an inhalation induction with oxygen, nitrous oxide and halothane. As many of the children who are referred to the dental school are needle phobic, this second approach is often used. After the child is asleep and the parent has left, a nasotracheal tube is placed and secured. This route of intubation gives the safest airway and the best access for the dentist. An intravenous cannula is placed and monitoring established by the dental and nursing staff during this period. Nasal bleeding has not been a problem with nasal intubation, no paediatric patient has required nasal packaging postoperatively since the dental suite opened in 1981.
3.8 Maintenance of Anaesthesia

Anaesthesia is maintained with nitrous oxide oxygen and a volatile anaesthetic agent, either halothane or isoflurane. If premedication was not given or refused then rectal paracetamol is inserted. If several molar teeth are being extracted then an opiate such as fentanyl is often given to smooth the postoperative course. Intravenous fluids are used if the child has been fasting for a long time or if the procedure is expected to last longer than 2 hours. Intravenous antibiotics may also be given if indicated.

3.9 Recovery and Discharge

The patients are extubated in the operating theatre, then taken to the recovery area of the Dental Suite. There they are cared for by the recovery nurses until awake. At this time the parent is invited to sit with their child. When they are able to sit unaided they are transferred to the play room and encouraged to drink. After a minimum of two hours the patients are allowed to go home in the company of an adult. Should a patient vomit repeatedly or suffer pain needing repeated opiates, they are admitted to the general paediatric ward in the main hospital for overnight observation and intravenous fluids. If nausea or mild vomiting occurs, an anti-emetic and further intravenous fluids are given in an attempt to reduce the need for hospitalisation over night.
4 Education in Dental Anaesthesia

The basis of this review is a study performed for the period of 1983 to 1991. The articles identified concern medical education as conducted in North America, the United Kingdom and Australia, were reviewed in detail (Eagle 1992).

4.1 Purpose of Education in Anaesthesia

All anaesthetists are periodically involved in educational tasks. These activities range from education of patients, medical trainers and other professionals, to one's own medical continuing education. This review has three objectives:

First, to analyse the peer-reviewed anaesthetic literature pertaining to education in terms of major themes.

Second, to use the medical education literature to identify commonly held views about the further direction of anaesthetic education.

Third, and finally to identify areas requiring further research in the field of general anaesthesia.

4.2 Further Direction in Medical Anaesthesia

Undergraduate medical education in North America is under intense scrutiny and pressure for change. The major themes of this criticism have been reviewed and can be summarised: medical education must place greater emphasis on learning than on teaching; on students than on teachers; on the community than on its hospitals; on problem solving than on fact-recall and on disease prevention than on illness (Eagle 1992).
A major shift of the focus of medical education toward preventive medicine in a community setting could have significant effects on the resources available for anaesthesia education, especially in this era of financial limitations.

Both the Royal College of Physicians and Surgeons of Canada (RCPSC) and the American Board of Anaesthesiology (ABA) emphasise the need for continuing education.

A few of the components featured by the ABA are: evaluation of current performance; written examination; a initial certificate will not be time-limited; and upon successful completion of further certificate will be issued. For the RCPSC the following components were developed: self directed education; learning objectives based on peer evaluation; scholarly contribution; and a minimal requirement of 80 points over a 5 year cycle (Eagle 1992).

Table 3.
Recertification in the United States of America and Canada.

<table>
<thead>
<tr>
<th>Feature</th>
<th>American Board of Anesthesiology</th>
<th>Royal College of Physicians and Surgeons of Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of program</td>
<td>Continued Demonstration of Qualifications (CDQ)</td>
<td>Maintenance of Competence Program</td>
</tr>
<tr>
<td>Cooperating groups</td>
<td>American Society of Anesthesiology</td>
<td>Canadian Anaesthetists' Society</td>
</tr>
<tr>
<td>Components</td>
<td>1 Evaluation of current performance</td>
<td>1 Self-directed education</td>
</tr>
<tr>
<td></td>
<td>(a) documentation of peer review</td>
<td>(40 points maximum)</td>
</tr>
<tr>
<td></td>
<td>(b) freedom from chemical dependency</td>
<td>Journals, conferences, rounds, self-assessment program</td>
</tr>
<tr>
<td></td>
<td>(c) description of current practice</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(d) unrestricted license to practice</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(e) quality assurance review</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 Written examination</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 The initial certificate will not be time-limited.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 Upon successful completion of CDQ a further certificate will be issued</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 Learning objectives based on peer evaluation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(30 points maximum)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Case recall interviews, OSCE, quality assurance, orals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 Scholarly contribution</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(20 points maximum)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Education, research, publication</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 Minimal requirements: 80 points over a 5-year cycle</td>
<td></td>
</tr>
</tbody>
</table>
5 Evaluation of Safety Procedures in Anaesthesia

The operating theatre is an area in which the anaesthetist is involved in a dynamic interrelationship with the patients and medical equipment.

To ensure a high standard of care for patients, quality assurance programs are being introduced.

5.1 Legislation and Protocol in Australia

The regulations attending the NSW Dentists Act, 1989. General anaesthesia-Regulation 41 (1).

A dentist must not carry out any procedure forming part of the practice of dentistry on a patient to whom a general anaesthetic has been administered unless the general anaesthetic has been administered by a registered medical practitioner who:

a. Is a specialist in anaesthesia or

b. Is accredited for the purpose of administering any general anaesthetic at a public or private hospital where surgery may lawfully be carried out.

Maximum Penalty: 5 penalty units.

Protocol for checking an anaesthetic machine before use as outlined by Faculty of Anaesthetists (RACS) in the following pages ABC and D.

Protocol for checking anaesthetic equipment have been set up by The Australian New Zealand College of Anaesthetists. However, few studies have addressed the teaching of these guidelines to the anaesthetists in training or evaluate the effect of routine checking on the process of delivering safe anaesthesia. It was therefore decided to evaluate the performance of a group of anaesthetic trainees in checking the anaesthetic machines, demonstrating a knowledge of a multifunction monitor, a defibrillator, and the hospital fire drill (Dentists Act 1989-1994, no. 139).
PROTOCOL FOR CHECKING AN ANAESTHETIC MACHINE BEFORE USE

CHECK LIST

1. GASES
2. FLOWMETERS
3. VAPORISERS
4. PRE-CIRCUIT LEAKS
5. BREATHING SYSTEM SELECTION
6. CIRCLE ABSORPTION SYSTEM
7. SCAVENGING SYSTEM
8. OTHER APPARATUS

February, 1990
FACULTY OF ANAESTHETISTS 
RACS 

PROTOCOL FOR CHECKING AN ANAESTHETIC MACHINE BEFORE USE 

1. BULK GAS SUPPLY AND RESERVE CYLINDERS
   1.1 Check bulk gas warning lights or gauges.
   1.2 Check level of contents of all cylinders on the anaesthetic machine.
      1.2.1 First open and then close each cylinder valve in turn, observing the related cylinder pressure gauge.
      1.2.2 A falling pressure on the cylinder pressure gauge indicates a high pressure leak.
      1.2.3 Reopen each cylinder valve in turn and then, with the bulk gas supply disconnected, open the appropriate flowmeter to check that gas is able to pass from the cylinder through the flowmeter. Finally, close each cylinder valve after each cylinder is tested.
   1.3 Replace oxygen cylinders less than one-quarter full.
   1.4 Test oxygen failure warning device.
      1.4.1 With nitrous oxide flowing at 2 litres/minute turn off or disconnect machine oxygen supply.
      1.4.2 Press emergency oxygen button to release the oxygen pressure in the machine.
         The audible warning device if present should operate. Devices fitted which operate to interrupt the flow of nitrous oxide when the oxygen supply fails should do so within 10 seconds.
      1.4.3 Restore the oxygen supply to the machine and the warning devices should cease to operate.
   1.5 "One gas" test (this eliminates the possibility of crossed pressure hoses).
      1.5.1 Check that the high pressure gas hose for oxygen is connected to the correct wall outlet or large cylinder regulator, and to the oxygen inlet on the machine.
      1.5.2 Check that the oxygen analyser is correctly calibrated and that the low oxygen alarm is working.
      1.5.3 With the oxygen supply "ON", turn off or disconnect all other gas sources.
      1.5.4 After other gases have been bled from the machine, open all flowmeter controls and check that only oxygen flows as detected by the oxygen analyser.
   1.6 Connect the high pressure gas hoses for nitrous oxide to the correct wall outlet or large cylinder regulator, and to the nitrous oxide inlet on the machine.
      1.6.1 Restore nitrous oxide flow to the machine and check that nitrous oxide flows in the correct flowmeter.
1.7 If air is available, connect the high pressure gas hose for air to the correct wall outlet or large cylinder regulator, and to the air inlet on the machine. Turn on the air flowmeter and check that the oxygen analyser detects 21% oxygen. Repeat this test for the reserve air cylinder.

