WAASM

Annual Report **2007**

Royal Australasian College of Surgeons

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The information contained in this Annual Report has been prepared by the Royal Australasian College of Surgeons Western Australian Audit of Surgical Mortality Management Committee, which is a declared quality improvement committee under Section 7(1) of the *Health Services (Quality Improvement) Act 1994* (Gazetted 26 July 2005). The Australian and New Zealand Audit of Surgical Mortality, including the Western Australian Audit of Surgical Mortality also has protection under the Commonwealth Qualified Privilege Scheme under Part VC of the *Health Insurance Act 1973* (Gazetted 6 November 2006).

ROYAL AUSTRALASIAN COLLEGE OF SURGEONS

Western Australian Audit of Surgical Mortality (WAASM)

ANNUAL REPORT 2007

THE UNIVERSITY OF WESTERN AUSTRALIA

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CHAIRMAN'S REPORT

THIS IS THE FOURTH ANNUAL REPORT of the Western Australian Audit of Surgical Mortality (WAASM). Once again, the report has shown that the overall standard of surgical care in Western Australia is of a high standard. The number of adverse events related to surgical deaths remains very small — the number of adverse events that caused death in reviewed cases for 2006 was seven (1.8%).

Some of the problems previously highlighted by WAASM[1,2] have subsequently been addressed by surgeons, and their incidence remains at a very low level. For example, complications from anticoagulant drugs have all but disappeared, despite their increasingly widespread use. In other areas, there is clear evidence of change in practice with improved outcome (e.g. consultant supervision with returns to theatre). However, there is no room for complacency. Three patients died from a pulmonary embolus because there was a failure to use deep vein thrombosis (DVT) prophylaxis, despite clear indications for its use.

Progress continues to be made in other areas. For example, in each of its previous annual reports, WAASM has emphasised the importance of postmortems and has lamented that postmortem reports are not routinely returned to the surgeon. The Western Australia Department of Health (WADH) is currently exploring strategies with the Coroner's Court of Western Australia on how to overcome this problem. This is but one example that illustrates how recommendations of WAASM extend well beyond surgery.

The management of fluid balance remains an area of considerable concern. A detailed account is contained in this annual report. In previous years, WAASM has held successful evening symposia on such generic issues, with very satisfactory responses and outcomes (e.g. an anticoagulation symposium in 2006). WAASM considers that a similar evening symposium on fluid balance may not on its own be the best way to educate clinicians, not least because it is an issue that involves all clinicians, not just surgeons. Previous symposia have mainly attracted consultants and, although it is important to educate them, day-to-day fluid management is managed by junior staff. Therefore, WAASM proposes to target different groups using different educational strategies. This strategy will include nurses, who will then be in a position to recognise inappropriate fluid management and to encourage trainees to seek input from senior staff.

The value of mortality reviews has been recognised both locally and nationally.[3,4,5,6,7] In January 2007, WADH introduced the Western Australian Review of Mortality (WARM).[8] This process requires every in-hospital death to be reviewed using a two-stage process similar to WAASM. The implications for WAASM are considered in more detail in this annual report. Nationally, the Royal Australasian College of Surgeons (the College) is expanding the Australian and New Zealand Audit of Surgical Mortality, which was introduced in 2005. Tasmania and South Australia have already started to collect data using the WAASM database. In addition, the Clinical Excellence Commission in New South Wales has started to collect data at pilot sites

in a form that it will submit to the College — this process will be progressively rolled out across the state. Queensland has acquired funding and will start collecting data shortly. It is unlikely that either of these projects would have been conceived had the Western Australian surgeons not only demonstrated that mortality audits were possible, but also that such audits do change and improve clinical practice.[9]

Two issues merit specific mention. The first is that this annual report provides clear evidence to support the idea that all deaths should undergo external, independent peer review. In approximately half the deaths in which the external assessor recorded an area for concern or adverse event, the patient's surgeon did not record any event (Table 3.6). Adverse events are a consequence of medical intervention and it is obviously of concern that surgeons do not appear to recognise these. This is a strong argument to support external, peer review of all deaths. This was a recommendation of the Douglas Inquiry at the King Edward Memorial Hospital,[10] and of an earlier enquiry by the Medical Board of Western Australia.[†] It is also a powerful reason for surgeons to review their patient deaths through WAASM, rather than WARM. Under WARM, these deaths would not have been reviewed externally.

The second issue is the outcome in people admitted as emergency patients. This group is becoming progressively larger and is being managed increasingly in public hospitals. Many of these patients are very high risk, with an American Society of Anaesthesiologists (ASA) grade of four or more; in addition, the proportion of these who do not receive surgery is increasing. Traditionally, emergency patients have been managed largely by surgical trainees. These observations have important implications for service delivery.

Looking to the future, surgeons in Western Australia need to consider how the principles established in WAASM can be extended for use in auditing surgical morbidity. Although it would be impossible to have external peer review of every morbidity, it may be possible to have targeted audits of key events. Hospitals are already required to collect data on some easily identified key events, such as unplanned returns to theatre, and these cases would be a good starting point.

Finally, this annual report will be the last produced by Jenny Mountain. Jenny is moving to a new role at the Telethon Institute for Child Health Research. It would be difficult to overstate the contribution Jenny has made to WAASM. Jenny came to WAASM with a broad experience in surgical audit and with extensive expertise in database analysis. This almost unique combination has been an enormous advantage to WAASM and has meant that it has been able to manage and analyse its data 'in-house'. The annual reports are an elegant testimony to her expertise. On behalf of all of Western Australia's surgeons, I would like to acknowledge her enormous input and wish her well in her new role.

James Aitken
WAASM Chairman

[†] http://www.medicalboard.com.au/

ABBREVIATIONS

ANZASM	Australian and New Zealand Audit of Surgical Mortality
ANZCA	Australian and New Zealand College of Anaesthetists
ASA	American Society of Anaesthesiologists
CEC	Clinical Excellence Commission
CI	confidence interval
CNR	case note review
CPD	continuing professional development
CT	computed tomography
CTEC	Clinical Training and Education Centre (University of Western Australia)
CVA	cerebrovascular accident
DoH	Department of Health
DVT	deep vein thrombosis
ENT	ear nose and throat
ERAS	enhanced recovery after surgery
ERCP	endoscopic retrograde cholangiopancreatography
GP	general practitioner
HCCWA	Health Consumers' Council of Western Australia
HDU	high dependency unit
HMDS	hospital morbidity data system
iCM	iSOFT Clinical Manager
ICU	intensive care unit
IQR	interquartile range
MJA	Medical Journal of Australia
PathWest	PathWest Laboratory Medicine Western Australia
PE	pulmonary embolism
PM	postmortem
QASM	Queensland Audit of Surgical Mortality
RACS	Royal Australasian College of Surgeons
SAAPM	South Australian Audit of Peri-operative Mortality
SASM	Scottish Audit of Surgical Mortality
SPSS	Statistical Package for Social Sciences
TASM	Tasmanian Audit of Surgical Mortality
TMS	theatre management system
TOPAS	the open patient administration system
UWA	University of Western Australia
VASM	Victorian Audit of Surgical Mortality
WA	Western Australia
WAASM	Western Australian Audit of Surgical Mortality
WADH	Western Australia Department of Health
WARM	Western Australian Review of Mortality

EXECUTIVE SUMMARY

Background

The Western Australian Audit of Surgical Mortality (WAASM) is an external, independent, peer-review audit of the process of care associated with surgically related deaths in Western Australia. WAASM started with a pilot project in June 2001, under the management of the University of Western Australia. In 2005, management was transferred to the Royal Australasian College of Surgeons (the College), and the Australian and New Zealand Audit of Surgical Mortality (ANZASM) was formed. The purpose of ANZASM was to extend similar audits to other Australian states and territories. The WAASM project is funded by the Western Australia Department of Health (WADH) and has protection under both state and federal legislation.

Western Australian Review of Mortality

In November 2006, WADH issued an operational directive requiring that all in-hospital deaths be classified and reviewed within three months of date of death — the Western Australian Review of Mortality (WARM). Deaths audited by WAASM are exempt from the WARM process if they are completed in accordance with the WARM policy. WAASM has certain advantages over WARM; for example, WAASM:

- provides independent scrutiny of all deaths where a surgeon was associated with the admission
- provides feedback of information to surgeons
- has qualified privilege under both the *Health Services (QI) Act 1994* (WA) and Part VC of the *Health Insurance Act 1973* (Commonwealth).

The effects of the introduction of WARM on WAASM will become clearer during 2007–2008.

Audit process and reporting conventions

WAASM is notified of deaths in all hospitals and, where a surgeon was involved in the care of the patient, the death is included in the audit. WAASM then sends a proforma to the surgeon for self completion, with events to be reported against the following criteria:

- *area for consideration* — where the clinician believes an area of care could have been improved or different, but recognises that there may be debate about this
- *area of concern* — where the clinician believes that an area of care should have been better
- *adverse event* — an unintended 'injury' that is caused by medical management, rather than by the disease process, and is sufficiently serious to:
    - lead to prolonged hospitalisation
    - lead to temporary or permanent impairment or disability of the patient at the time of discharge
    - contribute to or cause death.

The surgeon completes the proforma, highlighting any areas for consideration or concern, or adverse events that may have occurred during the process of care.

The completed proforma is anonymised and then given to another consultant surgeon for peer review (this process is referred to as 'first-line assessment'). The reviewing surgeon uses the criteria described above to decide whether the case warrants detailed case-note review ('second-line assessment'). Cases are referred for second-line assessment if areas of concern or adverse events are thought to have occurred, or where a more detailed review could usefully draw attention to lessons to be learned. WAASM provides the surgeon involved with feedback from the assessors.

Audit participation

The number of deaths reported to WAASM has increased over the period of the audit (2002–2006), and the number of proformas returned to WAASM has also increased every year. At the time of this analysis in 2006, 73% of proformas had been returned across the entire audit period. In 2005, 76% of proformas were returned; whereas, in 2004, 70% were returned. All hospitals in Western Australia participate in WAASM. A total of 74% of reported deaths over the audit period occurred in three major hospitals, and 25% of cases were transferred to another hospital where they died.

Second-line assessment

The proportion of cases referred for second-line assessment (case-note review) has decreased since WAASM commenced in 2002.

Analysis of completed cases

Data analysed for this report cover cases reported to WAASM from January 2002 to December 2006 that had completed the audit process by April 2007 (n=2198). WAASM analysed areas of concern or adverse events ascribed to each case by the first or second-line assessors. Where cases were associated with more than one event, the most serious event was included in the analysis. Not all data fields were always fully completed and some data are therefore missing; where this occurs, it is noted in the text.

Comparison of surgeons and assessors view of areas of concern and adverse events

Assessors reported 54% more areas of concern or adverse events than surgeons.

Patient sample demographics

Of the 2198 reported cases, the median age was 79 years, with an interquartile range (IQR) of 68–85 years. Neurosurgical patients had a median age of 60 years (IQR 44–75 years) and orthopaedic patients of 85 years (IQR 80–90 years). Fifty-five per cent of cases were male. Sixty-seven per cent had an American Society of Anaesthesiologists (ASA) grade of four or more. More than 90% of cases were associated with at least one significant comorbidity that contributed to the death of

the patient. The main causes of death in patients aged 70 years or less were heart failure, brain injury, brain haemorrhage and septicaemia. The main causes of death in patients older than 70 years were heart failure, septicaemia, multiple organ failure and pneumonia.

Areas for consideration, of concern and adverse events

The proportion of cases associated with areas of concern or adverse events has decreased every year since 2002. Overall, assessors thought that an adverse event caused the death of a patient in 4% of the 2198 cases. In 1% of cases, this adverse event was thought to be preventable. The most frequent adverse event reported was a fall. Over the audited period, 17 cases were reported where a patient had a serious fall; in 8 of those cases, the fall was the direct cause of the patient's death.

Admissions, public and private hospitals

A greater proportion of cases were emergency rather than elective admissions, and a greater proportion were admitted to public rather than private hospitals. The proportion of emergency patients admitted to private hospitals who underwent an operation (81%, n=273) was significantly greater than the proportion admitted to public hospitals who underwent an operation (68%, n=1751, $p<0.0001$, Pearson's chi-square test). The proportion of associated areas of concern or adverse events was similar between operative patients admitted to private and public hospitals. In the future, WAASM will undertake a detailed study of the nature of events in elective and emergency admissions, focusing in particular on delays.

Operative and non-operative deaths

In 25% of the 2198 audited deaths, no operation was performed. The proportion of cases where surgeons made an active decision not to operate increased over the audit period. In 6% of the remaining cases (n=1645), the operative procedure was abandoned on finding a futile situation. Nineteen per cent of audited patients underwent two or more operations. In 13% of cases, the surgeon reported an unplanned return to theatre. The more operations performed, the more likely the cases were to be associated with an area of concern or adverse event.

Grade of surgeon — teaching hospitals

The proportion of cases returned to theatre, and where a consultant surgeon was involved in the operation, increased over the audit period. The proportion of these returns to theatre that had an associated area of concern or adverse event decreased.

Prophylaxis of thromboembolism

The WAASM data suggest that surgeons have changed their practice with regard to deep vein thrombosis (DVT) prophylaxis. There was an increasing trend in the use of DVT prophylaxis over the audit period. Also, the proportion of cases where assessors considered that the use of DVT prophylaxis was appropriate increased ($p<0.0001$, 2-sided Cochran–Armitage trend test).

Fluid balance

WAASM examined 50 cases where problems with fluid balance were noted. The common theme was that these very elderly patients (median age 84 years) received significant volumes of sodium-containing fluid in the first 24–48 postoperative hours — on average, 17% of their bodyweight. This is an issue that clearly demands greater attention. Two simple steps could be enacted easily. The first would be to identify cases that are likely to have a postoperative fluid problem, so that a management strategy can be agreed in advance. The second would be to limit the volume of fluid that can be administered by an intern without discussion with a senior colleague.

Postmortems

During the five-year audit period, 10% of 1767 cases underwent a postmortem examination. Only 34% of 181 postmortem reports were read by the associated surgeon. WADH has been liaising with PathWest (the Western Australian public pathology service) and the Coroner. As a result, noncoronial postmortem results are becoming available to surgeons on the iCM system (iSOFT Clinical Manager) in metropolitan teaching hospitals. WADH is compiling summary reports from coronial inquests — *From Death we Learn: Lessons from the Coroner*[11] — which are distributed for educational purposes.

RECOMMENDATIONS

The recommendations of this report are as follows:

- Surgeons should be encouraged to support WAASM.
- The introduction of WARM should be monitored and surgeons should be provided with evidence of audit compliance in a timely manner.
- Communication channels with other states and territories where similar mortality audits are in progress should be facilitated.
- An interstate second-line assessment system should be established.
- The issue of fluid balance management should be brought to the attention of the Western Australian clinical community.
- WAASM, WADH and the Coroner's Court of Western Australia should liaise to ensure that postmortem results are routinely returned to surgeons.
- Falls remain the leading cause of adverse events. Surgeons should work with hospitals to reduce the incidence of falls.
- Delays are the greatest reported cause for an area of concern or adverse event. WAASM should undertake a detailed study of the nature of adverse events in elective and emergency admissions, and the reasons behind these delays.
- To comply with the WARM timetable, hospitals should review their timelines for providing surgeons with case notes for review.

1 INTRODUCTION

Key points

- The Western Australian Audit of Surgical Mortality (WAASM) is an external, independent peer review audit of the process of care associated with surgically related deaths in Western Australia.
- The present report covers the period 1 January 2002 to 31 December 2006.
- WAASM looks particularly at areas of concern and adverse events.
- The audit process involves self-assessment by the surgeon and a first-line assessment by another surgeon, followed, if necessary, by a more detailed review of the case notes (second-line assessment).
- The core purpose of WAASM is to feed back information to inform, educate, facilitate change and improve practice. It achieves this by providing feedback to surgeons, hospitals and the community.
- WAASM achieved some progress against all of the recommendations in its 2006 annual report (Chapter 4).
- The recent introduction of the Western Australian Review of Mortality (WARM) may affect WAASM (Chapter 5); this will become clearer in the 2008 audit.

1.1 Background

The Western Australian Audit of Surgical Mortality (WAASM) is an external, independent peer review audit of the process of care associated with surgically related deaths in Western Australia. The project is funded by the Western Australia Department of Health (WADH), and its methodology is based on the Scottish Audit of Surgical Mortality (SASM).[‡]

The timeline for the project was as follows:

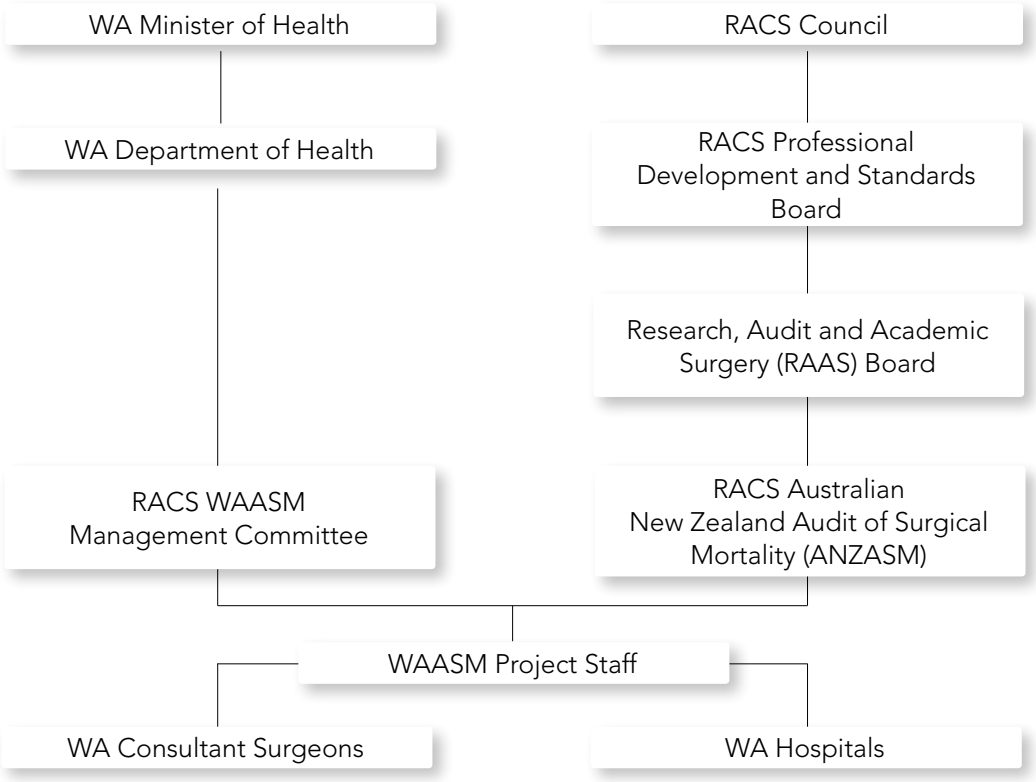
- WAASM started on 1 June 2001 under the management of the University of Western Australia (UWA).
- In January 2005, the management of WAASM transferred from UWA to the Royal Australasian College of Surgeons (the College), and the College's WAASM Management Committee was formed.
- In 2005, the College formed the Australian and New Zealand Audit of Surgical Mortality (ANZASM), with the purpose of extending a similar mortality audit to other states and territories.
- In November 2006, WADH issued an operational directive stating that all deaths that occur in public hospitals and licensed private health care facilities providing services for public patients, in Western Australia are required to be classified and reviewed under the Western Australian Review of Mortality (WARM). WARM came into effect on 1 January 2007. Deaths reviewed under the WAASM process are exempt from the WARM process.