2. FLOWMETERS
   2.1 Ensure that the indicator device moves freely.
   2.2 Turn off each flowmeter control and check that the position of the indicator device is at zero when no gas flows.

3. VAPORISERS
   3.1 Check each vaporiser in turn.
      3.1.1 That it is seated correctly and locked in place when applicable.
      3.1.2 That it can be turned on.
      3.1.3 That it is turned off.
      3.1.4 That it contains sufficient amount of the correct liquid agent.
      3.1.5 That the filling and emptying ports are closed.
   3.2 If flammable agents are to be used, the appropriate safety conditions and procedures must be observed.

4. TEST FOR LEAKS UPSTREAM OF THE COMMON GAS OUTLET
   4.1 Turn on the oxygen rotameter to two litres/minute and occlude the common gas outlet for ten seconds. If the rotameter bobbin does not fall, take steps to detect the sites of leakage.
   4.2 Repeat this test with each vaporiser turned “off” and “on” in turn.
   4.3 If gas flows of less than one litre/minute are to be used more precise testing should be performed to determine the leakage flow rate.

5. BREATHING SYSTEM SELECTION
   5.1 Check that the gas supply is connected to the selected breathing systems.
   5.2 Check that the size of the tube used to make this connection is adequate to cope with anticipated gas flows.

6. CIRCLE ABSORPTION SYSTEM
   6.1 Soda lime — check that this is not exhausted. Renew if necessary, and remove dust from soda lime when refilling canister.
   6.2 Breathing hoses — check that these are correctly and firmly connected.
   6.3 Valve function and leaks in breathing system.
      6.3.1 Close spill valve and attach a spare breathing bag to the patient connection line of the “Y” piece.
6.3.2 Depress the emergency oxygen button to fill the breathing bag.

6.3.3 Alternately squeeze the two bags to ensure that oxygen passes from one bag to the other and check visually that each unidirectional valve functions correctly.

6.3.4 Squeeze both bags simultaneously to raise the pressure in the circuit to approximately 30 cm water. Maintain pressure for five seconds, to test for major leaks.

6.3.5 If gas flows of less than one litre/minute are to be used more precise testing should be performed to determine the leakage flow rate.

6.3.6 Open spill valve and check that gas spills easily when both bags are squeezed.

6.4 Disconnect spare breathing bag and replace with a mask suitable for the patient.

7. SCAVENGING SYSTEM

7.1 Check that the scavenging system is connected correctly to the selected breathing system.

7.2 Check that all components of the scavenging system are unencumbered and allow free gas flow.

7.3 If negative pressure is used to aid scavenging check that this does not empty the breathing system.

7.3.1 Fill the breathing system with oxygen by occluding the patient outlet and depressing the emergency oxygen button.

7.3.2 Check that the circuit does not empty when the spill valve is opened.

7.3.3 Close the spill valve again when this check has been done.

8. APPARATUS MOUNTED ON THE ANAESTHETIC MACHINE

8.1 Other apparatus to be used in the conduct of the anaesthetic should be checked according to the protocol appropriate to the device.

8.2 Special attention should be given to:

8.2.1 Equipment for intubation of the trachea.

8.2.2 Suction apparatus.

8.2.3 Gas analysis devices.

8.2.4 Monitoring apparatus.

8.2.5 Ventilators.

8.2.6 Disconnection alarm. This should be checked to ensure that the alarm functions when the breathing system is disconnected from the patient airway.
5.2 Methods of Checking

Thirty eight (38) anaesthetic trainees were assessed without their prior knowledge that this was to be done.

The assessors graded the subjects using a checking list of 13 points. The ability to check each of these points areas was assessed as pass, fail or omitted.

5.3 Assessment of Procedures

Of the 38 subjects tested, 17 (45%) of them were able to check the machine according to the college guidelines, 13 (34%) of subjects omitted up to 2 points the remaining 8 (21%) omitted or performed inadequately on 3 or more points.

Figure 3.
Percentage of subjects adequately carrying out the following checks of the anaesthetic machine taken from the College of Anaesthetic Guidelines.
Only 16% of subjects displayed a complete working knowledge of the multifunction monitor with some subjects having a very poor knowledge of how to use even its basic functions. This monitor is used for measurement of inspired and oxygen concentrations and the use of different alarm settings for carbon dioxide "rebreathing".

Figure 4.
Percentages of subjects adequately checking or demonstrating adequate knowledge of the following aspects of the cardiocap monitor.
All subjects could use the defibrillator but problem solving skills to analyse causes of malfunction were poor.

Figure 5.
Percentages of subjects able to set up and use the defibrillator and problem solve any of the four potential problems which may lead to malfunction.

Over all, 24% of subjects could both use the defibrillator and display problem solving skills.

Only one subject had an adequate working knowledge of the fire drill.
Figure 6 shows the range of scores out of a possible maximum of 30 achieved by the 38 subjects. Out of this 7 (18.4%) subjects scored over 25 and 8% of subjects satisfactorily completed the assessment.

Figure 6.
Range of scores out of a possible maximum of 30 for subjects examined on checking the anaesthetic machine, malfunction monitor, defibrillator and knowledge of the fire drill.

5.4 Results of Evaluation of Safety Procedures

It has been shown through careful investigation, application of research and the continuing accident/incident data bases that human factors contribute to over 80% of accidents.

"Failure to check" equipment was 14% of AIMS incidents.

"Rechecking of equipment" was a suggested minimising factor in 17% of incidents.

"Equipment checking discipline" was a suggested corrective strategy in 20% of incidents (Clayton et al 1993).
6 Comparison of Paediatric and Adult Anaesthesia

Since 1985, the Committee on Professional Liability of the American Society of Anaesthesiologists (ASA) has evaluated closed anaesthesia malpractice claims. This study compared paediatric and adult closed claims with respect to mechanisms of injury, outcome, the costs, and the role of care judged to be substandard (Morrer et al 1993).

From 2400 total claims, 238 (10%) were in the paediatric age group, (15 years of age and younger). In particular, respiratory events were more common among paediatric claims 43% versus 30% in adult claims.

The mortality rate was greater in the paediatric claims 50% versus 35% in adult claims.

Anaesthetic care was judged less than appropriate 54% versus 44% in adult claims.

The distribution of payments was different, median payment, US $111 234 for children versus $90 000 in adult claims.

A higher prevalence of patients injury caused by inadequate ventilation in the paediatric claims 20% in children versus 9% in adult claims.

Studies of anaesthetic morbidity and mortality have suggested a greater risk for children compared with adults (Morrer et al 1993).

6.1 Methods

The ASA closed claims project is a structured evaluation of closed anaesthesia malpractice claims obtained from 28 insurance carriers throughout the United States. Some practicing anaesthesiologists visited each insurance company office to review closed claims according to a detailed set of instructions.
The severity of injury was graded on a 0-9 points scale with scores of 0-4 for temporary injury, 5-8 for permanent injury, and 9 for death. This report was generated from a total database of 2400 claims, of these 238 were paediatric claims 10% defined as those involving patients 15 years of age and younger (Morray et al 1993).

6.2 Results

Twenty eight percent (28%) of all paediatric claims involved children younger than 1 year of age, and 55% involved children 3 yrs of age or younger.

Table 4.
Demographic Data

<table>
<thead>
<tr>
<th>Age</th>
<th>Pediatric (n = 238)</th>
<th>Adult (n = 1,253)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Claims</td>
<td>%</td>
</tr>
<tr>
<td>0-6 mo</td>
<td>50</td>
<td>21</td>
</tr>
<tr>
<td>7-12 mo</td>
<td>17</td>
<td>7</td>
</tr>
<tr>
<td>13-24 mo</td>
<td>40</td>
<td>17</td>
</tr>
<tr>
<td>25-35 mo</td>
<td>24</td>
<td>10</td>
</tr>
<tr>
<td>4 yr</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>5-6 yr</td>
<td>30</td>
<td>13</td>
</tr>
<tr>
<td>7-8 yr</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>9-10 yr</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>11-12 yr</td>
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<td>5</td>
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<tr>
<td>13-15 yr</td>
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<tr>
<td>Sex</td>
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</tr>
<tr>
<td>Male</td>
<td>155</td>
<td>65</td>
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<td>Female</td>
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<td>1</td>
<td>83</td>
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</tr>
<tr>
<td>3</td>
<td>15</td>
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</tr>
<tr>
<td>4</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>Unknown</td>
<td>96</td>
<td>40</td>
</tr>
<tr>
<td>Year of event</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before 1970</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1970-74</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>1975-79</td>
<td>69</td>
<td>29</td>
</tr>
<tr>
<td>1980-84</td>
<td>118</td>
<td>50</td>
</tr>
<tr>
<td>1985-89</td>
<td>42</td>
<td>18</td>
</tr>
<tr>
<td>1990</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Unknown</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

NA = not applicable.
Claims involving children 6 months of age or younger accounted for more claims than in any other age group. General anaesthesia was used more commonly in paediatric cases 89% verses 70% of adult cases. Injuries were more severe in paediatric claims compared with the adults claims.