[‡] http://www.sasm.org.uk

1.2 Project governance

The project governance structure is illustrated in Figure 1.1. WAASM has protection under both state and federal legislation. The College's WAASM Management Committee is registered under the *Western Australian Health Services (Quality Improvement) Act 1994* (gazetted 26 July 2005). In addition, ANZASM has protection under the Commonwealth Qualified Privilege Scheme, under Part VC of the *Health Insurance Act 1973* (gazetted 6 November 2006).

Figure 1.1 Project governance structure



ANZASM =Australian and New Zealand Audit of Surgical Mortality, RACS = Royal Australasian College of Surgeons, WA =Western Australia, WAASM =Western Australian Audit of Surgical Mortality.

1.3 The audit process

1.3.1 Notification of deaths

WAASM is an audit of hospital deaths in which a surgeon was involved in the management of a patient, whether or not the patient underwent a surgical procedure. Through the open patient administration system (TOPAS), WAASM is notified of all deaths that occur in Western Australian hospitals. In the case of private and smaller regional hospitals that are not linked into the TOPAS system, WAASM is notified of deaths directly by medical records departments.

1.3.2 Methods

After notification of a death, WAASM sends the consultant surgeon associated with the patient a proforma for completion, with events to be reported against the following criteria:

- *area for consideration* — where the clinician believes an area of care could have been improved or been different, but recognises that there may be debate about this
- *area of concern* — where the clinician believes that an area of care should have been better
- *adverse event* — an unintended 'injury' that is caused by medical management, rather than by the disease process, and is sufficiently serious to:
    - lead to prolonged hospitalisation
    - lead to temporary or permanent impairment or disability of the patient at the time of discharge
    - contribute to or cause death.

The surgeon completes the form and returns it to WAASM, and it is anonymously assessed by a different surgeon — as a 'first-line assessment' or 'peer review'. The first-line assessor determines whether the case should undergo further assessment ('second-line assessment'), with a more detailed review of the case notes. Cases are referred for further assessment if:

- areas of concern or adverse events are thought to have occurred during the clinical care of the patient
- a report could usefully draw attention to lessons to be learned, either for clinicians involved in the case or as part of collated assessments for wider distribution.

Approximately 15% of cases require a second-line assessment.

The first-line assessor is a consultant surgeon; the second-line assessor is a consultant surgeon from the same specialty as the surgeon associated with the case, but working in a different hospital to the one where the death occurred. With the development of ANZASM, a process of review from other states and territories is envisaged.

1.3.3 Providing feedback

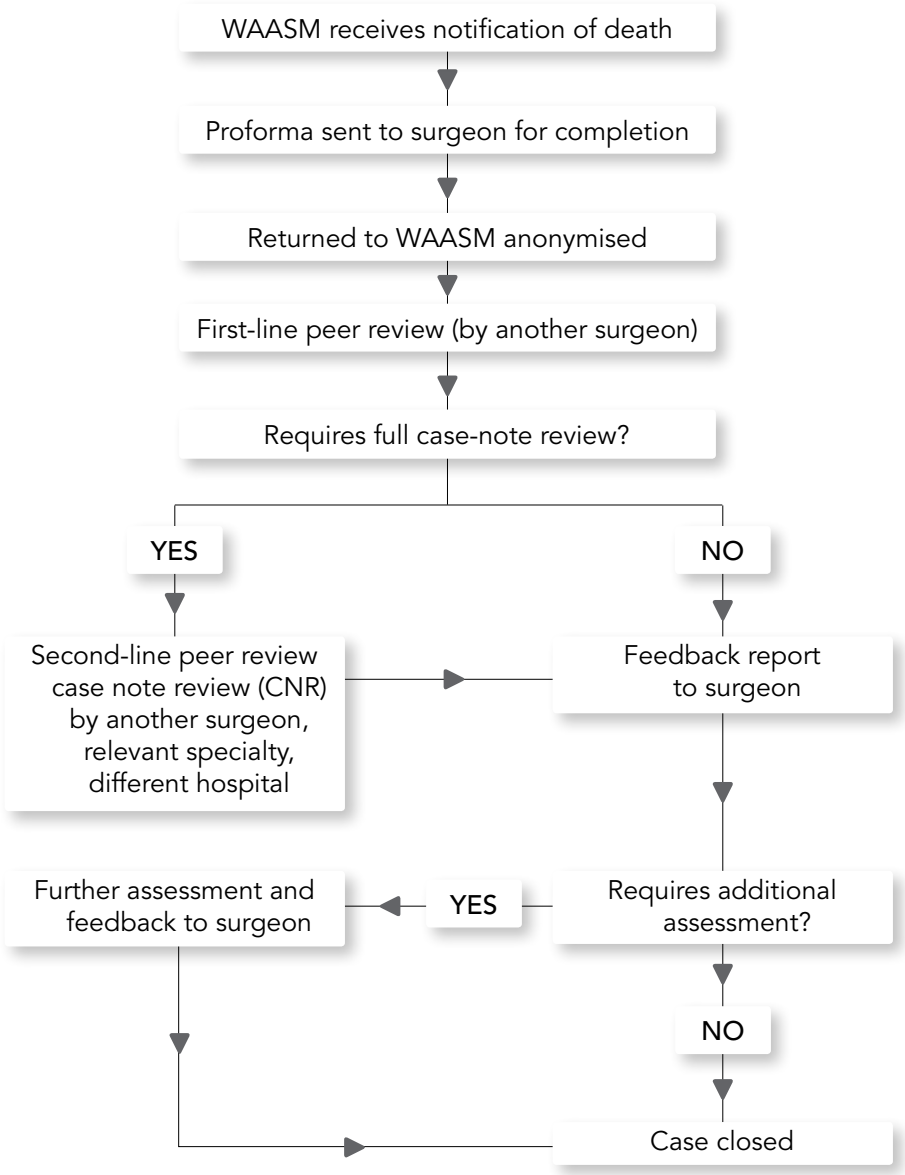
Individual surgeons receive feedback on their cases from the assessors. In addition, aggregated feedback is disseminated to all surgeons, hospitals or the public; this feedback is anonymised and events are not linked to patients, surgeons or hospitals. The process is managed by the WAASM team and is coordinated through an extensive database.

The core purpose of WAASM is to feed back information to inform, educate, facilitate change and improve practice.

WAASM provides feedback in the following ways:

- individual surgeons receive feedback from first or second-line assessors on their cases
- all surgeons receive summaries of second-line reviews, newsletters and copies of annual reports
- participating hospitals receive reports on aggregated, anonymised data relating specifically to their hospitals
- annual reports are available on the WAASM website for public access*; the data in these reports is aggregated and anonymous, with no information available on individual patients, surgeons or hospitals.

Figure 1.2 The Western Australian Audit of Surgical Mortality (WAASM) methodology



* http://www.surgeons.org/waasm

1.3.4 Audit inclusion and exclusion criteria

WAASM audits all deaths that occur in hospital while under the care of a surgeon, regardless of whether an operation was performed. If a patient is admitted under the care of a physician and subsequently undergoes an operative procedure, the case is included in the audit process. Terminal care cases are excluded from the full audit process.

1.4 Reporting conventions

1.4.1 Terminology

Surgeons and assessors are asked to:

- give their opinion as to whether the incident was preventable, under the categories:
  - definitely
  - probably
  - probably not
  - definitely not
- indicate who the incident was associated with, categorising this information as:
  - audited surgical team
  - another clinical team
  - hospital
  - other
- report on the impact of the incident on outcome, on whether the event:
  - made no difference to outcome
  - may have contributed to death
  - caused the death of a patient who would otherwise have been expected to survive.

1.4.2 Assessor opinion

The areas for consideration, areas of concern and adverse events contained in this report were events ascribed to the case by either the first or second-line assessors (referred to generically as 'assessors'). The categorisation of the severity of the event, the effect on outcome, and the team or location the event was associated with is the opinion of the assessors.

1.4.3 Focus of reporting

WAASM reports primarily on areas of concern and adverse events. Areas for consideration are excluded from the analysis because they generally make no difference to outcome and are simply an indication that there were different options. However, areas for consideration are included in the data collection process to facilitate reporting of 'less serious' events, which is important for improving overall patient care.

Some cases were associated with more than one event. In this situation, where analysis of events was reported by case, the most serious event was ascribed to the case for the purposes of analysis.

1.4.4 Missing data

Numbers in parentheses in the text (n) represent the number of cases analysed. Not all data were complete; therefore, the total number of cases used in the analysis varies.

Neurosurgeons complete an abbreviated neurosurgical proforma; therefore, some data is missing from the WAASM dataset. In some analyses, neurosurgical data is not included in the calculation; where this is the case it is noted.

1.4.5 Data analysis

This report covers deaths reported to WAASM from 1 January 2002 to 31 December 2006, and forms returned to WAASM by April 2007. Due to the time lag associated with the review process, some cases reported to WAASM during 2006 will, at the time of analysis, still be undergoing the audit process. These cases will be included in the next annual report. Similarly, figures in previous annual reports will vary from figures in this report, because cases completed after the return date are included in the dataset. Data are entered and stored in a Microsoft Access database and analysed using Statistical Package for the Social Sciences (SPSS) and Microsoft Excel.

1.5 Performance overview

The 2006 WAASM report[2] included recommendations. Whether these recommendations have been achieved or addressed is an important measure of the success of WAASM. Chapter 4 lists the recommendations and reports progress against them. Some progress has been made on each of the nine recommendations from the 2006 report and Chapter 4 also summarises other achievements of WAASM since its publication.

1.6 Effect of introduction of the Western Australian Review of Mortality

The WARM process, which was set up to review all in-hospital mortality across Western Australia, was introduced in January 2007. It is expected to have an effect on WAASM. Deaths reviewed under the WAASM process are exempt from the WARM process, which means that surgeons or hospital departments have to decide whether to review mortality through WAASM or WARM.

The data analysed in this report precede the introduction of WARM; however, Chapter 5 compares the two processes and discusses how WARM may affect WAASM. WAASM has already made changes to its protocol for audit and feedback to facilitate the WARM process — these changes are discussed in Chapter 5. In summary, WAASM has advantages over WARM in that:

- surgeons manage the process
- all deaths are independently reviewed
- surgeons receive feedback
- the process has qualified privilege.

2 AUDIT PARTICIPATION AND ASSESSMENT

2.1 Overview of participation

Key point ▮ Participation in WAASM is voluntary.

Participation in WAASM is voluntary. As explained in Chapter 1, WAASM is notified of all patient deaths where a surgeon is involved and this information is entered into the database. The surgeon is then sent a WAASM proforma to complete, unless he or she is a nonparticipant (ie has signed a participation form stating that they do not wish to participate). Percentage participation in the audit is calculated based on the completion and return of these proformas. The audit process is complete once the proforma has been assessed (by either the first-line or second-line assessor). Difficulties in gaining access to case notes or in finding available assessors can delay the assessment process.

Table 2.1 summarises the data on deaths reported to WAASM during the audit period. The table shows that the number of deaths reported to WAASM has increased each year during the audit period, apart from 2002–2003. The number of proformas returned to WAASM has also increased each year, apart from 2002–2003, as shown in Figure 2.1.

Table 2.1 Deaths reported to WAASM between 1 January 2002 and 31 December 2006 (audit status as at April 2007)

	No. cases (%)					
	2002	**2003**	**2004**	**2005**	**2006**	**Total**
Total deaths reported	672	639	694	715	735	3455
Audit process complete	411 (61)	382 (60)	465 (67)	497 (70)	443 (60)	2198 (64)
Proforma complete, awaiting assessment[a]	1	1	3(<1)	17 (2)	75 (10)	97 (3)
Proforma not returned	194 (29)	192 (30)	150 (22)	134 (19)	147 (20)	817 (24)
Terminal care cases (excluded)	5 (<1)	9 (1)	16 (2)	27 (4)	22 (3)	79 (2)
Case associated with nonparticipant[b]	61 (9)	55 (9)	60 (9)	40 (6)	48 (7)	264 (8)

a Case awaiting first or second-line assessment
b Nonparticipants are surgeons who have indicated that they do not wish to participate in WAASM.

Figure 2.1 Participation in the WAASM audit process from 2002 to 2006

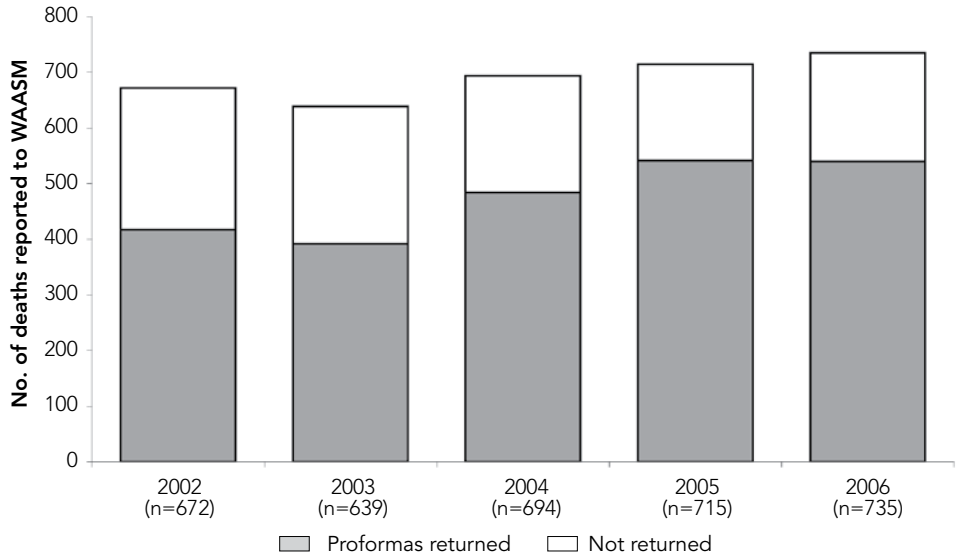


Figure 2.1 includes terminal care cases, cases still awaiting assessment and cases associated with nonparticipants (surgeons who have indicated that they do not wish to participate in WAASM).

2.2 Surgeon participation

Key points

- Participation in the audit by surgeons has increased over the audit period.
- Over the total audit period, surgeons returned 69% of proformas.
- The influence of WARM on participation in WAASM will become evident during 2007.

Surgeon participation in WAASM varies between years because it is voluntary, and because surgeons enter and leave the workforce. Participation is also affected by the fact that surgeons operate within specialties and with different types of patients. Some surgical specialties treat patients with complex medical conditions and an increased risk of death, whereas other surgical specialties have little associated mortality.

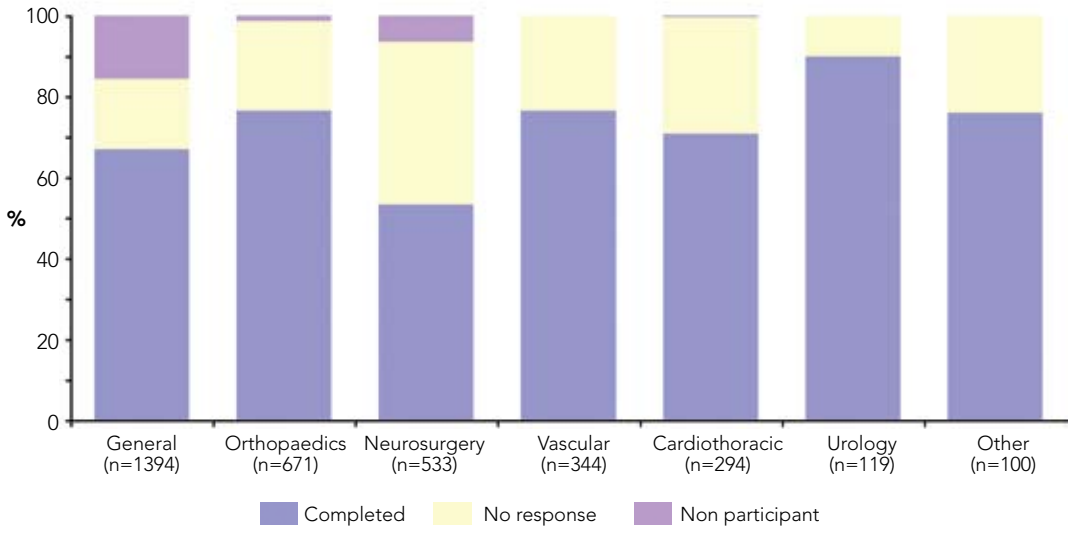
Over the five-year audit period, 262 individual surgeons were associated with 3455 deaths. A total of 193 (74%) surgeons had three or more associated deaths. These results are summarised in Table 2.2, which shows the number of surgeons participating in the audit, and in Figure 2.2, which shows the proportion of proformas returned by surgeons.

Table 2.2 Surgeons participating in the audit

	No. cases (%)					
	2002	2003	2004	2005	2006	Total
Reported deaths	672	639	694	715	735	3455
Surgeons associated with reported deaths	146	138	147	141	143	262
Proformas returned[a] (%)	417 (62)	392 (61)	484 (70)	541 (76)	540 (73)	2374 (69)
Surgeons with 3 or more deaths, who:	81	76	75	79	84	193
returned 100% of forms	34 (42)	32 (42)	31 (41)	41 (52)	34 (40)	73 (38)
returned >80% of forms	48 (59)	40 (53)	43 (57)	54 (68)	48 (57)	120 (62)
returned no forms[b]	19 (23)	17 (22)	8 (11)	6 (8)	7 (8)	7 (4)
signed as nonparticipants[c]	5 (6)	4 (5)	2 (3)	2 (3)	2 (2)	3 (2)

a Includes terminal care cases
b Includes non participants
c Nonparticipants in 2002 and 2003 subsequently became participants

Figure 2.2 Proportion of proformas for 2002–2006, returned by April 2007, by specialty[a]



a (n=3455)
Other=obstetrics and gynaecology, otolaryngology and ophthalmology, paediatrics and plastic surgery

Comment on surgeon participation

As explained in Chapter 1, the audit is a multistep process and there is a time lag for it to be completed. Nearly 70% (2374/3455) of proformas were returned to WAASM over the five-year period of the audit. During that time, the number of deaths reported to WAASM increased each year, apart from 2002–2003. Total participation for 2006 will be greater than reported, because there are additional cases moving through the audit process that will be included in the next report. The influence of WARM on the WAASM process will become clearer during 2007.

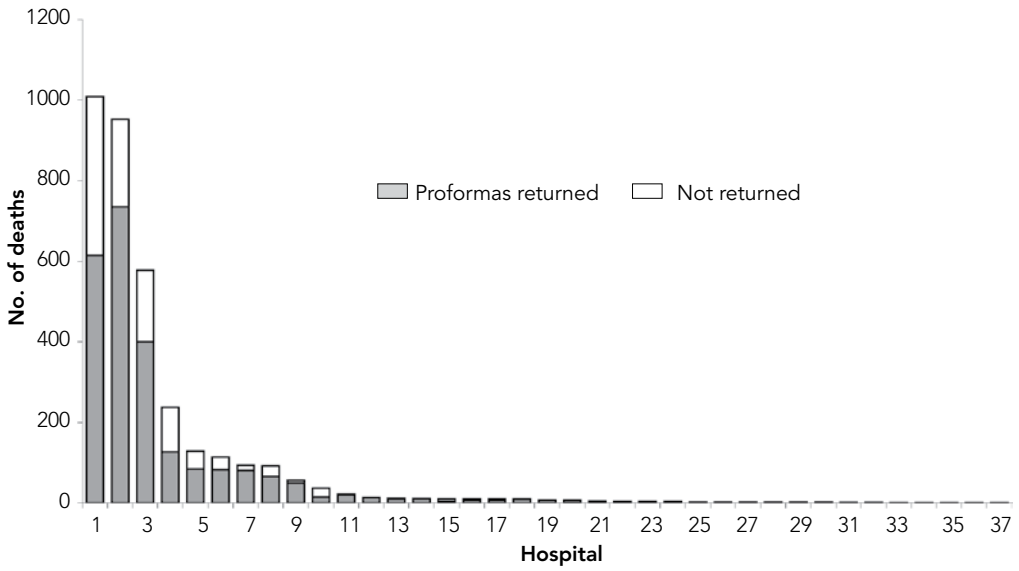
2.3 Hospital participation

Key points

- All hospitals in Western Australia (both public and private) in which surgical procedures take place (n=38) participate in the audit.
- During the audit period:
  - 80% of audited deaths occurred in public hospitals
  - 74% of audited deaths occurred in three public hospitals
  - 25% of cases had been transferred from one hospital to another.

All 38 hospitals in Western Australia (both public and private) in which surgical procedures take place participate in the audit. Hospitals in Western Australia range in size from small district hospitals to larger regional hospitals in rural areas and, in metropolitan areas, from large teaching hospitals, to smaller public and private hospitals.

Figure 2.3 Reported deaths associated with 38 hospitals in Western Australia in which surgical procedures take place[a]



a (n=3455)

Table 2.3 provides data on cases where the patient was transferred from one hospital to another (usually such transfers are from smaller regional or rural hospitals to larger metropolitan hospitals).

Table 2.3 Cases where the patient was transferred from one hospital to another hospital

	No. cases (%)					
	2002	**2003**	**2004**	**2005**	**2006**	**Total**
Completed cases[a]	400	379	453	435	336	2003
Patient transferred	93 (23)	104 (27)	109 (24)	105 (24)	86 (26)	497 (25)

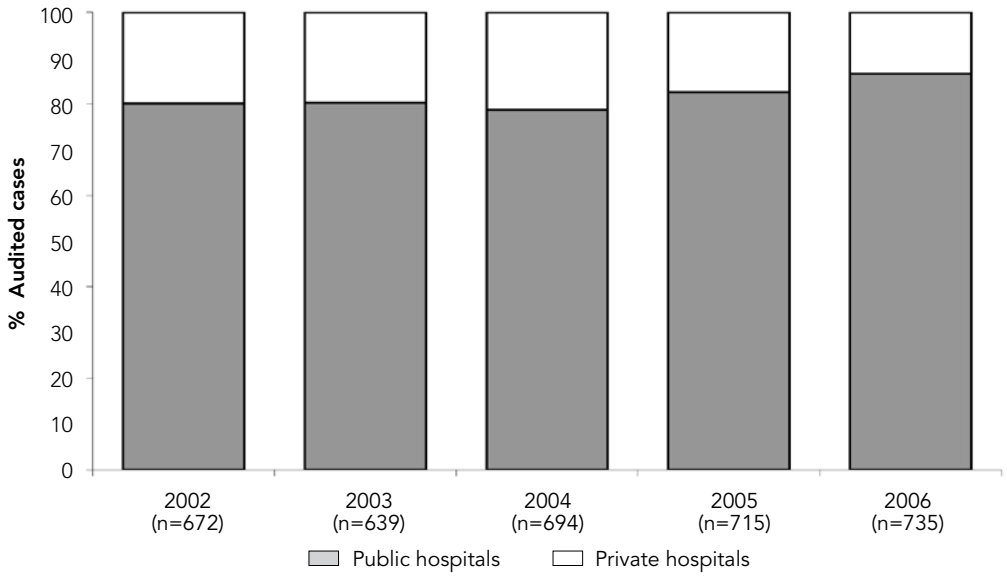
a These data were computed on completed cases; neurosurgical cases where the question was not on the neurosurgical proforma have been excluded. There are also missing data for these fields. Numbers of total completed cases are reflected in Table 3.1.

During the period of the audit:

- 74% of reported deaths occurred in the three largest public hospitals
- 25% of cases were transferred from one hospital to another.

Figure 2.4 shows the proportion of patients admitted to private and to public hospitals over the five-year period of the audit.

Figure 2.4 Patients admitted to public or private hospitals in Western Australia (2002–2006)



2.4 Second-line assessment

Key points

- Requests from first-line assessors for second-line review of cases have decreased over the audit period.
- The development of ANZASM is expected to lead to a process of interstate reviews.

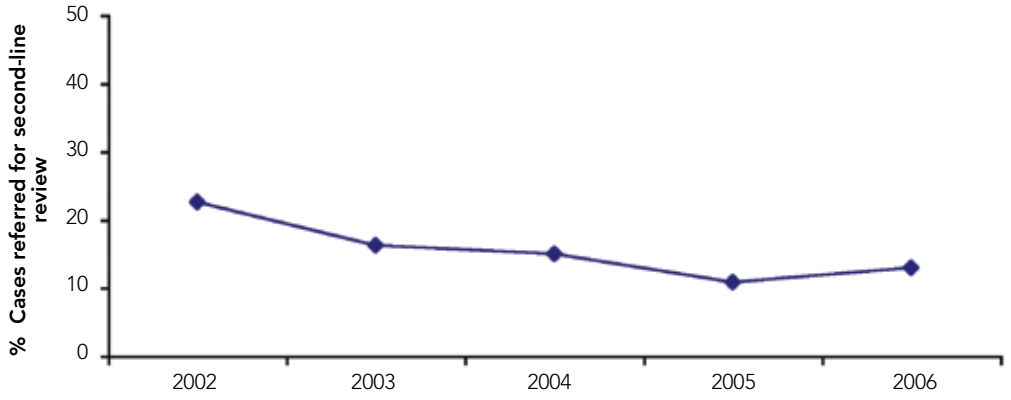
Table 2.4 and Figure 2.5 show that the proportion of cases requiring second-line assessment has fallen during the five-year audit period.

Table 2.4 Cases referred for second-line assessment (2002–2006)

	No. cases (%)					
	2002	**2003**	**2004**	**2005**	**2006**	**Total**
Completed cases[a] and cases with second-line assessment in progress	412	383	468	509	479	2251
Cases referred for second-line assessment	93 (23)	62 (16)	70 (15)	55 (11)	62 (13)	342 (15)
Proforma returned, first-line assessment in progress	0	0	0	5	39	44

a Terminal care cases were excluded

Figure 2.5 Proportion of cases referred for second-line assessment (2002–2006)



Comment on proportion of cases referred for second-line review

The proportion of cases referred for second-line review decreased over the five years of the audit (from 23% in 2002 to 13% in 2006). Difficulties in accessing case notes and in finding available second-line assessors can hamper completion of second-line assessment. The development of ANZASM is expected to lead to a process of interstate reviews, which will provide a larger pool of second-line assessors.

3 RESULTS

3.1 Overview and patient sample demographics

Key points

- Of the cases reported between 1 Jan 2002 and 31 December 2006, 2198 had completed the WAASM process by April 2007.
- The median age was 77 years for males (who made up 55% of the cases) and 81 years for females.
- Of the 1252 cases for which American Society of Anesthesiologists (ASA) grades were available, 67% of patients had an ASA grade of 4 (severe systemic disease that is a constant threat to life) or more.
- More than 90% of cases were associated with at least one significant comorbidity that contributed towards death.
- The most common causes of death in those aged <70 years were heart failure, and brain injury or haemorrhage, whereas in those aged ≥70, the main causes were heart failure and septicaemia.

As shown in Table 3.1, a total of 2198 of the cases reported between 1 Jan 2002 and 31 December 2006 had completed the WAASM process by April 2007, when data for this report were compiled.

Table 3.1 Completed cases (2002–2006)

	No. cases					
	2002	**2003**	**2004**	**2005**	**2006**	**Total**
Audit process complete	411	382	465	497	443	2198

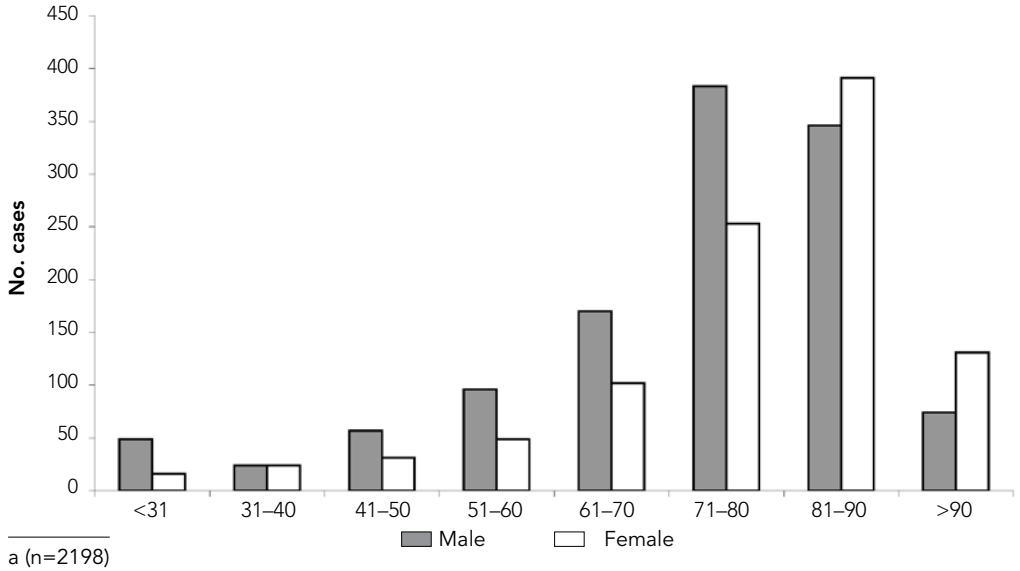
3.1.1 Age and sex distribution

Table 3.2 shows the median age and sex of the audited patients, and Figure 3.1 shows their age distribution by sex.

Table 3.2 Median age and sex (2002–2006)

	No. cases	**Median age (years)**	**Interquartile range (years)**
All patients	2198	79	68–85
Male (55%)	1201	77	65–83
Female (45%)	997	81	72–87

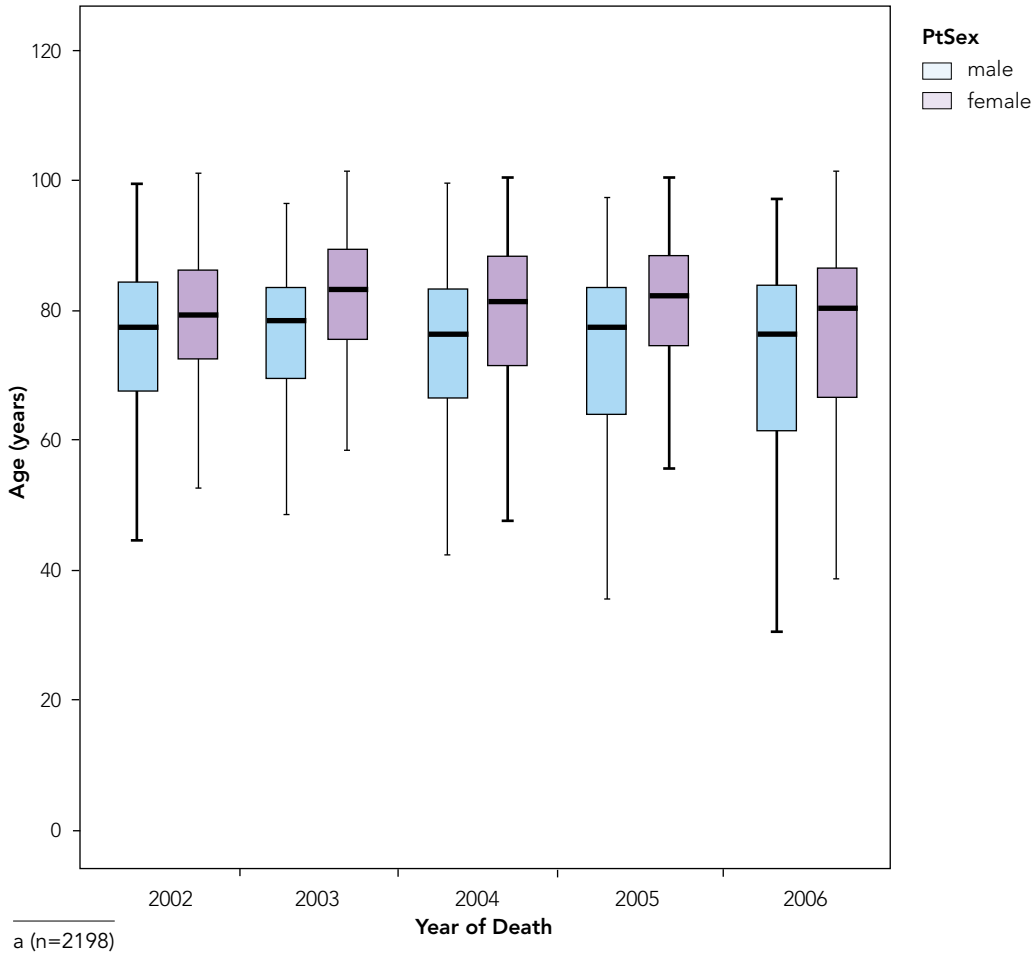
Figure 3.1 Age distribution by sex (2002–2006)[a]



a (n=2198)

Figure 3.2 shows the age distribution of audited patients by year and Figure 3.3 shows the age of patients against the specialty under which they were treated.

Figure 3.2 Age distribution of audited patients (2002–2006)[a]



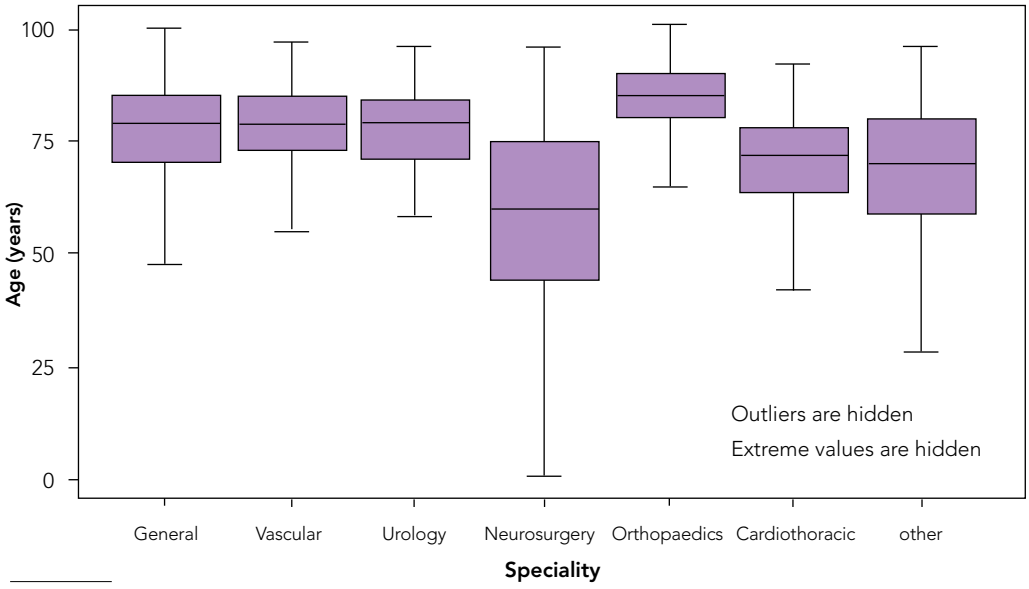
a (n=2198)

Figures 3.2 and 3.3 are box-and-whisker plots, in which:

- the central box represents the values from the lower to upper quartile (25–75 percentile)
- the middle line represents the median
- the vertical line (whisker) extends from the minimum to the maximum value, excluding outliers and extreme values (ie values larger than the upper quartile plus 1.5 or 3 times the interquartile range).

Outliers and extreme values can be displayed as separate points; however, in Figures 3.2 and 3.3 they were excluded.

Figure 3.3 Age of audited patients by specialty (2002–2006)[a]



a (n=2198)
Other =obstetrics and gynaecology, ophthalmology, otolaryngology, paediatrics and plastic surgery

3.1.2 American Society of Anesthesiologists grades

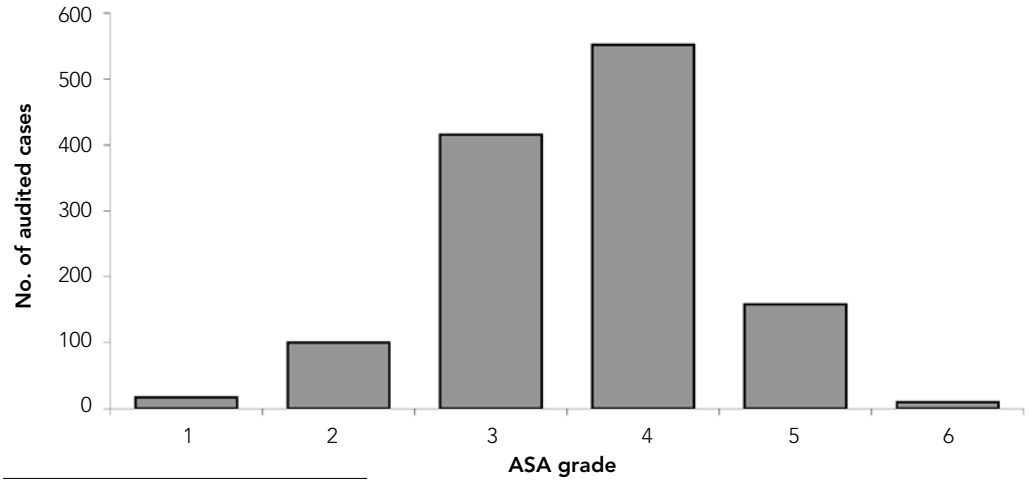
The American Society of Anesthesiologists (ASA) grades (Table 3.3) are an internationally recognised classification of preoperative physical status.

Table 3.3 American Society of Anesthesiologists (ASA) grades

ASA grade	Characteristics
1	A normal healthy patient
2	A patient with mild systemic disease and no functional limitation
3	A patient with moderate systemic disease and definite functional limitation
4	A patient with severe systemic disease that is a constant threat to life
5	A moribund patient unlikely to survive 24 hours, with or without an operation
6	A brain dead patient for organ donation

Data on ASA grades were available for 1252 of the 2198 completed cases. Figure 3.4 shows the distribution of the cases across the different grades; 67% of the 1252 cases were of grade four or greater.