Figure 7.
A comparison of patient injury in paediatric and adult closed malpractice claims.

Fifty percent (50%) of the paediatric patients died, and 30% had brain damage compared with 35% and 11% of the adults.
There was no difference between the two groups in the percentage of claims in which payment was made.

Table 5.
Payment data.

<table>
<thead>
<tr>
<th>Payment frequency</th>
<th>Pediatric (n = 238)</th>
<th>Adult (n = 1,953)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Claims</td>
<td>%</td>
</tr>
<tr>
<td>Payment</td>
<td>153</td>
<td>64</td>
</tr>
<tr>
<td>No payment</td>
<td>61</td>
<td>26</td>
</tr>
<tr>
<td>Data missing</td>
<td>24</td>
<td>10</td>
</tr>
<tr>
<td>Median payment</td>
<td>$111,234</td>
<td>≤0.05</td>
</tr>
<tr>
<td>Median payment by severity</td>
<td>Temporary</td>
<td>$9,000</td>
</tr>
<tr>
<td></td>
<td>Permanent</td>
<td>$554,000</td>
</tr>
<tr>
<td></td>
<td>Death</td>
<td>$88,000</td>
</tr>
</tbody>
</table>

The distribution of payments was different (Median payments $111,234 versus $90,000 for adult claims).
Damaging events relating to the respiratory system explained 43% of paediatric claims compared with 30% of adults claims.

Table 6.
Comparison of paediatric and adult damaging events.

<table>
<thead>
<tr>
<th>Damaging Event</th>
<th>Pediatric (n = 238)</th>
<th></th>
<th>Adult (n = 1953)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Claims</td>
<td>%</td>
<td>P</td>
<td>No. of Claims</td>
</tr>
<tr>
<td>Respiratory system</td>
<td>103</td>
<td>43</td>
<td>≤0.01</td>
<td>587</td>
</tr>
<tr>
<td>Inadequate ventilation</td>
<td>47</td>
<td>20</td>
<td>≤0.01</td>
<td>179</td>
</tr>
<tr>
<td>Esophageal intubation</td>
<td>13</td>
<td>5</td>
<td>NS</td>
<td>110</td>
</tr>
<tr>
<td>Airway obstruction</td>
<td>11</td>
<td>5</td>
<td>NS</td>
<td>40</td>
</tr>
<tr>
<td>Difficult intubation</td>
<td>9</td>
<td>4</td>
<td>NS</td>
<td>125</td>
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<tr>
<td>Inadvertent extubation</td>
<td>8</td>
<td>3</td>
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<td>16</td>
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<tr>
<td>Premature extubation</td>
<td>8</td>
<td>3</td>
<td>NS</td>
<td>24</td>
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<tr>
<td>Aspiration</td>
<td>5</td>
<td>2</td>
<td>NS</td>
<td>33</td>
</tr>
<tr>
<td>Endobronchial intubation</td>
<td>2</td>
<td>1</td>
<td>NS</td>
<td>13</td>
</tr>
<tr>
<td>Bronchospasm</td>
<td>0</td>
<td>0</td>
<td>NS</td>
<td>40</td>
</tr>
<tr>
<td>Inadequate FiO₂</td>
<td>0</td>
<td>0</td>
<td>NS</td>
<td>7</td>
</tr>
<tr>
<td>Cardiovascular system</td>
<td>30</td>
<td>13</td>
<td>≤0.01</td>
<td>102</td>
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<tr>
<td>Unexplained cardiovascular</td>
<td>14</td>
<td>6</td>
<td>≤0.01</td>
<td>27</td>
</tr>
<tr>
<td>Inappropriate fluid therapy</td>
<td>9</td>
<td>4</td>
<td>NS</td>
<td>26</td>
</tr>
<tr>
<td>Excessive blood loss</td>
<td>2</td>
<td>1</td>
<td>NS</td>
<td>18</td>
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<tr>
<td>Air embolism</td>
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<td>1</td>
<td>NS</td>
<td>11</td>
</tr>
<tr>
<td>Electrolyte imbalance</td>
<td>2</td>
<td>1</td>
<td>NS</td>
<td>5</td>
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<tr>
<td>Inadvertent intravascular</td>
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<td>&lt;0.5</td>
<td>NS</td>
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</tr>
<tr>
<td>injection</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Wrong blood</td>
<td>0</td>
<td>0</td>
<td>NS</td>
<td>13</td>
</tr>
<tr>
<td>Other cardiovascular event</td>
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<td>0</td>
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<td>1</td>
</tr>
<tr>
<td>Equipment problem</td>
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<td>13</td>
<td>NS</td>
<td>189</td>
</tr>
<tr>
<td>Wrong drug/dose</td>
<td>7</td>
<td>3</td>
<td>NS</td>
<td>68</td>
</tr>
<tr>
<td>Convulsion</td>
<td>5</td>
<td>2</td>
<td>NS</td>
<td>35</td>
</tr>
</tbody>
</table>

Inadequate ventilation was responsible for 20% of all paediatric claims compared with 9% of all adult claims.
When general anaesthesia was used halothane was employed more frequently in paediatric inadequate ventilation cases; enflurane, isoflurane, and narcotics were used less frequently.

The paediatric inadequate ventilation claims included less frequent administration of succinylcholine and non depolarising muscle relaxants and less frequent use of controlled ventilation.

Table 7.
Paediatric versus adult inadequate claims.

<table>
<thead>
<tr>
<th>Type of anesthetic</th>
<th>Pediatric</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Claims</td>
<td>%</td>
</tr>
<tr>
<td>Type of anesthetic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>48</td>
<td>98</td>
</tr>
<tr>
<td>Regional</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Airway management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intubated</td>
<td>26</td>
<td>55</td>
</tr>
<tr>
<td>Mask</td>
<td>14</td>
<td>30</td>
</tr>
<tr>
<td>No mechanical aids</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Primary anesthetic agent (general anesthesia only)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Halothane</td>
<td>34</td>
<td>74</td>
</tr>
<tr>
<td>Enflurane</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Opioid</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Isoflurane</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Muscle relaxant (general anesthesia only)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Succinylcholine</td>
<td>13</td>
<td>28</td>
</tr>
<tr>
<td>Nondepolarizing</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Mode of ventilation (general anesthesia only)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>22</td>
<td>48</td>
</tr>
<tr>
<td>Spontaneous</td>
<td>14</td>
<td>30</td>
</tr>
<tr>
<td>Assisted</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>Controlled</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>Bradycardia</td>
<td>30</td>
<td>64</td>
</tr>
<tr>
<td>Cyanosis</td>
<td>23</td>
<td>49</td>
</tr>
<tr>
<td>Outcome</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td>33</td>
<td>70</td>
</tr>
<tr>
<td>Brain damage</td>
<td>14</td>
<td>30</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Missing data not shown.

The paediatric inadequate ventilation claims included less frequent administration of succinylcholine and non depolarising muscle relaxants and less frequent use of controlled ventilation.
In the opinion of the Committee of Professional liability of the ASA, 89% of paediatric and 92% of adult claims of inadequate ventilation could have been prevented with better monitoring. The pulse oximeter and capnograph alone, or in combination with other monitors, were cited as preventive in most paediatric (89%) and adult (91%) inadequate ventilation claims (Morray et al 1993).
7 Paediatric Incidents in Australia

The first 2000 incidents reported to the Australian Incident Monitoring Study (AIMS) were analysed to compare anaesthetic incidents in infants and children with those in adults. Of the 2000, 1790 (90%) involved adults, 151 (7%) children and 56 (3%) infants.

"Infants are not little children and children are not little adults" (Van Der Walt et al 1993).

A survey by Tiet et al (1988) found that there was an incidence of 0.7 major complications per 1000 anaesthetics in infants and children. They found that the risk of major complications was significantly higher in the younger age group and increased with the ASA score, co-existing disease, previous history of anaesthesia, emergency procedures and when the duration of fasting was less than eight hours.

Olsson (1990) has reviewed complication of paediatric anaesthesia and focussed attention on age, aspiration and respiratory problems as risk factors.

Murray et al (1993) have more recently analysed closed malpractice claims in children younger than 15 years and found a prevalence of respiratory related damaging events most frequently related to inadequate ventilation. They stated that 89% of paediatric claims related to inadequate ventilation could have been prevented with pulse oximetry and capnography (Van Der Walt et al 1993).