Figure 3.4 American Society of Anesthesiologists (ASA) grades (2004–2006)[a]



a (n=1252), data missing for 946 cases

3.1.3 Causes of death

Table 3.4 is a summary of the most common causes of death among the audited cases. It shows that the most common causes of death in those aged less than 70 years were heart failure, and brain injury or haemorrhage, whereas in those aged 70 years or more, the main causes of death were heart failure and septicaemia. Details on all patients are provided in Appendix 1.

Table 3.4 Most common causes of death in audited cases (2002–2006)

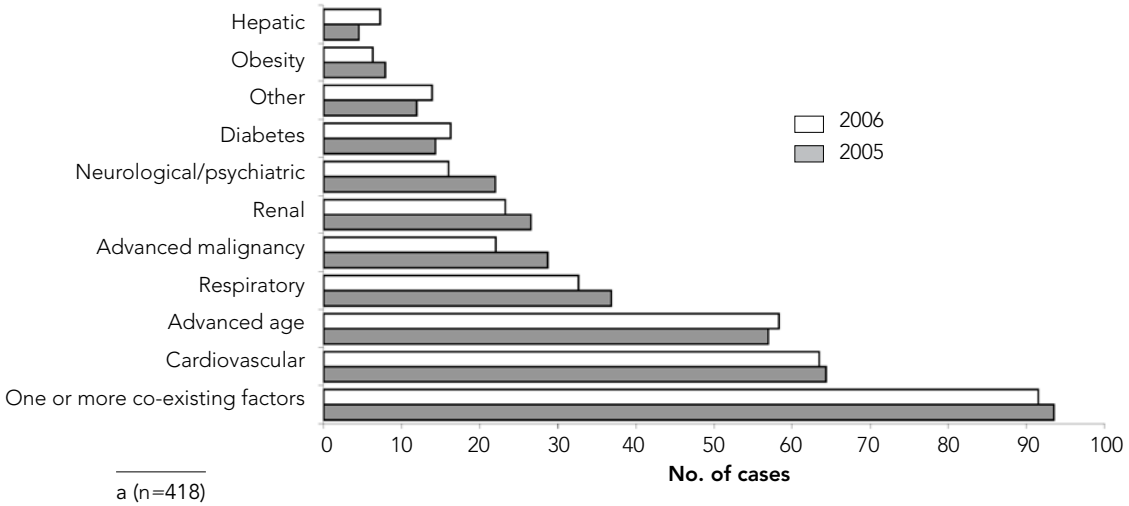
CAUSE OF DEATH	n	(%)
Cases <70 years old (n=618)		
Heart failure	72	(12)
Brain haemorrhage	64	(10)
Severe brain injury	63	(10)
Malignancy	57	(9)
Septicaemia	57	(9)
Multiple organ failure	55	(9)
Cases ≥70 years old (n=1578)		
Heart failure	396	(25)
Septicaemia	125	(8)
Multiple organ failure	100	(6)
Pneumonia	93	(6)
Respiratory failure	79	(5)

(n=2196), data missing for 2 of the 2198 cases

3.1.4 Comorbidity

When completing the proforma, surgeons are asked to indicate if there were significant coexisting factors increasing risk of death. The results are shown in Figure 3.5. Neurosurgeons do not complete this question in their form; therefore, neurosurgical cases are not included in this comorbidity analysis.

Figure 3.5 Comorbidity in completed cases, 2005[a] and 2006[b] (neurosurgical cases excluded)



a (n=418)
b (n=331)
'Other' includes alcohol abuse, anaemia, hyperthyroidism, leukaemia, malnutrition, peripheral vascular disease, sepsis and smoking.

The pattern of comorbidity in completed cases was similar to that seen in previous analyses.[1,2] More than 90% of cases had at least one significant comorbidity that contributed to death. In addition, more than 60% of audited patients had cardiovascular disease.

3.1.5 High dependency and intensive care units

Table 3.5 provides information about the use of high dependency units or intensive care units, and where assessors thought that patients should have been admitted to these units.

Table 3.5 Actual use and assessor opinion of use of a high dependency unit or intensive care unit (2002–2006)

No. cases (%)		2002 (n=395)	2003 (n=376)	2004 (n=413)	2005 (n=418)	2006 (n=331)
Use of	ICU	153 (39)	150 (40)	159 (38)	162 (39)	126 (38)
	HDU	52 (13)	53 (14)	64 (15)	56 (13)	36 (11)
Assessors' opinion on cases where patient was not admitted to either ICU or HDU:						
ICU should have been used		9 (2)	1	15 (4)	5 (1)	6 (2)
HDU should have been used		66 (17)	32 (9)	34 (8)	21 (5)	11 (3)

Excludes neurological cases. ICU =intensive care unit, HDU =high dependency unit

Comment on high dependency and intensive care units

WAASM's first annual report† noted that some patients may have benefited from admission to a high dependency unit. This issue was the subject of a plenary session at the joint state surgical and anaesthetic meeting in August 2005.¥ There has been a progressive reduction in the number of patients who were not admitted to a high dependency unit and who would have benefited from it. Given the increasing number of elderly and frail patients, it is important that hospitals under construction include adequate provision of high dependency units.

3.2 Comparison of surgeons' and assessors' views

Key points

- Assessors reported more areas of concern or adverse events than the associated consultants.
- WAASM data indicate that surgeons are under reporting (by approx. 54%) the number of areas of concern or adverse events.

Table 3.6 compares responses from surgeons and assessors to the question of whether they considered there were any areas for consideration, of concern, or adverse events in patient management. The system of classifying events as areas for consideration, of concern and adverse events was introduced in November 2003. Assessors recoded their responses for data collected during 2002 and 2003. As surgeons' responses were not recoded for the same time period, results cannot be compared for 2002 or 2003.

Table 3.6 Surgeons' and assessors' views on performance (2004–2006)

Year	Surgeon	Assessor				
		Consideration	Concern	Adverse event	No event	Total
2004	Consideration	23	14	5	22	64
	Concern	6	7	9	3	25
	Adverse event	3	0	5	3	11
	No event	42	23	16	284	365
	Total	74	44	35	312	465
2005	Consideration	13	14	4	16	47
	Concern	3	8	4	5	20
	Adverse event	1	1	5	1	8
	No event	25	21	21	355	422
	Total	42	44	34	377	497
2006	Consideration	8	4	3	15	30
	Concern	2	5	2	6	15
	Adverse event	2	2	2	3	9
	No event	18	9	11	351	389
	Total	30	20	18	375	443

Notes:
1. Data could only be analysed where both the assessor and surgeon had completed the proformas.
2. Missing data will account for differences from the year totals reported in Table 2.4.

† University of Western Australia, Western Australian Audit of Surgical Mortality. WAASM Annual Report 2003
¥ Combined Royal Australasian College of Surgeons and Australian and New Zealand College of Anaesthetists Scientific Meeting, 20 August 2005, University of Western Australia

From Table 3.6, the agreement between the responsible surgeon and the assessors reviewing the case can be seen. For example, in 2006:

- assessors reported 18 adverse events, whereas surgeons reported only 9 adverse events
- in only 2 cases did both assessors and surgeons agree that there were adverse events
- in 11 cases, assessors reported adverse events when surgeons had reported no adverse events.

Kappa scores measure the level of agreement or variation between observers — two or more observers or groups of observers will report different observed experiences when exposed to the same event. Kappa scores were obtained for surgeons and assessors views on performance from Table 3.6; these are shown in Table 3.7. The scores indicate 'fair agreement' between the surgeons and assessors.

Table 3.7 Kappa scores for surgeons and assessors views on performance

	Kappa score (95% confidence interval)
2004	0.29 (0.22–0.37)
2005	0.32 (0.24–0.40)
2006	0.30 (0.20–0.40)

Kappa scores are interpreted[12] as follows: <0 =no agreement, 0.0–0.19 =poor agreement, 0.20–0.39 =fair agreement, 0.40–0.59 =moderate agreement, 0.60–0.79 =substantial agreement, 0.80–1.00 =almost perfect agreement.

Comment on comparison of surgeons' and assessors' views

These data demonstrate the importance of external peer review. In each year, the number of areas of concern or adverse events noted by external assessors is approximately double that of surgeons. This strongly suggests that surgeons are under-reporting areas of concern or adverse events. These events would not have been detected if all cases had not undergone at least an external first-line review.

If a surgeon does not record an area of concern or adverse event under WAASM, it is likely the death will be classified 1–3 under WARM and, thus, will not be subject to a case-note review. Data collected by the WAASM process indicate that surgeons are under-reporting (by approximately 54%) the number of areas of concern or adverse events. These events are detected because all deaths reported to WAASM undergo external review. This situation provides strong evidence that an independent, external first-line assessor is essential.

3.3 Clinical events

Key points

- Assessors considered that areas of concern or adverse events were associated with 16% (366/2198) of cases.
- In 1% (23/2198) of cases, assessors considered that preventable adverse events caused the death.
- The proportion of cases associated with areas of concern or adverse events has decreased over the five-year audit period.
- The most common areas of concern or adverse events reported were:
  - anastomotic leaks following open surgery
  - delays to surgery or delays to transfer to a surgical unit
  - problems with fluid balance
  - aspiration pneumonia
  - failure to use deep vein thrombosis (DVT) prophylaxis
  - falls.
- Falls accounted for the majority of cases where assessors thought a preventable adverse event had caused death.

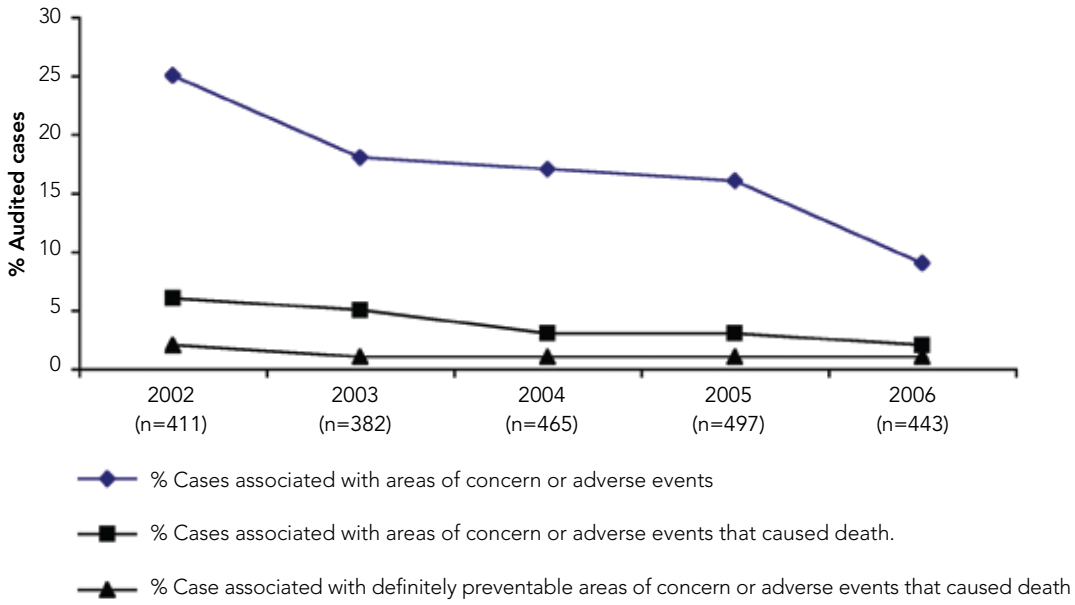
3.3.1 Reported areas for consideration, of concern and adverse events

When completing the proforma, assessors and surgeons indicate whether the event was preventable and who the event was associated with (Chapter 1, Section 1.4). Table 3.8 shows how the audited deaths were categorised, by year— full details are given in Appendixes 4 and 5. Figure 3.6 indicates that the proportion of cases associated with areas of concern or adverse events has decreased significantly over the audit period.

Table 3.8 Audited deaths associated with areas for consideration, of concern, or adverse events as reported by assessors (most significant event only) (2002–2006)

	No. cases (%)					
	2002 n=411	2003 n=382	2004 n=465	2005 n=497	2006 n=443	Total n=2198
Area for consideration	19 (5)	32 (8)	74 (16)	42 (8)	30 (7)	197 (9)
Area of concern	42 (10)	33 (9)	44 (9)	44 (9)	20 (5)	183 (8)
Adverse event	62 (15)	34 (9)	35 (8)	34 (7)	18 (4)	183 (8)
Adverse event that caused death	24 (6)	18 (5)	14 (3)	15 (3)	7 (2)	78 (4)
Adverse event that caused death, considered definitely preventable.	8 (2)	4 (1)	3 (1)	6 (1)	2 (<1)	23 (1)

Figure 3.6 Cases associated with adverse events or areas of concern (2002–2006)



The following results were found for the period 2002 to 2006 (significance was determined in each case using the Cochran–Armitage 2-sided trend test):

- the proportion of cases associated with areas of concern or adverse events decreased significantly ($p<0.0001$)
- the proportion of cases associated with areas of concern or adverse events that caused death also decreased significantly ($p=0.002$)
- the proportion of cases associated with preventable areas of concern or adverse events did not differ significantly ($p=0.153$).

Assessment of cases may be delayed by difficulties in accessing case notes or in finding available assessors. As the data from 2006 complete the audit cycle, it is reasonable to predict that the number of cases associated with areas of concern or adverse events may increase. If this is the case, it will be reflected in subsequent annual reports.

Appendix 6 contains the full list of areas of concern and adverse events reported over the five-year audit period. The most common events reported were:

- anastomotic leaks following open surgery
- delays to surgery or transfer to the surgical unit
- problems with fluid balance
- aspiration pneumonia
- failure to use DVT prophylaxis
- falls.

Comment on reported areas for consideration, of concern, or adverse events

Although the overall and important message is that these areas of concern or adverse events are small in number, the consequence for each individual patient is substantial. Of particular importance is the fact that about half of these events have been preventable. These figures almost certainly under-represent the number of preventable events.

3.3.2 Falls

Table 3.9 shows cases where a fall was reported as an area of concern or adverse event during the audit period.

Table 3.9 Cases where a serious fall was reported (2002–2006)[a]

	Made no difference to outcome	May have contributed to death	Caused death	**Total**
Concern	1	2	0	3
Adverse event	1	5	8	14
Total	2	7	8	17

a (n=17)

In eight cases, assessors thought that the fall caused the death of the patient; in a further five cases, the fall may have contributed to the death of the patient. Examination of the cases revealed that in seven cases, the fall caused the patient to fracture their neck of femur, and in six cases the fall resulted in a severe traumatic head injury.

Comment on falls

Falls are recognised internationally as a major problem for inpatients. Numerous international studies have indicated that falls are the leading cause of injury in hospitals.[13,14] In a recent extensive United Kingdom report on falls,[15] 21 of 101 199 falls examined in acute hospitals caused the death of the patient, and 1022 caused severe or permanent harm. There have been many studies on strategies to prevent falls in hospitals. A meta-analysis suggests that modest reductions in fall rates in hospital patients can be achieved using multifactorial interventions.[13] Another study suggests that a multistrategy approach to falls prevention will reduce fall-related injuries, but needs to be incorporated into all aspects of the daily care of the patient.[14]

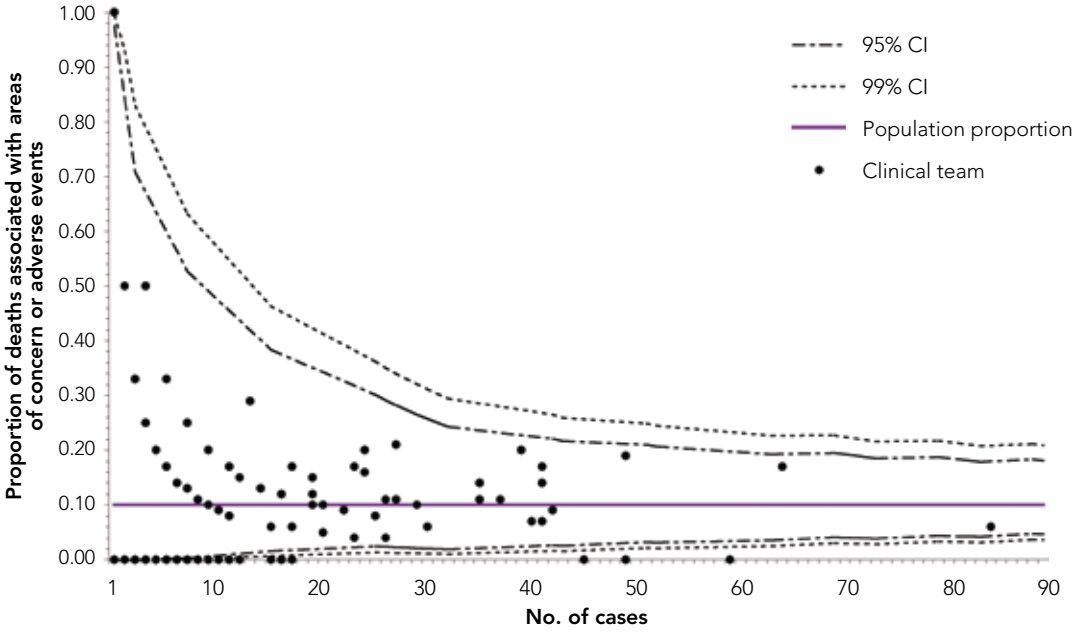
Most falls occur towards the end of the patient's hospital stay, when unassisted ambulation increases. Some patients may have an entirely successful surgery, only to suffer a fatal fall. Often, the discharge of patients from surgical wards is delayed because there is no 'downstream' bed that offers a more appropriate level of care. These patients remain in surgical wards, where they compete with acutely ill patients for nursing time. Some falls are undoubtedly an unintended consequence of patients remaining in surgical wards when they would be better managed in downstream beds.

3.3.3 Surgical performance

Figure 3.7 shows the proportion of deaths associated with areas of concern or adverse events for each clinical team. The figure is a funnel plot, which is a type of control chart. It shows the overall event proportion (population proportion) and the resulting exact 95% and 99% binomial confidence intervals (control limits). Individual event proportions are plotted against number of cases. Funnel plots are a useful way of presenting performance data. They allow for small numbers and individual performance to be seen in relation both to the performance of others and to the population proportion. Modified funnel plots have been used previously to examine quality and performance issues in healthcare.[16,17,18,19]

Of the 2198 completed cases, there were 218 (10%) cases where assessors indicated that areas of concern or adverse events were associated with the audited clinical team. In Figure 3.7, points located within the region bounded by the control limits represent performance that is not significantly different from the population proportion. Points are superimposed where clinical teams had the same number of operations and the same proportion of areas of concern or adverse events.

Figure 3.7 Proportion of deaths associated with areas of concern or adverse events for audited clinical teams (2002–2006)[a]



a (n=226)

CI =confidence interval

Comment on surgical performance

As in previous years, these data show no outlier clinical teams. However, as in previous reports, the data have not been risk adjusted. The data collected by WAASM are incomplete and are not sufficiently detailed to permit risk adjustment. After four years, WAASM has a substantial number of data points; by the laws

of statistics it is inevitable that an outlier will appear. Without risk-adjusted data the validity or otherwise of such an observation will be impossible to determine. Given this situation, it is unlikely that WAASM will be able to publish such data in subsequent years.