7.1 Australian Incident Monitoring Study.

7.1.1 Method.

The AIMS report form has a section asking the reporter to indicate the age of the patient involved by ticking one of three age categories

1. Less than 1 year (Infant).
2. 1 to 14 years (Child).
3. Greater than 14 years (Adult).
A comparison was made of the relative incidence, nature and contributing factors of incidents in these three age groups.

Difference between groups were tested by Chi Square analysis. Because multiple tests were applied, a value of $P=0.01$ was chosen as the significant threshold.

7.1.2 Results

Of the first 2 000 incidents reported to AIMS 1 790 (90%) involved adults, 56 (3%) infants and 15 (7%) children. The patients ASA grades are shown in Figure 8. There were significantly more ASA I patients in the child group.

Figure 8.
Frequency of infants, children and adults falling in the American Society of Anaesthesiologists group I-V.
There were significantly greater fractions of incidents arising from extubation, emergence from anaesthesia, laryngospasm, circuit misconnections, and circuit disconnection at the common gas outlet in the child/infants group than in the adults. When the "Clinical Situation" were analysed with the respect to their 7 main categories. The categories examined were, emergence, extubation, laryngospasm, misconnection, disconnection, skilled assistance, and protocol development.

Table 8.
Incidents arising by categories defined in the "Which monitor" study.

<table>
<thead>
<tr>
<th>Category</th>
<th>Infant n = 56</th>
<th>Child n = 151</th>
<th>Adult n = 1790</th>
<th>Significancea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergence</td>
<td>6 (11%)</td>
<td>29 (19%)</td>
<td>131 (7%)</td>
<td>P &lt; 0.0001</td>
</tr>
<tr>
<td>Extubation</td>
<td>5 (9%)</td>
<td>7 (5%)</td>
<td>23 (1%)</td>
<td>P &lt; 0.0001</td>
</tr>
<tr>
<td>Laryngospasm</td>
<td>14 (25%)</td>
<td>34 (23%)</td>
<td>169 (9%)</td>
<td>P &lt; 0.0001</td>
</tr>
<tr>
<td>Misconnection</td>
<td>3 (5%)</td>
<td>9 (6%)</td>
<td>34 (2%)</td>
<td>P &lt; 0.002</td>
</tr>
<tr>
<td>Disconnection (CGO)b</td>
<td>1 (2%)</td>
<td>9 (6%)</td>
<td>32 (2%)</td>
<td>P &lt; 0.01</td>
</tr>
<tr>
<td>Skilled assistance</td>
<td>13 (23%)</td>
<td>30 (20%)</td>
<td>187 (10%)</td>
<td>P &lt; 0.0001</td>
</tr>
<tr>
<td>Protocol development</td>
<td>13 (23%)</td>
<td>11 (7%)</td>
<td>170 (10%)</td>
<td>P &lt; 0.002</td>
</tr>
</tbody>
</table>

a Significance values calculated with combined infant/child groups compared with the adult group.

b CGO = common gas outlet
It is shown that incidents arising from the breathing circuit and respiratory system were significantly more common in the child/infants group than in the adult group. The clinical situation studied were machine-gas supply, breathing circuit, endotracheal tube, respiratory system, cardiovascular system, syndromes, and miscellaneous.

Table 9.
Incidents arising by clinical situations defined in the "Which monitor" study.

<table>
<thead>
<tr>
<th>Clinical situation in which problem arose</th>
<th>No. overall</th>
<th>No. in infants</th>
<th>No. in children</th>
<th>No. in adult</th>
<th>Statistical signif. (^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine/gas supply</td>
<td>160</td>
<td>3</td>
<td>23</td>
<td>133</td>
<td>0.089</td>
</tr>
<tr>
<td>Breathing circuit</td>
<td>347</td>
<td>5</td>
<td>21</td>
<td>320</td>
<td>0.003</td>
</tr>
<tr>
<td>Endotracheal tube</td>
<td>157</td>
<td>4</td>
<td>12</td>
<td>141</td>
<td>0.489</td>
</tr>
<tr>
<td>Respiratory system</td>
<td>292</td>
<td>16</td>
<td>41</td>
<td>235</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cardiovascular system</td>
<td>227</td>
<td>7</td>
<td>10</td>
<td>210</td>
<td>0.033</td>
</tr>
<tr>
<td>Syndromes</td>
<td>44</td>
<td>1</td>
<td>4</td>
<td>39</td>
<td>0.9</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>29</td>
<td>1</td>
<td>1</td>
<td>27</td>
<td>0.4</td>
</tr>
</tbody>
</table>

\(^a\) Significance values calculated with combined infant/child groups compared with the adult group.
The pattern of incident detection in infants, children and adult is shown in table 10.

Table 10.
A comparison of modes of incident detection of infants, children and adult.
Source: Van Der Walt et al (1993)

<table>
<thead>
<tr>
<th>Detection</th>
<th>Infant (%)</th>
<th>Child (%)</th>
<th>Adult (%)</th>
<th>Total</th>
<th>Signif.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>19 (34%)</td>
<td>39 (26%)</td>
<td>685 (38%)</td>
<td>743</td>
<td>$P &lt; 0.0001^*$</td>
</tr>
<tr>
<td>Human</td>
<td>16 (29%)</td>
<td>70 (46%)</td>
<td>516 (29%)</td>
<td>602</td>
<td>$P &lt; 0.0001^*$</td>
</tr>
<tr>
<td>Monitor</td>
<td>21 (37%)</td>
<td>42 (28%)</td>
<td>589 (33%)</td>
<td>652</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>56</td>
<td>151</td>
<td>1790</td>
<td>1997</td>
<td></td>
</tr>
</tbody>
</table>

* For methodology see Webb et al.¹
² NA = non-applicable incidents according to definition of Webb et al.¹
³ Significance values calculated with combined infant/child groups compared with the adult group.

Incidents in the infant/child group were more frequently clinically detected and less frequently monitor detected than in the adult group. Otherwise, there were no significant differences in monitor use or performance between the groups.
7.1.3 Discussion of the AIMS.

Of the 2,000 incidents, reported to AIMS 207 (10%) involved children (less than 14 years old) the "closed claims" analysis by Morray et al also found that 10% of claims were in the paediatric age group (less than 15 years).

The AIMS study found that a significantly greater fraction of incidents arose during head and neck procedures in the combined infant/child group than in adults.

Incidents arose from the breathing circuit and respiratory system significantly more frequently in the infant/child group. The fractions of problems arising from emergence of anaesthesia, extubation and laryngospasm, were significantly greater in the infant/child group than in the adult group. Also, the AIMS analysis show that misconnections, common gas outlet disconnection and humidifier problems were reported significantly more commonly in the infant/child group than in adults.

The paediatric anaesthetic breathing system most commonly used in Australia is "Ayres T-piece". Although simple in design, it is a subject to many modification, such as the addition of humidifiers and scavengers, thus increasing the potential for mis- and disconnection; common gas outlet disconnection are particularly frequent, and may be difficult to detect and locate.

Overall, problems with the breathing system, endotracheal tube and respiratory system accounted for just under half of all the incidents in the AIMS infant/child groups. Morray et al (1993) reported in their closed claims analysis that 43% of adverse events arose from problems related to breathing and the respiratory system. The high incidence of AIMS reports involving extubation problems (9%) in infants and (5%) in children compared with (1%) in adults and the respiratory system is consistent with findings in other studies (Van Der Walt et al 1993).
Comparison of the modes in incident detection showed that incidents in the infant/child group were more often clinically detected than in the adult group.

There was no difference between the age groups in the way individual monitors were used. The overall, recommendations with respect to monitoring are therefore as relevant to paediatric as to adult anaesthetic practice. Combined oximetry and capnography would have detected nearly 90% of all applicable problems in the AIMS study and could have prevented nearly 90% of the claims arising from inadequate ventilation.

7.2 Mortality Associated with General Anaesthesia in New South Wales 1984-1990

The Special Committee Investigating Deaths Under Anaesthesia (SCIDUA) in NSW reviewed 1,503 deaths in some 3.5 million surgical procedures (Warden et al 1994). In 60% the patient death was considered to be inevitable and in 4% fortuitous. Factors under the control of the anaesthetist caused or contributed to the fatal outcome in 172 cases (11%). Factors under the control of surgeon caused or contributed to the fatal outcome in 421 cases (28%). In 191 of the 421 deaths related to surgical factors and 11 of 172 deaths related to anaesthetic factors, no better alternative procedure was considered possible. In only one death in a child under 10 years of age and in two obstetric fatalities was the anaesthetic management considered to have contributed to the outcome. About 75% of deaths were related to abdominal cardiothoracic or vascular surgery, and 70% were related to emergency procedures. Male to female death ratio was 1.7:1.

Mortality rate was 4.4 per 10,000 operations, with a male female ratio of more than 2:1. Trauma in the 20-29 age group and vascular and cardiothoracic surgery in the 50-79 age group were mainly responsible for the sex difference in the number of deaths, but the difference was also seen in other surgical groups.
From 1984 to 1990, deaths under the control of the anaesthetist caused or contributed to the fatal outcome at a rate of 1 in 20,000 operations. This figure compares favourably with a rate of 1 in 5,500 operations in New South Wales in 1960 and 1 in 10,250 operations in 1979. Deaths with relation to anaesthesia in New South Wales are reviewed by an expert committee appointed by New South Wales Minister of Health. This process of review has continued since 1960 (Warden et al. 1994).

The Special Committee Investigating Deaths Under Anaesthesia (SCIDUA) receives notification from the state coroners, offices of deaths "Under, as a result of, or within 24 hours of anaesthetic". After notification of any such death, the committee requests the anaesthetists concerned to complete a questionnaire on the management of the case. All information provided is confidential. It is the committee, rather than the reporting anaesthetist, who decides whether factors relating to the anaesthetic contributed in any way to the fatal outcome. Most deaths occurred in the operating suite, recovery area or intensive care unit, some in the ward and a few more remotely from the surgical event (Warden et al. 1994).
The primary function of SCIDUA is to address anaesthesia-related factors in pre-operative mortality, but clearly this is impossible without some consideration of surgical factors, and this is acknowledged in the composition of the committee.

Table 11.
Composition of the NSW Special Committee Investigating Deaths Under Anaesthesia.

1: Composition of the New South Wales Special Committee Investigating Deaths Under Anaesthesia (SCIDUA)

Committee appointments are made by the Minister of Health following a nomination by each of the following bodies:

- NSW Department of Health
- Departments of Anaesthetics and Surgery, University of Sydney
- School of Surgery and Discipline of Anaesthesia and Intensive Care, University of New South Wales
- Faculty of Anaesthetists, Royal Australasian College of Surgeons (now the Australian and New Zealand College of Anaesthetists)
- Australian Society of Anaesthetists
- Royal Australasian College of Surgeons
- Royal Australian College of Obstetricians and Gynaecologists
- Royal Australian College of General Practitioners
- Department of Anaesthesia, University of Newcastle
7.2.1 Data Collection and Analysis

By legislative requirement, the death of any person in New South Wales occurring under, as a result of, or within 24 hours of an anaesthetic must be reported to a coroner. In turn, coroner's office notify the SCIDUA secretariat of the name, date and place of death. In many instances, they also forward a copy of the Notification of Death Relating to Anaesthesia.

The coroner's office also supplies a copy of the autopsy report.

Completed questionnaires, with identifying details of the patients name, name of the hospital and name of the anaesthetist removed, are considered at monthly meetings of the committee. Recovery from anaesthesia is defined as full recovery of consciousness, muscle power and protective reflexes, and return of the circulatory state to the pre-operative level. The cause of death is classified under one of the eight categories (Warden et al 1994).

Table 12.
Classification of deaths within 24 hours of anaesthesia.

2: Classification of deaths within 24 hours of anaesthesia

*All deaths reviewed for this report were numbered in one of these categories:

I  Reasonably certain that death was caused by the anaesthetic agent or technique of administration, or in other ways coming directly within the anaesthetist's province.

II Some doubt whether the agent or technique was entirely responsible for the fatal result.

III Patient's death caused by both the anaesthetic and surgical technique.

IV Death entirely referable to surgical technique.

V Inevitable death, such as death due to severe general peritonitis, in which anaesthetic and surgical techniques were apparently satisfactory.

VI Fortuitous death, such as death due to pulmonary embolism.

VII Death which cannot be assessed despite considerable data.

VIII Death on which an opinion could not be formed because of inadequacy of data.

*From Edwards et al.*
7.2.3 Findings

The data refer to the 1503 deaths classified by the committee, by type of surgery.

Table 13.
Deaths by type of surgery and urgency.

<table>
<thead>
<tr>
<th>Type of surgery</th>
<th>Scheduled</th>
<th>Urgent non-emergency</th>
<th>Emergency</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal</td>
<td>26</td>
<td>4</td>
<td>404</td>
<td>434 (28.9)</td>
</tr>
<tr>
<td>Cardiothoracic</td>
<td>195</td>
<td>58</td>
<td>158</td>
<td>411 (27.3)</td>
</tr>
<tr>
<td>Vascular</td>
<td>17</td>
<td>4</td>
<td>313</td>
<td>334 (22.2)</td>
</tr>
<tr>
<td>Neurological</td>
<td>6</td>
<td>5</td>
<td>73</td>
<td>84 (5.6)</td>
</tr>
<tr>
<td>Orthopaedic</td>
<td>18</td>
<td>50</td>
<td>7</td>
<td>75 (5.0)</td>
</tr>
<tr>
<td>Diagnostic/endoscopy</td>
<td>10</td>
<td>6</td>
<td>24</td>
<td>40 (2.7)</td>
</tr>
<tr>
<td>General (non-abdominal)</td>
<td>4</td>
<td>5</td>
<td>21</td>
<td>30 (2.0)</td>
</tr>
<tr>
<td>Urological</td>
<td>16</td>
<td>4</td>
<td>5</td>
<td>25 (1.7)</td>
</tr>
<tr>
<td>Gynaecological</td>
<td>6</td>
<td>1</td>
<td>5</td>
<td>12 (0.8)</td>
</tr>
<tr>
<td>Ear, nose and throat</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>12 (0.8)</td>
</tr>
<tr>
<td>Plastic/burns</td>
<td>4</td>
<td>—</td>
<td>1</td>
<td>5 (0.3)</td>
</tr>
<tr>
<td>Eye</td>
<td>8</td>
<td>—</td>
<td>1</td>
<td>9 (0.6)</td>
</tr>
<tr>
<td>Obstetric</td>
<td>—</td>
<td>—</td>
<td>4</td>
<td>4 (0.3)</td>
</tr>
<tr>
<td>Renal</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>3 (0.2)</td>
</tr>
<tr>
<td>Dental</td>
<td>2</td>
<td>—</td>
<td>—</td>
<td>2 (0.1)</td>
</tr>
<tr>
<td>Other</td>
<td>—</td>
<td>2</td>
<td>21</td>
<td>23 (1.5)</td>
</tr>
<tr>
<td>Total</td>
<td>316</td>
<td>144</td>
<td>1043</td>
<td>1503</td>
</tr>
</tbody>
</table>
7.2.4 Age and Sex

Deaths in males predominated over all 63% and in all age groups except the over 79 age group. Deaths were most frequent in the ages of 60-69 for males and 70-79 for females.

Figure 9.
Anaesthesia related deaths, NSW 1984-1990.
Deaths related to vascular and cardiothoracic surgery, particularly in patients aged over 60, contributed most to the sex difference, although in the 20-29 age group the difference was entirely due to trauma.

Figure 10.
Anaesthesia related deaths in trauma cases, NSW 1984-1990.

Deaths in males also predominated in the 206 trauma-related procedures, except in the under 10 and over 79 age groups.
7.2.5 Contributory Factors

One hundred and seventy-two (11%) were classified as categories I, II, and III, that is, cases in which factors under the control of the anaesthetist were considered to have caused or contributed to the cause of death.

Figure 11.
Number of anaesthesia related deaths, NSW 1984-1990, by type of surgery.
Anaesthetic factors contributed to death in over 6% of the emergency cases, 19% of the schedule cases and 31% of the urgent non emergency cases.

Table 14.
Urgency of procedure and contributing cause of death.

<table>
<thead>
<tr>
<th>Category*</th>
<th>Scheduled</th>
<th>Urgent non-emergency</th>
<th>Emergency</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Anaesthetic</td>
<td>21</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>II</td>
<td>Anaesthetic predominantly</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>III</td>
<td>Anaesthetic and surgical</td>
<td>27</td>
<td>19</td>
<td>36</td>
</tr>
<tr>
<td>IV</td>
<td>Surgical</td>
<td>216</td>
<td>58</td>
<td>65</td>
</tr>
<tr>
<td>V</td>
<td>Inevitable</td>
<td>4</td>
<td>17</td>
<td>880</td>
</tr>
<tr>
<td>VI</td>
<td>Fortuitous</td>
<td>22</td>
<td>16</td>
<td>21</td>
</tr>
<tr>
<td>VII</td>
<td>Unclassifiable</td>
<td>10</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>VIII</td>
<td>Inadequate data</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>316</td>
<td>144</td>
<td>1043</td>
</tr>
</tbody>
</table>
Anaesthetic factors were involved in half or more of the obstetrics, gynaecology, dental, ear, nose, throat, eye, plastic/burns and renal surgery deaths. These groups made up only 3.1% of all deaths but 14.5% of those deaths in which anaesthetic factors were identified (figure 11). Inevitable deaths (category V, in which surgery could not prevent the patients death) were the largest part of the total-60%.

Figure 12.
Number of anaesthesia related deaths, NSW 1984-1990, by type of surgery.