3.4 Admissions

Key points

- Over the period 2002–2006, 80% of cases were admitted to public hospitals.
- Of the 1751 cases admitted to public hospitals, 14% were elective admissions. Of the 447 cases admitted to private hospitals, 39% were elective admissions.
- Of the emergency cases admitted to public hospitals, 68% underwent operation, compared to 81% of emergency cases admitted to private hospitals ($p<0.0001$)[a].
- The proportion of areas of concern or adverse events associated with cases that underwent operation (elective and emergency admissions) was not significantly different between public and private hospitals ($p=0.678$)[a].
- Considering all hospitals, the proportion of areas of concern or adverse events associated with emergency admissions (14%) was significantly less than the proportion of events associated with elective admissions (28%) ($p<0.0001$)[a].

a Pearson's chi-square test

3.4.1 Overview of admissions

The audit data concerning admissions cover:

- the type of hospital (public or private)
- the type of admission (elective or emergency)
- whether the patient underwent operation (operative or non-operative).

The results presented in this section examine these different areas; further information on operative and non-operative cases is provided in Section 3.5, below.

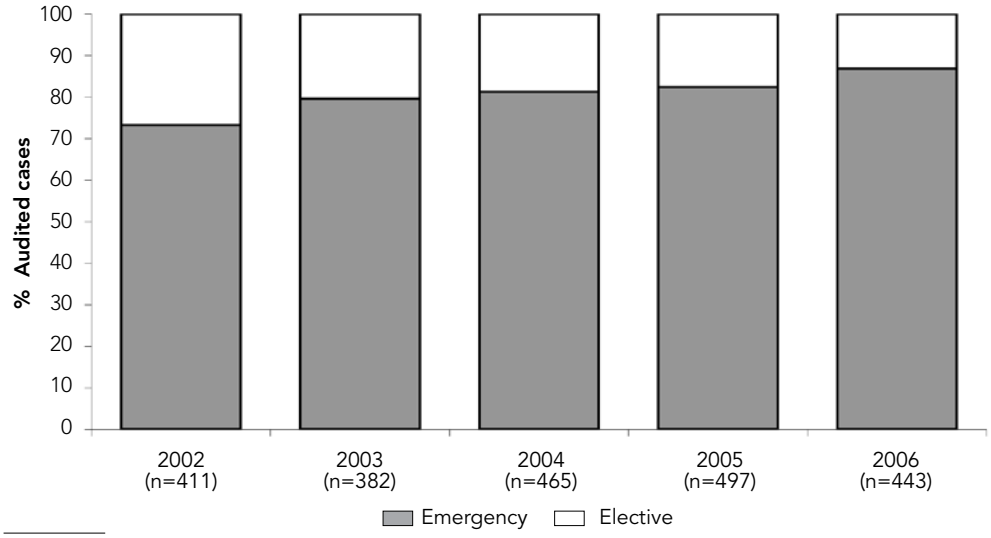
The proportion of cases admitted as emergency admissions is increasing, as is the proportion of cases admitted to public hospitals (Table 3.10). These results are shown graphically in Figure 3.8 (emergency and elective admissions) and Figure 3.9 (public and private hospital admissions).

Table 3.10 Emergency and public hospital admissions of audited patients[a]

	2002	2003	2004	2005	2006	Total
Audit process completed	411	382	465	497	443	2198
Percentage of emergency admissions[b]	(73)	(80)	(81)	(83)	(87)	(81)
Percentage of public hospital admissions[b]	(79)	(76)	(75)	(81)	(83)	(79)

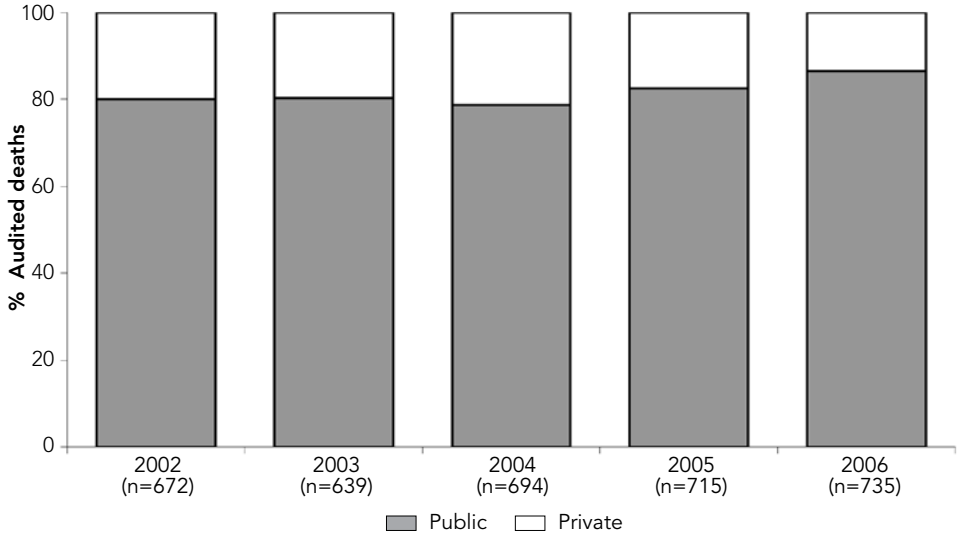
a n=2198
b Significant increase (p<0.0001 Pearson's chi-square test)

Figure 3.8 Emergency and elective admissions in audited patients (2002–2006)



a (n=2198)

Figure 3.9 Admission of cases to public and private hospitals[a]



Comment on admissions

A greater proportion of cases were admitted as emergency rather than elective admissions. The proportion of cases admitted to public hospitals increased. This would suggest that public hospitals are now receiving an increasing proportion of seriously ill patients (i.e. those who are dying). This has important implications for the management of such patients.

3.4.2 Relationship between factors related to admissions data

Key points

- Of the 2198 cases, 75% underwent one or more operations.
- Most (95%) of the 420 elective cases underwent an operation. Among elective cases undergoing surgery, the proportion admitted to private hospitals (96%) was not significantly different from the proportion admitted to public hospitals (95%) ($p=0.678$)[a].
- Of the 1778 emergency admissions, 70% underwent an operation. A significantly higher proportion of emergency admissions to private hospitals underwent surgery (81%) when compared to those admitted as an emergency to public hospitals (68%) ($p<0.0001$)[a].
- Among emergency admissions undergoing surgery and associated with an area of concern or adverse event, the proportion admitted to a private hospital (16%) was not significantly different from the proportion admitted to a public hospital (18%) ($p=0.467$)[a].
- Among elective cases undergoing surgery and associated with areas of concern or adverse events, the proportion admitted to a private hospital (24%) was not significantly different from the proportion admitted to a public hospital (32%) ($p=0.063$)[a].
- Among cases undergoing surgery, the proportion of elective cases associated with areas of concern or adverse events (29%) was significantly greater than the proportion of emergency cases associated with such events (17%) ($p<0.0001$)[a].

a Pearson's chi-square test

Table 3.11 shows admissions to private and public hospitals for all elective and emergency admissions (Table 3.11a), for those undergoing surgery (Table 3.11b) and for those undergoing surgery associated with an area of concern or adverse event (Table 3.11c). The data from Table 3.11 are broken down by specialty (Table 13.12a) and reasons why an operation was not performed (Table 13.12b).

Table 3.11 Elective and emergency admissions to public and private hospitals (all cases, 2002–2006)

	No. cases (%)		
(a) All cases — elective and emergency admissions, public and private hospitals			
	Elective	**Emergency**	**Total**
Private	174 (39)	273 (61)	447
Public	246 (14)	1505 (86)	1751
Total	420 (19)	1778 (81)	2198
(b) Cases that underwent an operation — elective and emergency admissions, public and private hospitals[a]			
	Elective	**Emergency**	**Total**
Private	167 (96)	222 (81)	389 (87)
Public	234 (95)	1022 (68)	1256 (72)
Total	401 (95)	1244 (70)	1645 (75)
(c) Cases that underwent an operation that were associated with an area of concern or adverse events[b]			
	Elective	**Emergency**	**Total**
Private	40 (24)	35 (16)	75 (19)
Public	76 (32)	182 (18)	258 (20)
Total	116 (29)	217 (17)	333 (20)

a Percentages relate to the figures given in part (a) of the table (all cases).
b Percentages relate to the figures given in part (b) of the table (all cases).

The data from Table 3.11 are also shown in Figure 3.10 (elective admissions) and Figure 3.11 (emergency admissions). Cumulative data on the proportion of cases associated with areas of concern or adverse events are shown in Figure 3.12 (operative cases) and Figure 3.13 (all cases).

Seventy-five per cent of 2198 cases underwent one or more operation and 95% of the 420 elective cases underwent operation, compared to 70% of 1778 emergency admissions (Table 3.11a,b). A similar proportion of elective cases admitted to private hospitals (96%) and to public hospitals (95%) underwent surgery ($p=0.678$, Pearson's chi-square test) (Table 3.11b).

Patients admitted as an emergency were more likely to undergo surgery when admitted to a private hospital (81%) than to a public hospital (68%) ($p<0.0001$, Pearson's chi-square test) (Table 3.11b).

The proportion of areas of concern or adverse events associated with patients that underwent surgery following an emergency admission was no different if the patient was admitted to a private hospital (16%) or admitted to a public hospital (18%) ($p=0.467$, Pearson's chi-square test) (Table 3.11c).

Similarly, the proportion of areas of concern or adverse events associated with elective cases undergoing surgery was not significantly different in patients admitted to private hospitals (24%) when compared to those admitted to public hospitals (32%) (p=0.063, Pearson's chi-square test) (Table 3.11c).

However, the proportion of all elective cases (both public and private admissions) undergoing surgery that were associated with areas of concern or adverse events (29%) was significantly greater than the proportion of events associated with emergency patients undergoing surgery (17%) (p<0.0001, Pearson's chi-square test) (Table 3.11c).

Table 3.12 Emergency admissions to private and public hospitals (2002–2006)

(a) By specialty	No. cases (%)	
	Emergency admission to private hospital (n=273)	**Emergency admission to public hospital (n=1505)**
Specialty:		
General	131 (48)	541 (36)
Orthopaedics	75 (28)	378 (25)
Urology	20 (7)	34 (2)
Cardiothoracic	19 (7)	87 (6)
Vascular	18 (7)	178 (12)
Neurosurgery	4 (2)	248 (16)
Other[a]	6 (2)	39 (3)
Underwent operation	222 (81)	1022 (68)

(b) Emergency admissions where no operation was performed		
	Emergency admission to private hospital (n=51)	**Emergency admission to public hospital (n=483)**
Reason for no operation:		
Active decision not to operate	27 (53)	255 (53)
Not a surgical problem	5 (10)	62 (13)
Patient refused operation	1 (2)	24 (5)
Rapid death	4 (8)	26 (5)
Missing data	14 (27)	116 (24)

a Other =obstetrics and gynaecology, ophthalmology, otolaryngology, paediatrics and plastic surgery

Figure 3.10 Elective admissions that underwent an operation (2002–2006)

Figure 3.11 Emergency admissions that underwent an operation (2002–2006)

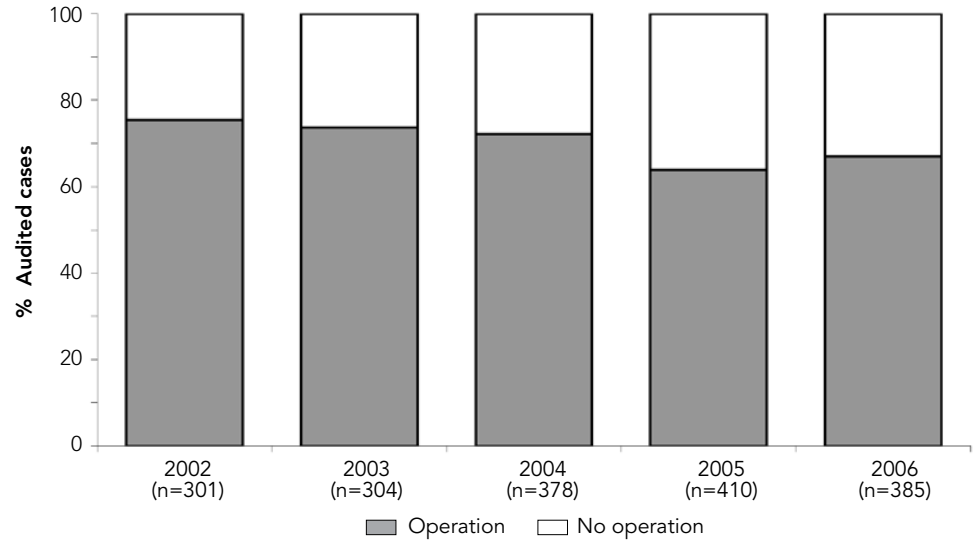


Figure 3.12 Cumulative proportion of operative cases associated with areas of concern or adverse events — elective and emergency admissions (2002–2006)

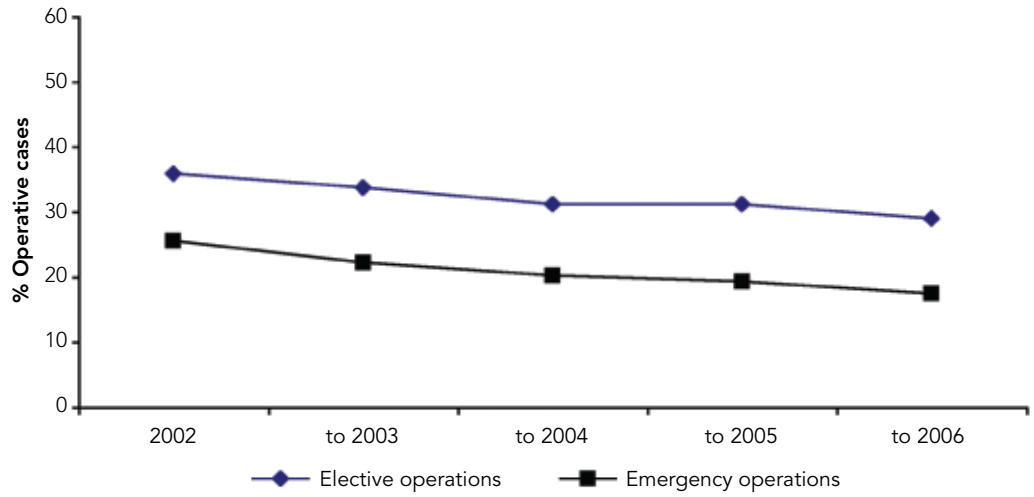
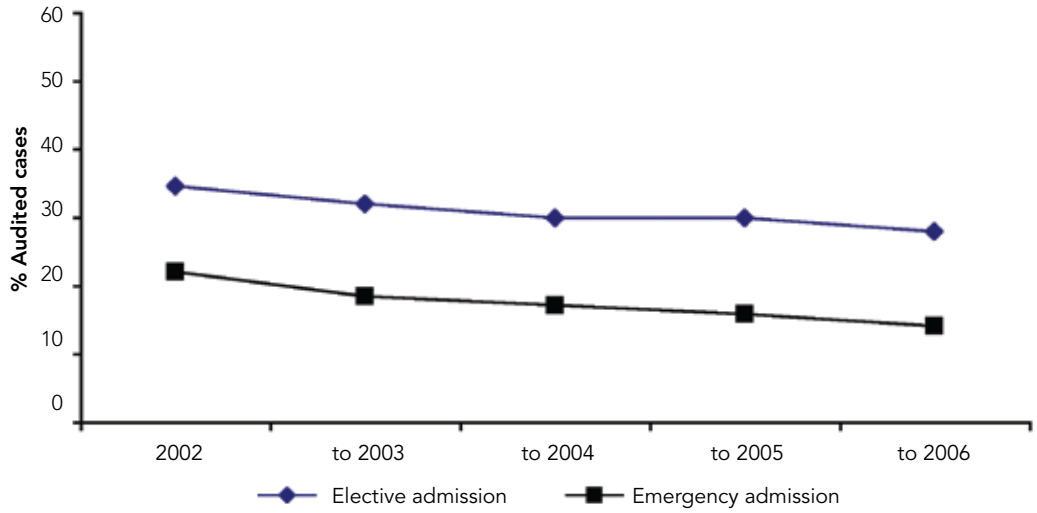


Figure 3.13 Cumulative proportion of all audited emergency and elective admissions associated with areas of concern or adverse events (2002–2006)



3.4.3 Areas of concern or adverse events associated with emergency or elective admissions

Table 3.13 summarises the data on emergency and elective admissions associated with areas of concern or adverse events. A significantly higher proportion of elective admissions were associated with areas of concern or adverse events (28%) when compared with the proportion of emergency admissions associated with events (14%) ($p < 0.0001$ Pearson's chi-square test).

Table 3.11 shows that elective admissions are more likely to undergo an operation than emergency admissions. Tables 3.14 and 3.15 list the areas of concern and adverse events as reported by assessors.

Table 3.13 Emergency and elective admissions that were associated with areas of concern or adverse events (2002–2006)

	Areas of concern or adverse events		
	Yes	**No**	**Total**
Elective admission	117 (28)	303 (72)	420
Emergency admission	249 (14)	1529 (86)	1778
Total	366 (17)	1832 (83)	2198

Table 3.14 All areas of concern or adverse events associated with elective admissions (2002–2006)[a]

Area of concern or adverse event	**No.**	**(%)**
Related to open surgery	52	(12)
Incorrect or inappropriate therapy	34	(8)
Delays	30	(7)
General complications	22	(5)
Assessment problems	13	(3)
Failure to use facilities	13	(3)
Communication failures	10	(2)
Staff problems	8	(2)
Drug-related problems	6	(1)
Patient factors	5	(1)
Related to endoscopic surgery	5	(1)
Anaesthesia-related problems	4	(1)
Related to laparoscopic surgery	3	(1)
Transfer problems	2	(<1)
Diagnosis-related problems	1	(<1)
Total	**208**	

a (n=420), some cases associated with more than one event

Table 3.15 All areas of concern or adverse events associated with emergency admissions (2002–2006)[a]

Area of concern or adverse event	No.	(%)
Delays	82	(5)
Incorrect or inappropriate therapy	54	(3)
Related to open surgery	49	(3)
Failure to use facilities	31	(2)
General complications	30	(2)
Communication failures	27	(2)
Patient factors	19	(1)
Diagnosis-related problems	17	(1)
Staff problems	15	(1)
Drug-related problems	13	(1)
Assessment problems	11	(1)
Related to radiological surgery	6	(<1)
Transfer problems	6	(<1)
Resuscitation problems	4	(<1)
Related to endoscopic surgery	4	(<1)
Related to laparoscopic surgery	3	(<1)
Monitoring problems	2	(<1)
Problems with blood or blood products	2	(<1)
Anaesthesia-related problems	1	(<1)
Equipment-related problems	1	(<1)
Total	**377**	

a (n=1778), some cases associated with more than one event

Comment on emergency and elective admissions

Delay remains the most common reason for an area of concern or adverse event in emergency admissions. Many emergency admissions have sepsis and delay in the face of sepsis is very detrimental to outcome. Often these delays are preventable, with many occurring before the patient is seen by a surgeon. This re-emphasises how the influence of WAASM extends well beyond the surgical community. WAASM is proposing to study the causes for delay in greater detail.