Types of surgery
1 Abdominal
2 Cardiothoracic
3 Vascular
4 Neurological
5 Orthopaedic
6 Diagnostic/endoscopy
7 General (non-abdominal)
8 Urological
9 Gynaecological
10 Ear, nose and throat/ head and neck
11 Eye
12 Other
About 98% of deaths were in emergency procedures.

Table 15.
Urgency of procedure and contributing cause of death.

<table>
<thead>
<tr>
<th>Category*</th>
<th>Scheduled</th>
<th>Urgent non-emergency</th>
<th>Emergency</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Anaesthetic</td>
<td>21</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>II</td>
<td>Anaesthetic</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>III</td>
<td>Anaesthetic</td>
<td>27</td>
<td>19</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>and surgical</td>
<td>216</td>
<td>58</td>
<td>65</td>
</tr>
<tr>
<td>IV</td>
<td>Surgical</td>
<td>4</td>
<td>17</td>
<td>880</td>
</tr>
<tr>
<td>V</td>
<td>Inevitable</td>
<td>22</td>
<td>16</td>
<td>21</td>
</tr>
<tr>
<td>VI</td>
<td>Fortuitous</td>
<td>10</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>VII</td>
<td>Unclassifiable</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>VIII</td>
<td>Inadequate data</td>
<td>316</td>
<td>144</td>
<td>1043</td>
</tr>
</tbody>
</table>

Most deaths were related to abdominal, vascular or cardiothoracic diseases.

Table 16.
Type of procedure and contributing cause of death.

<table>
<thead>
<tr>
<th>Category*</th>
<th>Abdominal</th>
<th>Cardio-thoracic</th>
<th>Vascular</th>
<th>Neurological</th>
<th>Orthopaedic</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Anaesthetic</td>
<td>10</td>
<td>1</td>
<td>1</td>
<td>11</td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td>II</td>
<td>Anaesthetic</td>
<td>7</td>
<td>—</td>
<td>4</td>
<td>2</td>
<td>11</td>
<td>18</td>
</tr>
<tr>
<td>III</td>
<td>Anaesthetic</td>
<td>32</td>
<td>8</td>
<td>8</td>
<td>3</td>
<td>14</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>and surgical</td>
<td>39</td>
<td>244</td>
<td>22</td>
<td>4</td>
<td>7</td>
<td>23</td>
</tr>
<tr>
<td>IV</td>
<td>Surgical</td>
<td>326</td>
<td>148</td>
<td>290</td>
<td>71</td>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td>V</td>
<td>Inevitable</td>
<td>14</td>
<td>3</td>
<td>8</td>
<td>1</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>VI</td>
<td>Fortuitous</td>
<td>3</td>
<td>6</td>
<td>—</td>
<td>2</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>VII</td>
<td>Unclassifiable</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>—</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>VIII</td>
<td>Inadequate data</td>
<td>434</td>
<td>411</td>
<td>344</td>
<td>84</td>
<td>75</td>
<td>165</td>
</tr>
</tbody>
</table>

*See Box 2 for full definition of categories
7.2.6 Trauma

From 154 deaths, patients with non-orthopaedic trauma, over 93% were inevitable.

Table 17.
Trauma cases and contributing cause of death.

<table>
<thead>
<tr>
<th>Category*</th>
<th>Abdominal</th>
<th>Cardiotoracic</th>
<th>Vascular</th>
<th>Neurological</th>
<th>Orthopaedic</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>I  Anaesthetic</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>7</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>II Anaesthetic predominantly</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>9</td>
<td>10</td>
<td>—</td>
</tr>
<tr>
<td>III Anaesthetic and surgical</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>10</td>
<td>11</td>
<td>—</td>
</tr>
<tr>
<td>IV Surgical</td>
<td>2</td>
<td>—</td>
<td>1</td>
<td>—</td>
<td>3</td>
<td>—</td>
<td>6</td>
</tr>
<tr>
<td>V Inevitable</td>
<td>82</td>
<td>17</td>
<td>3</td>
<td>36</td>
<td>5</td>
<td>6</td>
<td>149</td>
</tr>
<tr>
<td>VI Fortuitous</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>11</td>
<td>—</td>
<td>11</td>
</tr>
<tr>
<td>VII Unclassifiable</td>
<td>—</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>6</td>
<td>—</td>
<td>7</td>
</tr>
<tr>
<td>VIII Inadequate data</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>—</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>18</td>
<td>4</td>
<td>37</td>
<td>52</td>
<td>10</td>
<td>206</td>
</tr>
</tbody>
</table>

*See Box 2 for full definition of categories.

Fifty percent of deaths in the 52 orthopaedic trauma cases were considered to involve anaesthesia related factors, 25% to involve surgical factors and 21% to be fortuitous.

7.2.7 Children

The patient was a child under 10 years of age in 5% of the cases (figure 9) and 63% of these were under one year of age. Cardiothoracic surgery for congenital defects and abdominal procedures, principally accounted for most deaths in children under one year of age. Anaesthetic factors were considered to have contributed to only one of the 76 deaths of children under 10 years of age.
8 Services for Dentistry. Some Government and Private Examples

As a part of his thesis the writer visited 3 government and 3 private practices which use general anaesthesia. At these clinics the anaesthetist in charge was asked to complete a questionnaire and the results are outlined in the following sub sections.

8.1 Adamstown Dental Clinic

The Adamstown dental clinic is in the Hunter Area Health Services, it is situated on the corner of Kyle and Gosford streets at Newcastle. They treat all patients including children, however, the cut off point age for children is 16.

The anaesthetist was Dr Ross Holland, who was previously situated at Westmead Hospital. They give general anaesthetic treatment to about 140 patients per year, and the duration for each patient's treatment is about 40 minutes.

The Adamstown clinic is free for all patients, because all must hold Health Care Cards, in order to be able to receive free dental treatment. However, the Anaesthetist charges patients under Medicare and the average rebate is about $80 per patient (see appendix 2).

The medications and induction gases used for general anaesthesia are Thiopentone, Atropine, Suxamethonium, Nitrous Oxide, and Halothane.
The Adamstown Dental Clinic treats about 40 handicapped patients with general anaesthetic per year. These patients can turn up anytime they want and they will receive treatment, no waiting list is required for any of them.

### Adamstown

**Number of Handicapped Patients Compared to Normal Patients**

- **Handicapped Patients**: 28.6%
- **Normal Patients**: 71.4%
About 5% of patients who attended for treatment with general anaesthesia were trauma related.

Overall, patients who attended for dental treatment 95% were caries related.
Indication for the use of general anaesthesia include, non co-operative patients, child patients, medically compromised patients and patients who suffer behavioural problems.

The contra-indications for these is that they have severe medical conditions eg. heart disease, bleeding disorders and obesity.

The parents attitudes towards general anaesthesia is quite positive.

The Adamstown dental clinic has a budget of $5 944 000 for all the Hunter areas, this is to cover the 244 000 patients. For the Adamstown clinic $354 000 was allocated from June 1993 to July 1994, a period of 1 year. They also have 350 patients per month for treatment of various dental problems which comes to about 4200 patients per year.
8.2 Double Bay

The Double Bay dental clinic private dental clinic, is run by dentists, Dr Alan Polyblank, Dr Noel Hodge and Dr Diana Fabijan, at 401 New South Head road Double Bay. The clinic is situated on the 1st floor with 4 operating rooms, which have all been supplied with a general anaesthesia system which is fixed on the wall, plus monitors, oximeter and extra cylinders. They have used general anaesthesia in the last 12 months (1994), on about 150 patients per year.

The average length of time for each general anaesthesia patient is about 1 hour.

The average cost for each patient for general anaesthesia was about $300 per treatment, which covers the dental fee, the operating room fee and the dental charge.

The Anaesthetist is a physician and can therefore charge patients under Medicare, the patient rebate is $120 from Medicare. In this case Dr D O'Brien is the Anaesthetist who works with Dr A Polybank at the Double Bay Dental Clinic.
The Double Bay dental clinic treats 50 children under the age of 18 years with general anaesthesia per year.
The Double Dental Clinic treats about 20 handicapped patients with general anaesthesia per year.

Double Bay
Number of Handicapped Patients Compared to Normal Patients

Handicapped Patients 13.3%

Normal Patients 86.7%
About 80% of patients who attended the Double Bay Dental Clinic were caries related and 20% were trauma related.

The indication for general anaesthesia use was because of patient apprehension, duration of treatment and extensive surgery.

The parents attitudes towards the general anaesthesia was positive, most people accepted the Anaesthetists assurance.
8.3 Waterloo

Dr Michael Walker's private clinic is located at 694-696 Elizabeth street Waterloo. Dr Walker's clinic was very nice and clean, although the building was quite old, however, he managed to have enough space for 3 operating rooms, of which 2 are used for general anaesthesia. The general anaesthesia tubing system was permanently fixed into the wall and it has monitors, oximeter and extra cylinders.

Dr M Walker uses general anaesthesia at his clinic, a full session consists of about 12 patients, but it depends on the amount of work to be done on each individual. The dentist will treat about 70 patients with general anaesthesia a year, and the average length of treatment is about 1 hour per patient.

Each patient can be charged from $300 to $3000, it depends on the type of work to be done. The sorts of medication and induction gases the anaesthetist uses for patients are Decadron, Halothane, Isoflurane, Diprivan, Atropine, Norcuron, and Suxamethonium Chloride.
The number of children under the age of 18 treated with general anaesthesia at the Waterloo Dental Clinic were about 23 patients per year.

Waterloo
Total Number of Children Compared to Adults

Total Number of Patients
70

Children
23

Adults
47
The number of handicapped children treated with general anaesthesia at the Waterloo Dental Clinic were about 5 patients per year.

Waterloo
Number of Handicapped Patients Compared to Normal Patients

Handicapped Patients
7.1%

Normal Patients
92.9%
From a total of 70 patients, 10 patients were trauma related and 60 were caries related.
8.4 Bondi Junction

Dr J Murray, Dr B Turner and Dr G Manning, have a private dental clinic which is located at 20 Spring Street on the 1st floor at Bondi Junction.

They use general anaesthesia and sedation techniques at their clinic.

They received about 80 patients for general anaesthesia treatment with duration of 1 hour per patient.

Dr P Mayne, the Anaesthetist, attends their clinic on the allocated day for general anaesthesia patients.

The charges depend on the treatment but the Medicare rebate is $154.

The medication and induction gases used on general anaesthesia patients are Nitrous Oxide/Fluothane, Halothane, and Penthetal.
The Bondi Junction Dental Clinic treat about 25 child patients with general anaesthesia per year.
The Bondi Junction Dental Clinic treats about 4 handicapped patients with general anaesthesia a year.

Bondi Junction

Number of Handicapped Patients Compared to Number of Normal Patients

- Handicapped Patients: 5.0%
- Normal Patients: 95.0%
About 5% of patients attended the clinic for trauma related treatment, and 60% of the patients who attended the clinic received caries related treatment.

Most of the patients who received general anaesthesia were patients who were medically compromised or patient who required long surgical procedures.

The anaesthetist will prefer general anaesthesia rather than intravenous sedation for patients with long procedures and for those in which intravenous sedation is contra-indicated.

Parent attitudes towards general anaesthesia is cautious but readily reassured by the Anaesthetist. Patients attitudes towards general anaesthesia is positive when they know a specialist is watching over their treatment.
8.5 Community Dental Health Unit, Westmead Hospital

The Community Dental Health Unit is situated on the third floor at Westmead Hospital, the Head of the Community Dental Health Unit is Dr P King. The Community Dental Health Unit treats about 300 patients per year, and the operation period is between 1 to 2 hours. The aim of the treatment is to improve the patients oral health status.

Patients who attended the Community Dental Health Unit were eligible to receive free treatment with Health Care Cards.

The medications used include premedication which is Midazolam (Hypnovel), in orange juice given by the Anaesthetist, Chlorohydrate, Valium, Temazepam (Given By the patients General Practitioner).

Induction gases used are Oxygen, Nitrous Oxide and Halothane and intravenous cannula eg Thiopentone.
At the Community Dental Health Unit, Westmead Hospital about 25 children are treated with general anaesthesia per year.

Community Dental Health Unit at Westmead Hospital
Number of Children Compared to Adults

Total Number of Patients 300

Adults 275
Children 25
At the Community Dental Health Unit, Westmead Hospital all the children treated with general anaesthesia were handicapped and the remaining 275 were adult patients.
At the Community Dental Health Unit, Westmead Hospital, 1% of cases were trauma related and 70% of cases were caries related. Other treatment includes extraction of wisdom teeth and periodontal problems.
The indication for general anaesthesia is that the patient must be physically healthy enough to undergo general anaesthesia. Anxious, unco-operative patients where sedation is unsuccessful, psychiatric patients, multiple extractions and long surgical procedures.

Patients with severe medical problems, that is ill health, and short life expectancy will not be given general anaesthesia. All risks/side effects must be explained to the legal guardian prior to general anaesthesia and a consent form signed (witnessed/dated). Patients understand that general anaesthesia is used when no other alternatives exist.
8.6 Paediatric Dentistry Unit, Westmead Hospital

At the Westmead Hospital Paediatric Dentistry Unit, the Anaesthetists are Dr N Street and Dr M Brown who anaesthetise children and Dr R Widmer and Dr A Cameron who perform operations on those children who are eligible to receive treatment under general anaesthesia.

At Westmead Hospital Paediatric Dentistry Unit, they have allocated Wednesdays for treatment/surgical procedures on children.

The Paediatric Dental Unit performs about 1200 operations per year with general anaesthesia on children, plus treatment on a daily basis on the 3rd floor at Paediatric Dentistry Unit at Westmead Hospital.

Each operation with a child under general anaesthesia lasts from about 45 minutes to 1 hour in duration.

All children come into the hospital with Health Care Cards and do not need to pay for treatment.

The medications and induction gases include Paracetamol, Nitrous Oxide, Oxygen, Halothane and Isoflurane.
From a total of 1500 cases which were treated over a period of about 15 months (from January 1994 to April 1995), about 800 cases were caries related, 100 were trauma related and the remaining 600 patients received other treatment.

Paediatric Dentistry Unit at Westmead Hospital

Number of Caries Related Cases Compared to Trauma Related Cases

- Caries Treatment: 53.3%
- Trauma Treatment: 6.7%
- Other Treatment: 40.0%
From a total of 1500 patients, about 600 patients were either mentally, physically or behaviourally handicapped.
8.7 Total Number of Patients who Attended Westmead Hospital for Treatment after Receiving General Anaesthesia

An analysis has been made of dental emergency for children at Westmead Hospital from June 1993 to November 1993, which was a period of six months. The analysis was necessary so that provision of future emergency services for children from 6 months of age to 14 years of age is carried out in the most efficient, appropriate and atraumatic way.

From a total of 607 children 157 (25.9%) of them required general anaesthesia. Out of these 14 (2.3%) children needed general anaesthesia for trauma and 143 (23.6%) needed general anaesthesia for restorative treatment of both primary and secondary dentition. These treatments included restoration of caries effected teeth, root canal therapy and extraction of primary and permanent teeth, when it was necessary.

Out of this 157 children who received general anaesthesia, 55 (35%) of them received treatment on their first visit and never returned, 90 (57.3%) children received treatment twice after general anaesthesia, and 12 (7.7%) returned three time or more after general anaesthesia.

![Paediatric Dentistry Unit](chart.png)

**Paediatric Dentistry Unit**

**Total Number of Patients Who Attended Westmead Hospital for Treatment After Receiving General Anaesthesia**

- Returned Once 35.0%
- Returned Twice 57.4%
- Returned Three Times 7.6%
9. Discussions and Conclusions

The Paediatric Dental Unit at Westmead Hospital has the facility for using the Dental Operating Suite all day on Wednesdays for general anaesthetic procedures.

The need for a general anaesthetic is usually the final solution to treating a child dental problems.

It is the responsibility of the Operating Suite management committee to allocate the privilege of operating in the operating suite. Anaesthetists and dentist should be well trained in caring for the paediatric patient as they cannot simply be treated as little adults.

The administration of general anaesthesia to a patient for a dental procedure which taken place in the normal dental environment will be far smoother and safer if there is clear understanding and co-operation between the dentist and the anaesthetist.

All anaesthetists are involved in an activities include education of patients, medical trainers and other professionals.

According to Dentist Act, a dentist cannot administer general anaesthesia to any patient unless the general anaesthetic has been administered by a registered medical practitioner.

The Australian Incident Monitoring Study (AIMS) analysed anaesthetic incidents in infants and children compared with those of adults. Of the 2 000 cases 1 790 (90%) involved adults, 151 (70%) children and 56 (3%) infants.

Mortality associated with general anaesthesia in NSW, reviewed 1 503 deaths in some 3.5 million surgical procedures. In 60% of these case patients death was related to be inevitable and 4% fortuitous. In 191 of the 421 deaths related to anaesthetic factors, no better alternative procedures was considered possible.
As a part of this thesis, the writer was required to visit some government and private practices. To determine an overview of general anaesthetic practices.