3.5 Operative and non-operative cases

Key points

- Of all cases, 25% did not undergo an operation.
- The proportion of cases where no operation was performed showed a trend towards increase over the audit period (p<0.0001, 2-sided Cochran–Armitage trend test).
- The proportion of surgeons making an active decision not to operate increased over the audit period.
- In the 1645 cases where an operation was undertaken, the operation was abandoned in 6% of cases and the patient was returned to theatre in 12% of cases.
- The more operations the patient had, the more likely they were to encounter an area of concern or adverse event.
- The proportion of operations performed by a consultant when a patient was returned to theatre increased over the audit period.
- The proportion of areas of concern or adverse events associated with cases returned to theatre decreased over the audit period.

The number of audited patients who did not have an operation increased significantly (p<0.0001) over the audit period (Table 3.16 and Figure 3.14). Figure 3.15 shows the same data by specialty.

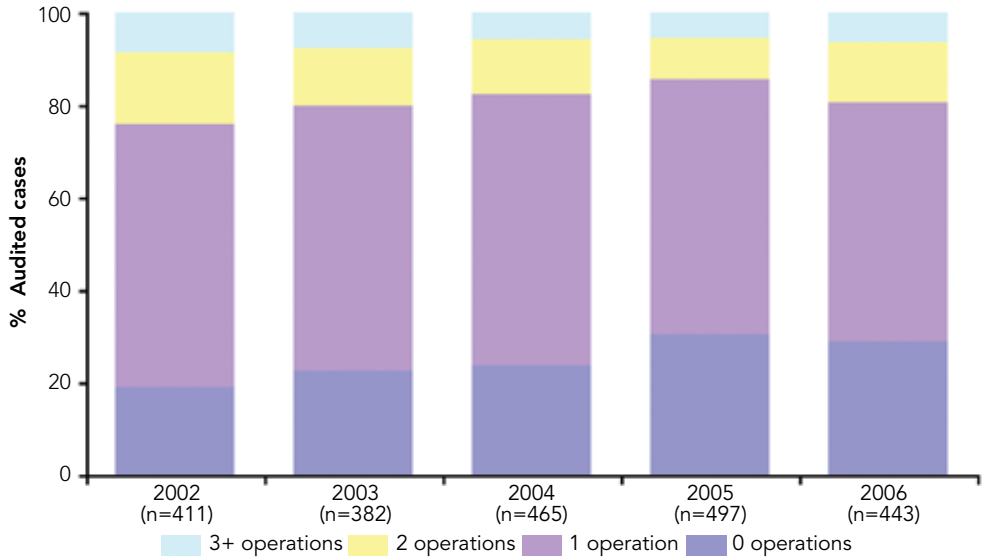
Table 3.16 shows that, of the 2198 cases, 25% did not undergo an operation, 56% underwent one operation, 12% underwent two operations and 7% were returned to theatre three or more times. The association between number of operations and areas of concern or adverse events is discussed in Section 3.5.3, below.

Table 3.16 Operations performed (2002–2006)

	No. cases (%)					
	2002 (n=411)	**2003 (n=382)**	**2004 (n=465)**	**2005 (n=497)**	**2006 (n=443)**	**Total (n=2198)**
No operation[a]	78 (19)	86 (23)	110 (24)	151 (30)	128 (29)	553 (25)
1 operation	234 (57)	219 (57)	273 (59)	274 (55)	229 (52)	1229 (56)
2 operations	64 (16)	48 (13)	55 (12)	45 (9)	58 (13)	270 (12)
3 or more operations	34 (8)	29 (8)	27 (6)	27 (5)	28 (6)	146 (7)

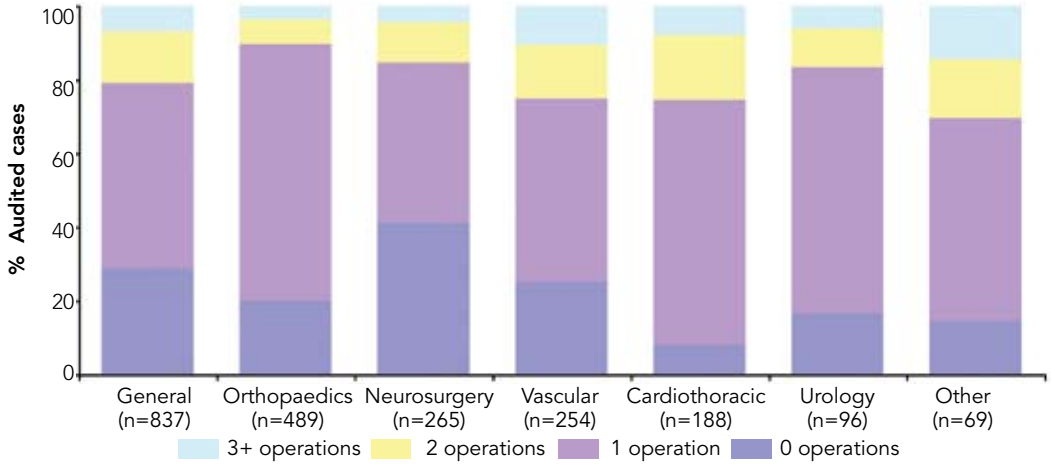
a The proportion of cases where no operation was performed increased significantly over the audit period (p<0.0001, 2-sided Cochran–Armitage trend test).

Figure 3.14 Number of operations (2002–2006)[a]



a (n=2198)

Figure 3.15 Number of operations, by specialty (2002–2006)[a]



Other =ear, nose and throat; obstetrics and gynaecology; ophthalmology; plastic surgery
a (n=2198)

3.5.1 Non-operative cases

When a patient did not undergo an operation, the reason for the decision not to operate was not always given on the proforma. For cases where the proforma included the reasons for nonsurgical management, the data are shown Figure 3.16. Missing data accounts for the difference in patient numbers between Figure 3.16 (n=414) and Table 3.16 (n=553) for cases undergoing no operations.

Surgeons may also report when an operation is abandoned because proceeding would be futile. These data are shown in Table 3.17.

Figure 3.16 Reason for no operation, all specialties (2002–2006)[a]

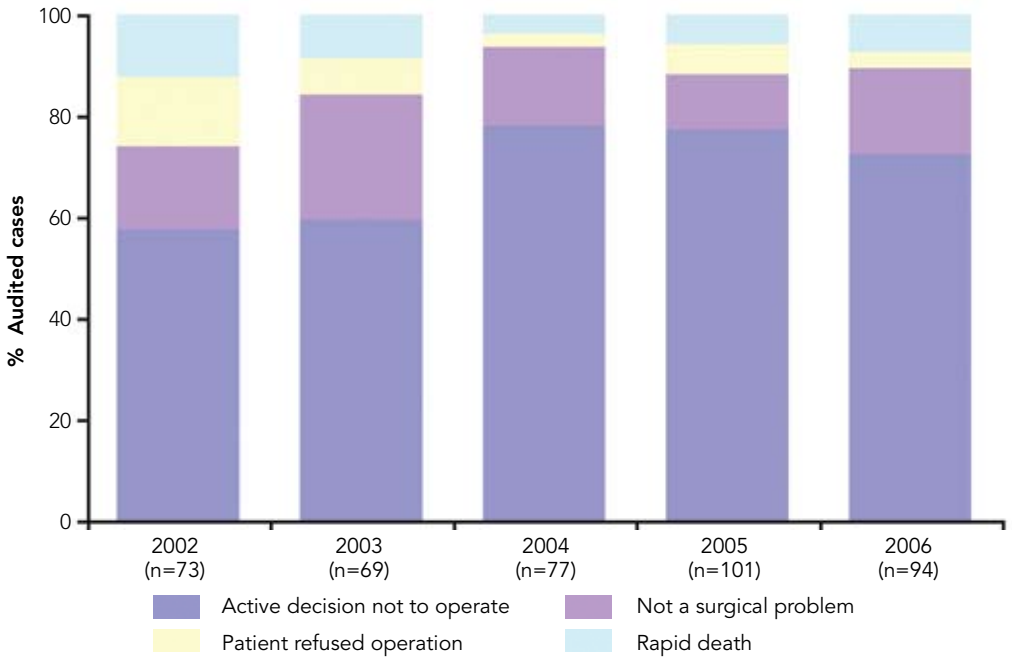


Table 3.17 Operations abandoned, including patients undergoing one or more surgical procedures (2002–2006)

	2002	2003	2004	2005	2006	Total
1st operation	19	22	11	18	7	77
2nd operation	6	2	2	4	2	16
3rd operation	2	3	1	4	0	11
Total number of abandoned cases	27	27	14	26	9	104
(%)	(8)	(9)	(4)	(8)	(3)	(6)
Total number of operative cases	333	296	355	346	315	1645

Comment on reason for no operation

On review of the case notes, it is evident that, for many of the 'abandoned' operations, information that was available (or that should have been available) before surgery indicated that an operation was contraindicated. For example, some patients with upper gastrointestinal malignancies had their scheduled laparotomies abandoned when they were found to have disseminated malignancy. Better pre-operative assessment might have detected this dissemination, in which case no operation might have been a better management option for some of these patients.

3.5.2 Risk of death before surgery

Surgeons and assessors are asked for their view on the overall risk of death before surgery. In the 1318 cases where complete information was available, 67% of assessors and 60% of surgeons indicated that the risk of death before surgery was considerable or expected (Table 3.18). In 49% of cases, both the surgeon and the assessor agreed that the risk of death for the particular patient before surgery was considerable or expected.

Table 3.18 Comparison of views of surgeons and assessors on pre-operative risk of death in cases undergoing an operation[a]

Assessors' view of risk	No. cases (%) Surgeons' view of risk			
	Minimal/small	Moderate	Considerable/expected	Total
Minimal/small	75 (6)	19 (1)	27 (2)	121 (9)
Moderate	40 (3)	142 (11)	128 (10)	310 (24)
Considerable/expected	50 (4)	196 (15)	641 (49)	887 (67)
Total	165 (13)	357 (27)	796 (60)	1318

a (n=1318) (cases in which complete information from both assessor and surgeon was available); Kappa score (K) =0.33, 95% CI 0.28–0.37), indicating that surgeons and assessors were in 'fair agreement'.

3.5.3 Areas of concern or adverse events associated with operative and non-operative cases

Table 3.16 showed the number of operations performed. Figure 3.17 shows that as more operations were performed, the more likely the case was to be associated with an area of concern or adverse event. However, Figure 3.17 also shows that the proportion of associated areas of concern or adverse events has fallen for all categories over the audit period.

Figure 3.17 Cumulative proportion of cases associated with areas of concern or adverse events in all participating hospitals

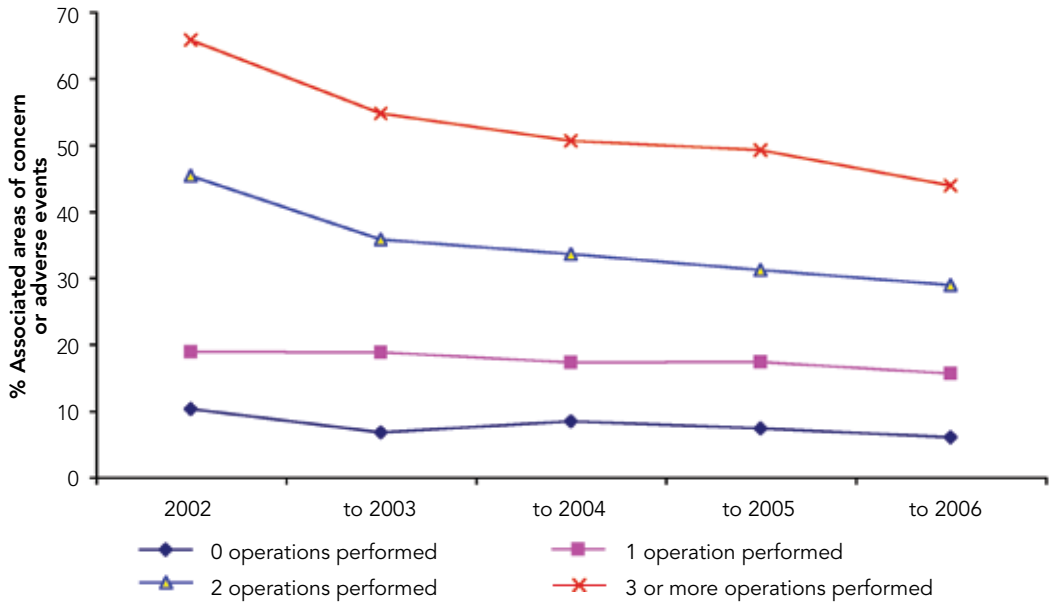
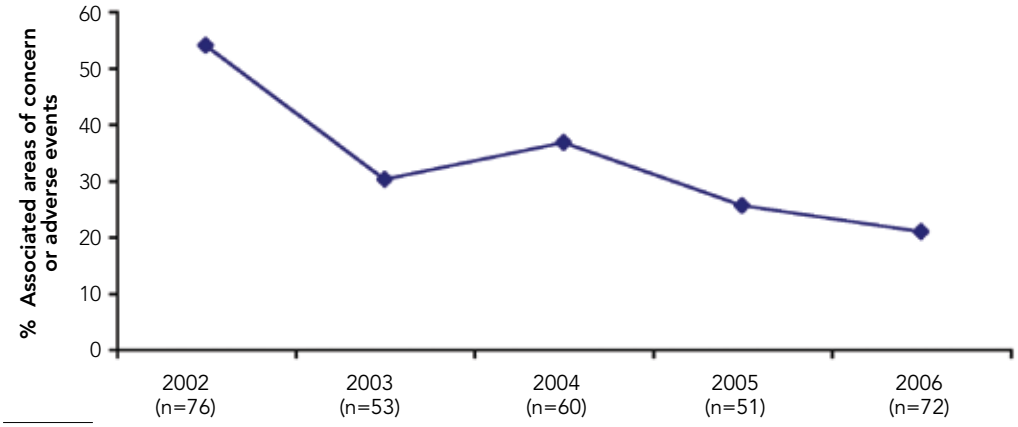


Figure 3.18 shows the areas of concern or adverse events associated with the 312 cases from Western Australian teaching hospitals in which more than one operation was performed.

Figure 3.18 Areas of concern or adverse events associated with cases where more than one operation was performed in Western Australian teaching hospitals (2002–2006)[a]



a (n=312)

3.5.4 Unplanned return to theatre

Since November 2003, surgeons have been asked to indicate whether there was an unplanned return to theatre. Over the three-year period from 2004 to 2006, 13% of audited patients undergoing an operative procedure had an unplanned return to theatre. These data are presented in Table 3.19.

Table 3.19 Unplanned return to theatre (2004–2006)

	2004	2005	2006	Total
Total number of cases where an operation was performed	355	346	315	1016
Cases where surgeons reported an unplanned return to theatre (%)	49 (14)	49 (14)	34 (11)	132 (13)

3.6 Grade of surgeon (teaching hospitals)

Key point ▮ The proportion of consultant surgeons performing the operation when a patient is returned to theatre has increased.

When completing the WAASM proforma, surgeons are asked to indicate the grade of surgeon making the operative decision, the grade of surgeon performing the operation and the grade of surgeon directly assisting in the operation. This information is not always completed.

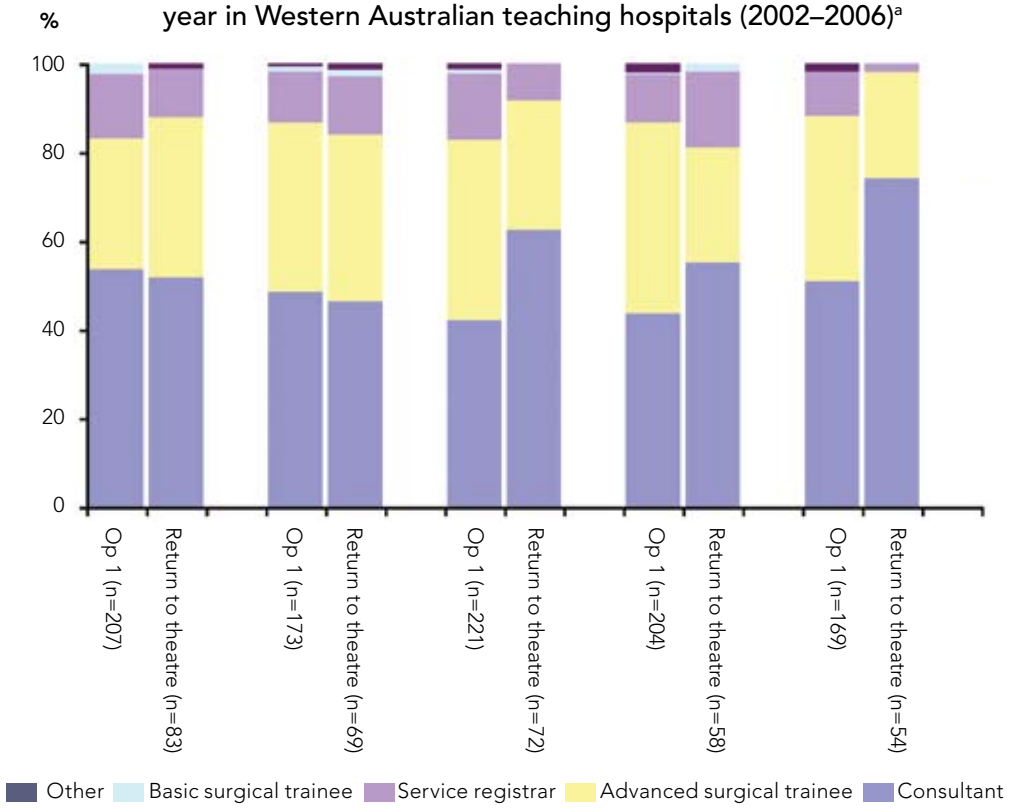
Table 3.20 shows the data for cases that underwent at least one operation in Western Australian teaching hospitals.

Table 3.20 Cases that underwent operation in Western Australian teaching hospitals (2002–2006)

	No. cases				
	2002	2003	2004	2005	2006
Consultant decision to operate	210	179	223	205	174
Consultant operating or directly assisting	207	174	224	204	170
Total audited operative cases in teaching hospitals	225	191	242	253	246

As shown in Figure 3.19, the proportion of consultants performing an operation when a patient is returned to theatre has increased. Figure 3.20 shows the proportion of consultants operating or directly assisting in a primary operation (based on the information shown in Table 3.20). Figure 3.18, above, suggests that the proportion of areas of concern or adverse events associated with cases that are returned to theatre is decreasing.