A total of 154 trauma related children received general anaesthesia, the numbers were, 7 (4.5%) at Adamstown, 30 (19.5%) at Double Bay, 10 (6.5%) at Waterloo, 4 (2.5%) at Bondi Junction, 3 (2%) at the Community Health Unit at Westmead Hospital and 100 (65%) were treated at the Paediatric Unit at Westmead Hospital.
A total of 2240 patients received general anaesthesia, the numbers were, 140 (6.3%) patients at Adamstown, 150 (6.7%) at Double Bay, 70 (3%) at Waterloo, 80 (3.6%) at Bondi Junction, 300 (13.4%) at the Community Dental Health Unit, Westmead Hospital and 1500 (67%) at the Paediatric Dental Unit, Westmead Hospital.
A total number of 694 handicapped patients received general anaesthetic, the numbers were, 40 (5.76%) at Adanstown, 20 (2.88%) at Double Bay, 5 (0.72%) at Waterloo, 4 (0.58%) at Bondi Junction, 25 (3.6%) at the Community Dental Health Unit, Westmead Hospital, and 600 (86.4%) at the Paediatric Dental Unit, at Westmead Hospital.
A total number of 1763 children received general anaesthesia, the numbers were, 140 (7.94%) at Adamstown, 50 (2.85%) at Double Bay, 23 (1.3%) at Waterloo, 25 (1.45%) at Bondi Junction, 25 (1.45%) at the Community Dental Health Unit, Westmead Hospital and 1500 (85%) at the Paediatric Dental Unit at Westmead Hospital.
A total number of 1,371 caries related children received general anaesthesia, the numbers were, 133 (9.7%) at Adamstown, 120 (8.75%) at Double Bay, 60 (4.38%) at Waterloo, 48 (3.5%) at Bondi Junction, 210 (15.32%) at the Community Dental Health Unit, Westmead Hospital, and 800 (58.35%) at the Paediatric Dental unit, at Westmead Hospital.
In conclusion, the writer has gathered a range of information from 6 dental practices which treated a total of 2240 patients with general anaesthesia per year. The 6 practices were comprised of 3 government practices which treated 1940 patients and 3 private practices which treated 300 patients with general anaesthesia for dental treatment per year.

There was no basic difference between government and private practices with regard to treatment procedures and the use of medications and induction gases. However, there was a great difference between the number of patients who received treatment at Westmead Hospital compared to the rest of the government and private practices. The Paediatric Dental Unit performs about 1200 operations per year with general anaesthesia on children whereas the other government and private practices combined only treat about 740 child patients per year (Appendix A1).

In government and private practices, the presence of an anaesthetist is essential for administration of general anaesthesia on patients. The anaesthetist is entitled to charge patients with medicare like a physician does (Appendix A2).

In Westmead Hospital Paediatric Dentistry Unit, the control of pain while performing dental procedures with general anaesthesia is the most important component supporting sound principles of children safety. The Paediatric Dentistry Unit provides anaesthetists who are specially trained to anaesthetise children. More staff are present in case of a emergency situation at Westmead, as it is a big government hospital. Westmead Hospital Paediatric Dentistry Unit has got specialised paediatric anaesthetists whereas other clinics have a general anaesthetist.
The medication and induction gases used were Paracetamol, Nitrous Oxide, Oxygen, Halothane, Isoflurane, Thiopentone, Atropine, Suxamethonium, Decadron, Dipravin, Norcuron, Penthetal and Fluothane. These medications/induction gases were commonly used in all dental practices observed in both government and private practices.

The procedure of using general anaesthesia includes a consent form filled by a parent/guardian, fasting instruction for all patients (child and adult), full explanation of the procedure to be carried out to the patient and the child parent/guardian. Patient is taken to operating theatre and medication/induction gas administered by anaesthetist. After operation the anaesthetist brings the patient to a conscious state then recovery staff take over the patients case and takes the patient to the recovery area until discharge. These procedures are carried out at all dental practices.

To maintain patient safety, legislation in NSW requires all dental practices which treat patients with general anaesthesia to have a Pulse Oximeter, Cardiocap, Carbon Dioxide Monitor, Oxygen cylinder and Nitrous Oxide cylinder.

The attitude of patients toward the use of general anaesthesia is quite positive, especially when they feel the anaesthetist as a physician is present. However, some child or adult patients need more assurance by the anaesthetist about the implications of general anaesthesia and procedures. An anaesthetist can't guarantee a totally risk free procedure for the patient and the anaesthetist leaves the decision completely up to the patient or parent/guardian whether or not they want to go ahead with the procedure.
The main use of general anaesthesia in dental procedures is for patients who are mentally, physically or behavioural compromised (handicapped). The need for general anaesthesia represents the clinicians final solution for child and adult patients. For patients with needle phobia, and/or extensive treatment required, general anaesthesia is found to be the most effective and efficient option for the patient and the operator.

The procedures used in Westmead Hospital for general anaesthesia for child dental patients follow accepted guidelines for safety. The procedures are appropriate and of high quality for the needs of a child patient.
<table>
<thead>
<tr>
<th>Visit</th>
<th>No of patients</th>
<th>Length of GA</th>
<th>Medicare rebate</th>
<th>Charges made</th>
<th>Cost for GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adamstown</td>
<td>140</td>
<td>40 minutes</td>
<td>Nill</td>
<td>Nill</td>
<td>Nil</td>
</tr>
<tr>
<td>Double Bay</td>
<td>150</td>
<td>75 minutes</td>
<td>$120</td>
<td>Nill</td>
<td>$300-3000</td>
</tr>
<tr>
<td>Waterloo</td>
<td>70</td>
<td>120 minutes</td>
<td>$120</td>
<td>Nill</td>
<td>$300-3000</td>
</tr>
<tr>
<td>Bondi Junction</td>
<td>80</td>
<td>90 minutes</td>
<td>$164</td>
<td>Nill</td>
<td>Nil</td>
</tr>
<tr>
<td>Com. Dent Unit</td>
<td>300</td>
<td>120 minutes</td>
<td>Nil</td>
<td>Nill</td>
<td>Nil</td>
</tr>
<tr>
<td>P.d Westmead</td>
<td>1500</td>
<td>60 minutes</td>
<td>Nil</td>
<td>Nill</td>
<td>Nil</td>
</tr>
</tbody>
</table>

**Patient attitude**
- Positive
- Negative

**Notes:**
- No of child <16
- No h. capped
- Trauma
- Caries
ANAESTHETIC FEES FROM - 1 NOVEMBER 1994

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>DESCRIPTION</th>
<th>FEE</th>
<th>MEDICARE REBATE</th>
</tr>
</thead>
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<tr>
<td></td>
<td></td>
<td></td>
<td>INCLUDING CONSULT. FEE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>FEE</td>
</tr>
<tr>
<td>104</td>
<td>Consultation Without Anaesthetic</td>
<td>$60.00</td>
<td>$52.50</td>
</tr>
<tr>
<td>17603</td>
<td>Pre-operative Instruction</td>
<td>($50.00)</td>
<td>$23.60</td>
</tr>
<tr>
<td>18105</td>
<td>Simple Extraction Less Than 30 Mins</td>
<td>$180.00</td>
<td>$107.85</td>
</tr>
<tr>
<td>18109</td>
<td>Surgical Extraction Less Than 30 Mins</td>
<td>$225.00</td>
<td>$131.15</td>
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<td>18113</td>
<td>Filling Less Than 30 Mins</td>
<td>$180.00</td>
<td>$107.85</td>
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<tr>
<td>18118</td>
<td>1 Hour Restorative Work</td>
<td>$250.00</td>
<td>$154.40</td>
</tr>
<tr>
<td>18118</td>
<td>1 1/2 Hours Restorative Work</td>
<td>$300.00</td>
<td>$154.40</td>
</tr>
<tr>
<td>17713</td>
<td>2 Hours (Unusual Length)</td>
<td>$350.00</td>
<td>$177.70</td>
</tr>
<tr>
<td></td>
<td>(Usual Item 18118)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17714</td>
<td>2 1/2 Hours</td>
<td>$400.00</td>
<td>$190.00</td>
</tr>
<tr>
<td>17716</td>
<td>3 Hours</td>
<td>$450.00</td>
<td>$217.40</td>
</tr>
<tr>
<td>17718</td>
<td>3 1/2 Hours</td>
<td>$500.00</td>
<td>$244.80</td>
</tr>
<tr>
<td>17720</td>
<td>4 Hours</td>
<td>$550.00</td>
<td>$272.20</td>
</tr>
<tr>
<td>17722</td>
<td>4 1/2 Hours</td>
<td>$600.00</td>
<td>$299.60</td>
</tr>
<tr>
<td>17724</td>
<td>5 Hours</td>
<td>$650.00</td>
<td>$327.00</td>
</tr>
</tbody>
</table>

ANAESTHETICS ARE CALCULATED TO INCLUDE PRE-OPERATIVE CONSULTATION IN WAITING ROOM

4 OR MORE VMK ADD 50% OF GA PRICE

TIME BASIS: TOTAL TIME ANAESTHETIST INVOLVED INCLUDING THEATRE FEE PER CASE $100.00 TO PRACTICE
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