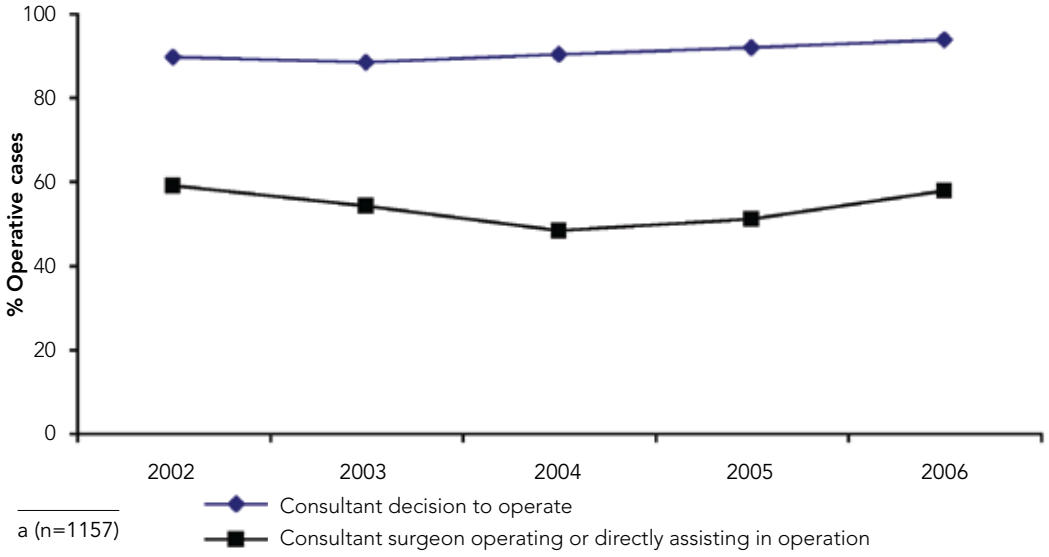
Figure 3.19 Grade of surgeon performing first and subsequent operations, by year in Western Australian teaching hospitals (2002–2006)[a]



a (n=974)

Notes:
1. 'Return to theatre' includes all second, third or subsequent operations.
2. Some of the information on grade of operating surgeon was missing.
3. 'Other' includes intern and resident medical officers, and senior registrars.

Figure 3.20 Consultant surgeons involved in primary operations, by year in Western Australian teaching hospitals (2002–2006)[a]



a (n=1157)

Comment on grade of surgeon — teaching hospitals

The first WAASM annual report[§] looked at the involvement of the consultant when patients were returned to theatre. Since then, there has been a progressive increase in the involvement of consultants when a patient undergoes a second or subsequent operation. At the same time, the proportion of these patients associated with an area of concern or an adverse event has fallen (Figure 3.18). As this trend is more pronounced in patients undergoing two or more operations, it is likely that the two events are related. Second and subsequent operations are rarely elective operations. This observation has important implications for the organisation of non elective operations.

3.7 Prophylaxis of thromboembolism

Key points

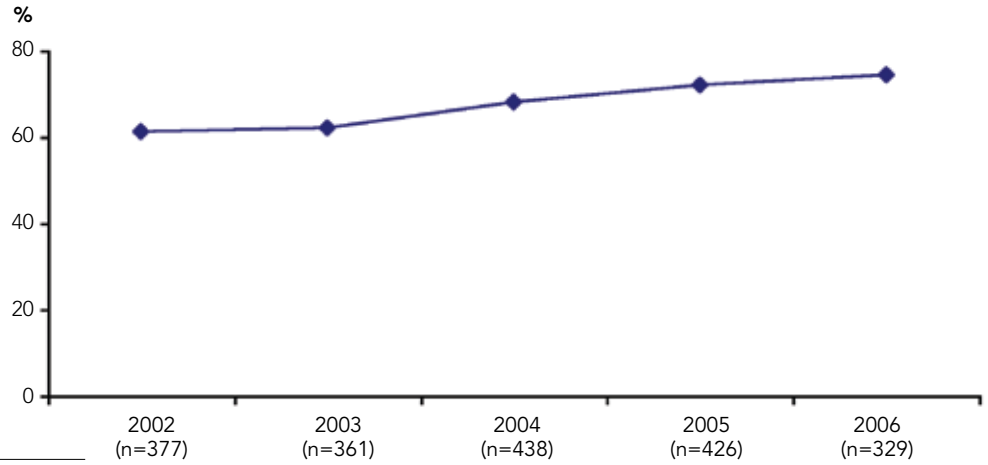
- The use of DVT prophylaxis has increased over the audit period.
- The proportion of cases where assessors have commented that the use of DVT prophylaxis was appropriate has increased.

Surgeons are asked to indicate on the proforma whether DVT prophylaxis was used and, if not, the reasons why it was withheld. At case review, assessors indicate whether they think that the decision on the use of DVT prophylaxis was appropriate.

When the WAASM audit started in 2002, there were many cases where assessors indicated that DVT prophylaxis was inappropriate. WAASM raised this issue through feedback directly to surgeons and organised a discussion meeting on DVT prophylaxis. Figure 3.21 suggests that surgeons have significantly increased their use of DVT prophylaxis; Figure 3.22 shows that the proportion of cases in which assessors noted that DVT prophylaxis was appropriate also increased.

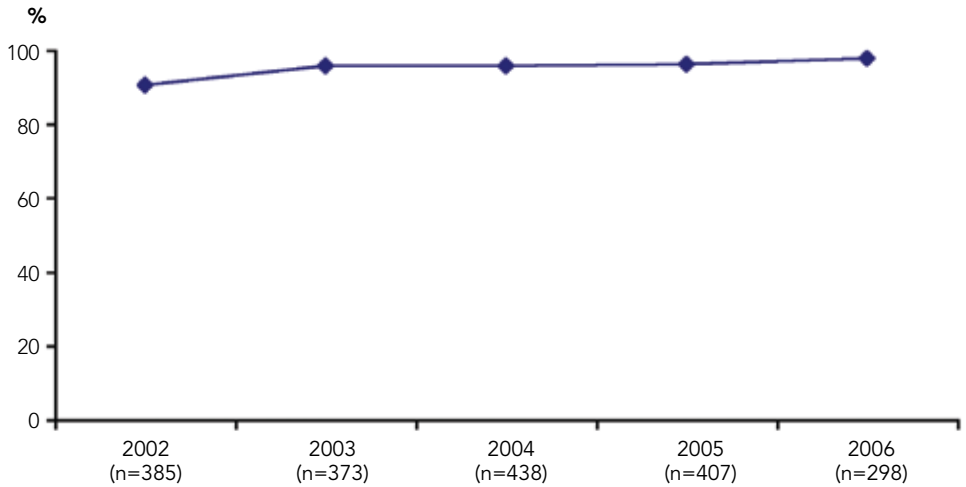
[§] University of Western Australia. Western Australian Audit of Surgical Mortality. WAASM Annual Report, 2003.

Figure 3.21 Use of deep vein thrombosis (DVT) prophylaxis, by year (2002–2006)[a]



a (n=1931)
The proportion of cases where DVT prophylaxis was used increased significantly (p<0.0001, 2-sided Cochran–Armitage trend test).

Figure 3.22 Cases where assessors noted that use of deep vein thrombosis (DVT) prophylaxis was appropriate, by year[a]



a (n=1901)
Notes:
1. Neurosurgeons do not complete this question in their proforma unless it has been flagged as an area of concern or adverse event. Cases where this information is missing have been excluded from the calculations.
2. The proportion of cases where the use of DVT prophylaxis was deemed appropriate by assessors increased significantly (p<0.0001, 2-sided Cochran–Armitage trend test).

3.8 Fluid balance

Key points

- WAASM examined 50 cases where problems with fluid balance were noted.
- The common theme was that these very elderly patients received significant volumes of sodium-containing fluid in the first 24–48 postoperative hours.
- Fluid balance is an issue that clearly demands greater attention.

During the initial WAASM collection period (2002–2003), it was noted that assessors were reporting problems related to fluid balance and were commenting on fluid balance issues in their review assessments. In response, WAASM added a question in the dataset addressed to both surgeons and assessors, requesting information on problems related to fluid management. These data have been collected since November 2003. Data collected from 2004 to 2006 are shown in Table 3.21. In 6% of cases, the surgeon or assessor indicated that there was a problem with fluid balance.

Table 3.21 Cases where there was a reported problem with fluid balance, by year (2004–2006)

	Problem with fluid balance (%)	Total
2004	34 (7)	465
2005	32 (6)	497
2006	22 (5)	443
Total	88 (6)	1405

WAASM examined a random selection of 72 case notes where assessors or surgeons had noted issues with fluid balance. Twenty-two patients were excluded because of one or more of the following factors:

- the patient:
  - did not undergo an operation
  - had pre-existing renal failure
  - had a hospital stay of more than 45 days
- the medical record information was incomplete.

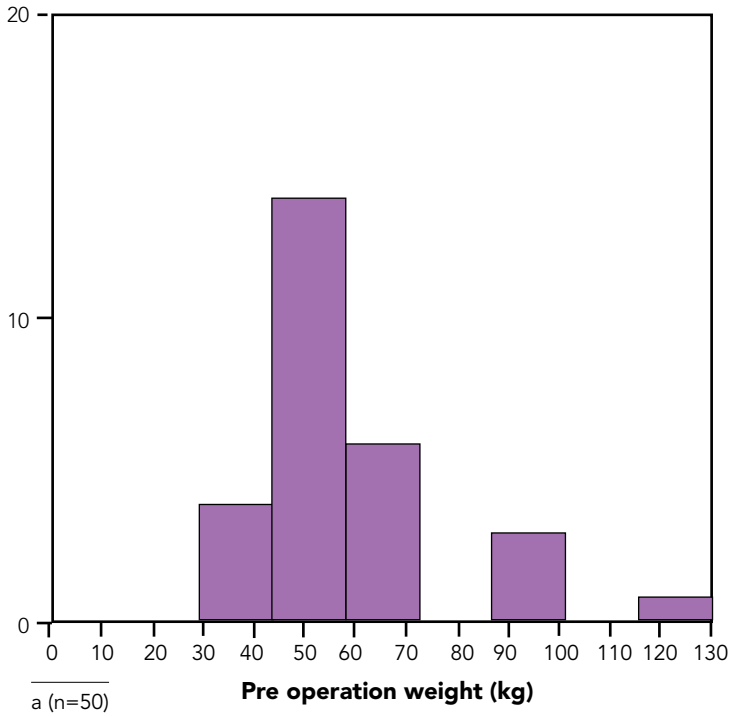
WAASM recorded data on the perioperative fluid management of the remaining 50 cases. The demographics of these 50 patients are shown in Table 3.22.

Table 3.22 Demographics of 50 cases examined

		(%)	IQR
Males	18	(36)	–
Median age (years)	84	–	78–90
Median days to death from day of operation	5.5	–	3.75–11.25
Median weight (kg)	53	–	46.25–60

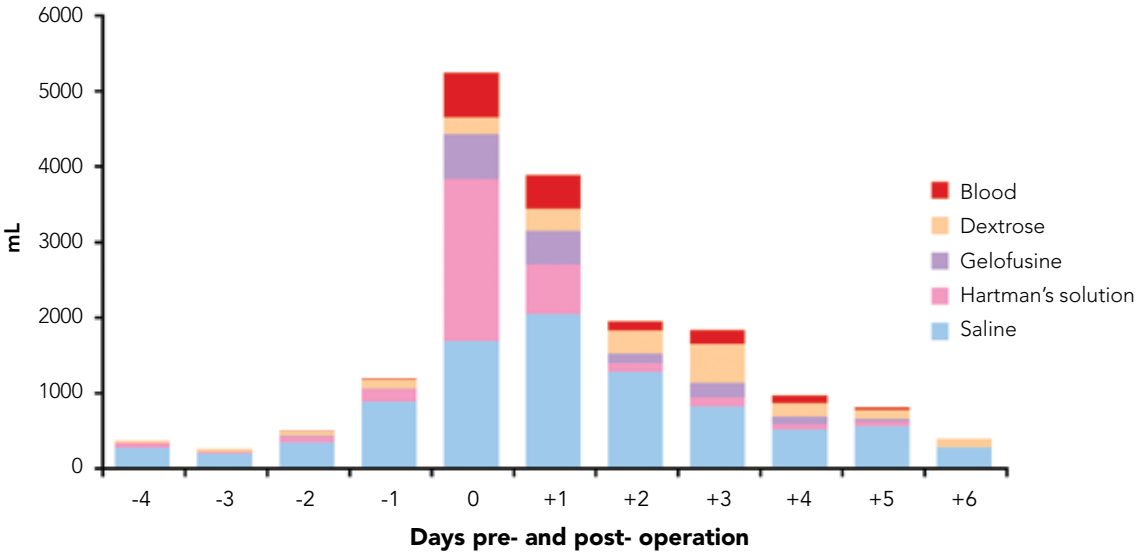
IQR =interquartile range

Figure 3.23 Recorded weight of patients in cases where problems with fluid balance were noted[a]



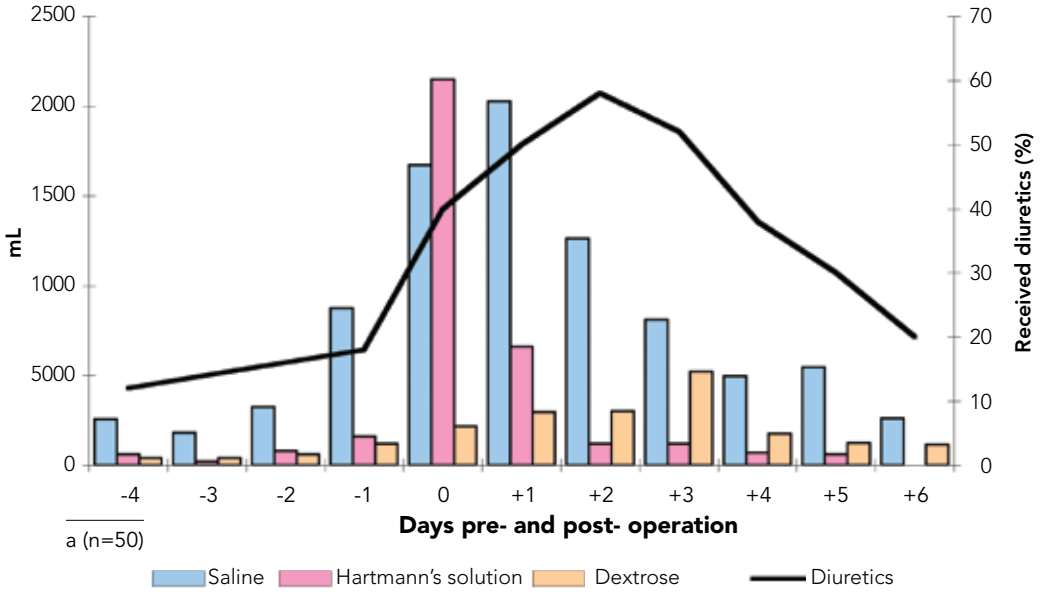
a (n=50)

Figure 3.24 Average volume of intravenous fluids administered peri-operatively to patients in cases where problems with fluid balance were noted[a]



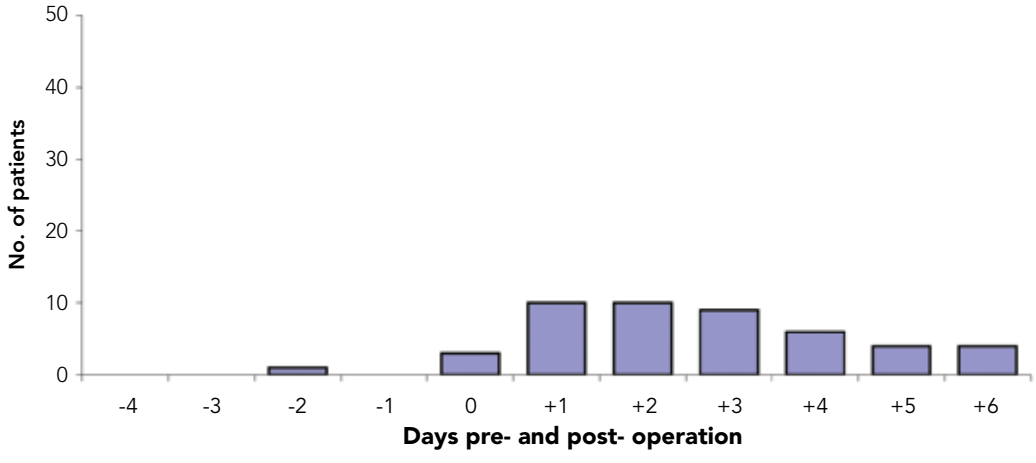
a (n=50)

Figure 3.25 Average volume of administered crystalloids and proportion of patients who received diuretics, in cases where problems with fluid balance were noted[a]



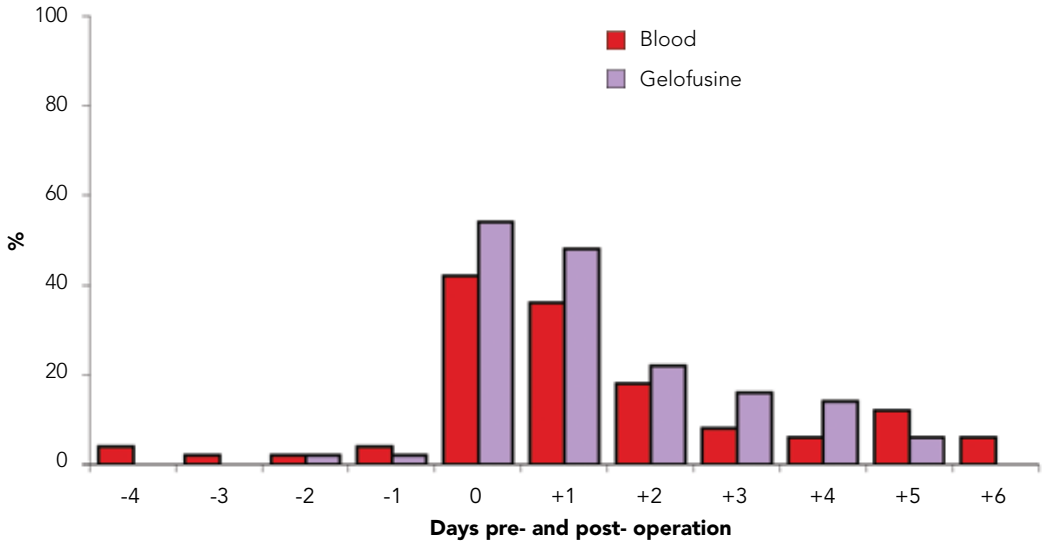
a (n=50)

Figure 3.26 Patients developing pulmonary oedema, in cases where problems with fluid balance were noted[a]



a (n=50)

Figure 3.27 Administration of colloids, in cases where problems with fluid balance were noted[a]



a (n=50)

Data on these patients were sourced from fluid charts and medical notes. Data included volume and type of intravenous fluids administered to the patient from four days before the operation and up to six days after the operation, as well as the administration of diuretics. These data are shown in Figures 3.23–3.25.

Comment on fluid balance

The common theme with patients where problems with fluid balance were noted was that they were elderly (median age 84 years), and had received significant volumes of sodium-containing fluid in the first 24–48 hours after the operation. The patients had a relative low body weight (median 53 kg) and the average infused volume of sodium-containing fluids during the first 48 hours after the operation was 9052 mL (equivalent to 17% of their average body weight).

WAASM data and reviewers comments suggest that fluid overload may have played a role in other cases that were not 'flagged' by a patient's surgeon. Undoubtedly, the deaths where fluid balance problems were noted represent only a part of the problem.

The metabolic response to surgery includes an obligatory retention of sodium, and with it water, during the first 24–48 hours after surgery.[20,21] An increasing body of literature suggests that careful attention to fluid balance in the immediate postoperative period improves the return of cellular function.[22, 23] This is the basis

of the enhanced recovery after surgery (ERAS) protocols being widely introduced in Europe and the United States.[24,25]

A large number of studies have reported results in patients following ERAS protocols.[22,25,26] Most have been in patients undergoing large bowel surgery and have clearly demonstrated that better peri-operative fluid administration reduced hospital stays, hastened the return of gastrointestinal function and reduced postoperative complications.[27,28,29] One of these studies prompted an assessor to review recent colectomies at his institution; the review showed that an excess of sodium and water was routinely administered.[30] The assessor noted that 'fluid overloading has become the norm', and that surgical trainees have become desensitised to the administration of high volumes of fluid in a patient population with smaller third-space losses, more chronic illness and a risk of cardiopulmonary complications.[30] Although the introduction of ERAS protocols into routine practice has been slow, its uptake is increasing in both Europe and the United States.[31,32,33,34]

With an increasingly ageing population, fluid balance clearly demands greater attention. Two simple steps could be enacted easily:

- identify cases likely to have a postoperative fluid problem so that a management strategy can be agreed in advance
- limit the volume of fluid that can be administered by an intern without discussion with a senior colleague.

3.9 Postmortem

Key points

- Among 1767 cases, a coronial postmortem was performed in 8% of cases and a hospital postmortem in 2% of cases.
- Of 181 postmortem reports, only 34% were read by the consultant involved in the case.
- Among 1586 cases where no postmortem was performed, the surgeon indicated in 8% of cases that a postmortem would have been preferred.

Of the 2198 cases, data on whether a postmortem was conducted were available for 1767, of which 10% underwent a postmortem (Table 3.23a). Of the 181 cases that underwent a postmortem, 33 were performed by the treating hospital and 148 were performed by the Coroner.

In a further 137 cases, the surgeon was unaware of whether a postmortem had been performed (Table 3.23b).

In 128 cases where no postmortem was performed, or a postmortem was refused, the treating surgeon indicated a postmortem would have been preferred.

Table 3.23 Postmortems conducted — audited cases (2002–2006)

	No. cases (%)					
	2002	**2003**	**2004**	**2005**	**2006**	**Total**
(a) Cases for which postmortem information was available						
Hospital-conducted	11 (3)	4 (1)	7 (2)	9 (2)	2 (1)	33 (2)
Coroner-conducted	30 (8)	36 (11)	26 (6)	36 (9)	20 (7)	148 (8)
No information on why no postmortem was conducted	300 (85)	278 (85)	357 (88)	322 (84)	272 (91)	1529 (87)
Family refused postmortem	13 (4)	10 (3)	14 (4)	17 (5)	3 (1)	57 (3)
Total responses	354	328	404	384	297	1767
(b) Total audited cases						
Audited cases	411	382	465	497	443	2198
Unknown	0	12	40	46	39	137
Missing data	57	42	21	67	107	294

In 62 (34%) of the181 cases in which postmortems were conducted, consultants said they had read the postmortem report (Table 3.24).

Table 3.24 Audited cases where a postmortem was conducted and the surgeon read the postmortem report (2002–2006)

	2002	**2003**	**2004**	**2005**	**2006**	**Total**
PM conducted	41	40	33	45	22	181
Surgeons read the PM report	16	8	14	17	7	62
Percentage PM reports read	(39)	(20)	(42)	(38)	(32)	(34)
PM contributed additional information that, if known, may have changed management	4	3	3	6	1	17
Where no PM was performed, or it was refused, surgeon would have preferred a PM	40	23	26	24	25	128

PM =postmortem

Comment on postmortem

Postmortem reports and coronial findings provide an important source of information for hospitals and health services. Inquest findings are useful to clinicians and hospital governance groups. The WADH Office of Safety and Quality in Healthcare has, in partnership with the Coroner's Court of Western Australia, organised to distribute summaries of the Coroner's inquest findings, and have made these available to the clinical community and the general public. The publication *From death we learn: Lessons from the Coroner*[11] contains summary reports of coronial inquests, which have become widely used for educational purposes.

The WADH Office of Safety and Quality in Healthcare has been liaising with PathWest and the Coroner to make postmortem reports available to surgeons. As a result, noncoronial postmortems are now becoming available to surgeons through the hospital iCM systems. WADH is also negotiating to have a hard copy of the postmortem report (coronial and hospital) sent as a matter of course to the consultant in charge.

Autopsy rates are decreasing in Australia.[35,36] This is of increasing concern to the medical community because information from autopsies can be valuable as a learning tool and can ultimately contribute to improvements in surgical care. From WAASM data, 27% of surgeons who had read a postmortem report on an audited case indicated that the report contributed information that, if known, would have changed management.

It is clear that the value of postmortems is not being fully realised. Many postmortems are not undertaken, despite the surgeon believing that it might be useful. In addition, even when postmortems are performed, only a small proportion of consultants get to read the report. The latter problem could be addressed simply by making it a matter of routine that reports are sent to consultants. The former problem is more complex and has been a subject of many international studies. An additional complication in Australia is that hospital postmortems generate a fee for the patient's estate and would certainly have to be part of the informed (financial) consent taken from the family at a time of great stress. There would seem to be a compelling case for the Health Service to pay the fee for postmortem for patients undergoing a hospital postmortem when a death occurs after surgery.

4 PERFORMANCE OVERVIEW

Key points

- Significant progress has been made against each of the nine recommendations of the 2006 WAASM annual report.
- Other major achievements of 2006 were the organisation of a meeting to discuss peri-operative anticoagulation and the production of a consumer pamphlet.

The 2006 WAASM report[2] included recommendations and an important measure of the success of WAASM is whether these recommendations have been achieved or addressed.

4.1 Progress against recommendations

This section reviews progress against each of the nine recommendations of the 2006 WAASM annual report.

4.1.1 Increase surgeon participation in the Western Australian Audit of Surgical Mortality

WAASM has approached surgeons both directly and indirectly, through newsletters and reports, to encourage participation in the audit. Over the audit period, the number of cases reported to WAASM and the number of cases audited (Table 5.2) have increased steadily. At the time of analysis, complete figures for 2006 were not available, but it is clear from Table 2.1 that surgeon participation continues to rise. In 2004, 57% of surgeons (43 of 75) who were associated with three or more deaths returned more than 80% of their forms; in 2005, this number increased to 68% (54 of 79). WAASM is committed to encouraging and increasing surgeon participation. It is not clear how the introduction of WARM will affect surgeon participation in WAASM.

The recognition of WAASM as an approved audit by the continuing professional development (CPD) Programme of the College encourages surgeons to participate in the audit.

4.1.2 Renew commitment of surgeons to better completion of proformas

WAASM has requested that surgeons complete their proformas fully and legibly. Assessors have also commented on legibility and attention to detail in feedback to surgeons. WAASM has observed an increase in the provision of typed notes accompanying the proformas, which is an indication that surgeons are willing to provide complete and detailed information to the project.

4.1.3 Liaise with the Coroner and hospitals to establish a timely and robust mechanism for the routine return of postmortem results to the responsible clinician

The WADH Office of Safety and Quality in Healthcare has been liaising with PathWest and the Coroner about access to postmortem reports. Through this liaison, results of noncoronial postmortems are now available to surgeons on the iSOFT Clinical Manager (iCM) systems at teaching hospitals. The Department is also

negotiating for a hardcopy of the postmortem report (coronial and hospital) to be sent routinely to the consultant surgeon.

4.1.4 Increase communication with other states and territories where similar audits are in progress

There is a central office of the College in Adelaide for the Australian and New Zealand Audit of Surgical Mortality (ANZASM). The office has established links with other audit offices, including the Tasmanian Audit of Surgical Mortality (TASM), the South Australian Audit of Peri-operative Mortality (SAAPM), the Queensland Audit of Surgical Mortality (QASM) and the Victorian Audit of Surgical Mortality (VASM).

4.1.5 Establish interstate second-line assessment, especially for small specialties

Interstate second-line assessments are currently undertaken on a small scale. The aim is to provide information for a future web-based system that will monitor and track larger volumes of interstate second-line assessments. The use of interstate assessors is relevant for small specialties, states and territories with small populations, and a small number of contentious deaths.

4.1.6 Give greater attention to fluid management in the elderly

WAASM has produced a summary report on issues arising from the audit associated with the management of fluid balance . WAASM is organising a series of symposia to bring this matter to the attention of clinicians and other health care workers directly involved with the management of fluid balance in patients.

4.1.7 Work with the Western Australia Department of Health to ascertain the feasibility of obtaining denominator data

The hospital morbidity data system (HMDS) holds summaries of all hospital admissions records in Western Australia since 1971. The Western Australia data linkage system contains links within and between the unique collection of population health data in Western Australia (including the HMDS). WAASM could examine the audit data for the past five years in relation to total number of surgical admissions. Currently, the data are analysed using 'total number of reported deaths where a surgeon was involved' as the denominator. A denominator based on the total number of surgical admissions could potentially provide insight into changing trends. The existence of the Western Australia data linkage system provides WAASM with the potential to expand the audit to cases where surgical patients have been discharged, but have died within 30 days of the operation.

4.1.8 Provide clinicians with information on their own participation data

The aim of providing clinicians with their own participation data is so that they may submit the information to hospitals for clinical governance and accreditation purposes, and to the College for CPD credits. WAASM has modified its database, with reports now being generated for each individual surgeon on participation in terms of proforma return, and completed first and second-line assessments. WAASM provides this information to surgeons at six-monthly intervals; it also

provides a quarterly report to each surgeon listing the status of their cases, in order to comply with WARM requirements.

4.1.9 Examine in greater detail the underlying causes for delay

Delay is the largest contributor to areas of concern and adverse events in emergency presentations. WAASM has established a record of cases where assessors have noted that delay was an issue in the management of the patient. These cases are currently being examined.

4.2 Other achievements in 2006

This section highlights achievements of WAASM in 2006 that were additional to the recommendations.

4.2.1 Meeting to discuss peri-operative anticoagulation

In March 2006, WAASM organised an educational meeting to discuss the issues surrounding peri-operative anticoagulation. Increasing numbers of patients are receiving oral anticoagulants and antiplatelet drugs. WAASM reviewed 20 cases where the patient had been on anticoagulation therapy before admission to hospital for surgery. Assessment of some of these cases revealed inconsistencies in the approach to stopping and restarting anticoagulation therapy; in some cases, complications resulted relating to perioperative anticoagulation management. The meeting brought together physicians and surgeons to discuss the critical issues pertaining to perioperative anticoagulant management, the patient's risk of thromboembolism when anticoagulant therapy is interrupted and the risk of bleeding that is associated with the surgery or procedure. The meeting also provided an opportunity to update surgeons on changes to the management of heart disease and the related use of anticoagulant therapy.

4.2.2 Consumer pamphlet

The Health Consumers' Council of Western Australia (HCCWA) is supportive of the WAASM project. The HCCWA previously recommended that WAASM should be part of core business in all health services and stated that WAASM provides assurance to the community that there are statewide initiatives to address the safety of healthcare.[37] The HCCWA requested that WAASM produce a consumer version of its annual report. However, it was agreed to produce a general information booklet because the annual report is available to the public on the website of the College.[1] The WADH agreed to fund the production costs of an information pamphlet on the audit process and outcomes. This pamphlet is available on the College's website. A health consumer representative from the HCCWA has been appointed to the WAASM management committee.

1 http://www.surgeons.org/WAASM

5 EFFECTS OF THE INTRODUCTION OF THE WESTERN AUSTRALIAN REVIEW OF MORTALITY

Key points

- Surgeons or hospital departments need to decide whether they will review mortality though the WAASM process or the WARM process.
- To facilitate the WARM process, WAASM has made changes to its audit and feedback protocol.
- The main advantage of the WAASM process is that it is managed by surgeons. In addition, WAASM offers independent external review of all deaths, surgeons receive feedback information and WAASM has qualified privilege (which provides safeguards by protecting certain information from disclosure and protecting persons involved from civil liability).

In November 2006 the WADH issued an operational directive[38] stating that all deaths that occur in public hospitals and licensed private health care facilities providing services for public patients in Western Australia have to be classified and reviewed under the Western Australian Review of Mortality (WARM).[8] Compliance with operational directives is mandatory and WARM came into effect on 1 January 2007.

Under the WARM process, the death of a patient is required to be recorded under the surgery mortality categorisation set by the Health Roundtable (Table 5.1).[39] This categorisation is undertaken by a mortality review team (Table 5.2)[8] and deaths classified as Category 4 or 5 are required to undergo a detailed clinical review.

Table 5.1 Surgery mortality categorisation determined by the Health Roundtable

Category	Situation
1a	Anticipated death due to terminal illness (anticipated by clinicians and family); and/or
1b	Death following cardiac or respiratory arrest before arriving at hospital
2	Not unexpected death, which occurred despite the health service taking preventative measures
3	Unexpected death which was not reasonably preventable with intervention
4	Preventable death where steps may not have been taken to prevent it
5	Unexpected death resulting from intervention

Table 5.2 Mortality review team

The mortality review team includes the following members:
◗ the consultant responsible for managing or supervising the case
◗ the registrar responsible for managing or reviewing the case
◗ one or more consultants not directly involved in the care of the patient
◗ one or more registrars not directly involved in the care of the patient.

EFFECTS OF THE INTRODUCTION OF THE WESTERN AUSTRALIAN REVIEW OF MORTALITY

Surgeons participating in the peer review of deaths through the WAASM process are exempt from the WARM process. However, surgeons who have their patients' deaths reviewed through WAASM still have to comply with a three-month reporting period to qualify for exclusion from WARM.

The WAASM process is compliant with WARM. Surgeons auditing their deaths through WAASM do not in addition have to complete the WARM process. Once the decision has been made to use one process or another, it is not possible for individual surgeons to flit between WARM and WAASM. WARM has established a clear minimum standard for the mandatory review of deaths. However, WAASM has advantages for the review of surgical deaths; for example, it:

- is managed by surgeons for surgeons, who have control over the organisation, processes, data collection, analysis and dissemination
- controls how outliers (if any) will be identified and reviewed
- offers an independent external review of all deaths, including those that only undergo a first-line assessment
- provides feedback to surgeons individually; it also provides information regularly to all surgeons through case-note review booklets, newsletters, etc.
- is part of the College's national mortality audit, ANZASM
- allows participating surgeons to earn CPD credits through the College
- has qualified privilege both under the Health Services (QI) Act 1994 (WA) and under Part VC of the Health Insurance Act 1973 (Commonwealth).

To facilitate reporting to the WADH, the WARM categorisation has been included in the WAASM assessment process.

The current annual report provides clear evidence of the value gained when deaths are reviewed by an external assessor. In approximately half of the cases in which assessors considered there was an area of concern or adverse event, the associated surgeon reported no events associated with the case (see Table 3.6). Under the WARM process, it is only mandatory for deaths recorded by the mortality review team as Category 4 or 5 (Table 5.1) to undergo a second-level review process by the same mortality review team. In addition, the WARM process requires that a mortality review team meet and discuss all deaths, which may be time consuming.

Under the WAASM process, information is provided back to the associated surgeon and, where it is thought that there are valuable lessons to be learned, to the wider surgical community.

Once the College has fully established its national mortality audit, it is possible that participation will be a mandatory requirement of the College's CPD program. It is unlikely that WARM will be considered an acceptable substitute for WAASM.

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- University of Western Australia
- College's WAASM Management Committee:
  Mr James Aitken MBBS, LRCP, MRCS, FRCS (Ed), FCS (SA), FRACS, MS
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- WAASM staff:

Chairman	Mr James Aitken
Project Manager	Ms Jenny Mountain
Project Officer	Ms Claire Findlater
Project Officer	Ms Adeline Neo

APPENDICES

Appendix 1 Causes of death reported to WAASM

Table A1.1 Cause of death in men aged <70 years (n=396)

	n	(%)
Heart failure	51	(13)
Severe brain injury	49	(12)
Malignancy	35	(9)
Septicaemia	32	(8)
Brain haemorrhage	31	(8)
Multiple organ failure	31	(8)
Brain stroke	19	(5)
Pneumonia	17	(4)
Respiratory failure	12	(3)
Renal failure	9	(2)
Cardiorespiratory failure	9	(2)
Severe multiple injuries	9	(2)
Aortic aneurysm	8	(2)
Aspiration pneumonia	8	(2)
Pulmonary embolism	7	(2)
Liver failure	6	(2)
Cause unknown	6	(2)
Vascular insufficiency of the intestine	5	(1)
Severe burns	4	(1)
Other	48	(12)

Table A1.2 Cause of death in women aged <70 years (n=222)

	n	(%}
Brain haemorrhage	33	(15)
Septicaemia	25	(11)
Multiple organ failure	24	(11)
Malignancy	22	(10)
Heart failure	21	(9)
Severe brain injury	14	(6)
Brain stroke	10	(5)
Respiratory failure	8	(4)
Aspiration pneumonia	5	(2)
Pulmonary embolism	4	(2)
Renal failure	4	(2)
Other	52	(23)

Table A1.3 Cause of death in men aged ≥70 years (n=803)

	n	(%)
Heart failure	205	(26)
Septicaemia	59	(7)
Pneumonia	57	(7)
Malignancy	44	(5)
Respiratory failure	41	(5)
Aortic aneurysm	40	(5)
Multiple organ failure	40	(5)
Renal failure	39	(5)
Vascular insufficiency of the intestine	28	(3)
Brain haemorrhage	23	(3)
Aspiration pneumonia	23	(3)
Cardiorespiratory failure	22	(3)
Brain stroke	21	(3)
Pulmonary embolism	15	(2)
Pulmonary oedema	13	(2)
Severe brain injury	10	(1)
Cause unknown	10	(1)
Other	113	(14)

Table A1.4 Cause of death in women aged ≥70 years (n=775)

	n	(%)
Heart failure	191	(25)
Septicaemia	66	(9)
Multiple organ failure	60	(8)
Respiratory failure	38	(5)
Pneumonia	36	(5)
Renal failure	36	(5)
Malignancy	29	(4)
Cardiorespiratory failure	29	(4)
Vascular insufficiency of the intestine	28	(4)
Aortic aneurysm	23	(3)
Brain stroke	22	(3)
Brain haemorrhage	18	(2)
Cause unknown	18	(2)
Pulmonary embolism	17	(2)
Aspiration pneumonia	15	(2)
Peripheral vascular disease	13	(2)
Pulmonary oedema	10	(1)
Other	126	(16)

Appendix 2 Deaths audited by WAASM (2002–2006)

Table A2.1 Deaths audited by WAASM that were associated with areas for consideration, of concern or with adverse events as reported by assessors (most significant event only) (2002–2006)

		Outcome of report					
Year	Associated area	None	Made no difference to outcome	May have contributed to death	Caused death	Total	%)
2002	Consideration	0	17	2	0	19	(5)
	Concern	0	13	29	0	42	(10)
	Adverse event	0	0	38	24	62	(15)
	No events	288	0	0	0	288	(70)
	Total (2002)	288	30	69	24	411	(100)
2003	Consideration	0	28	4	0	32	(8)
	Concern	0	9	23	1	33	(9)
	Adverse event	0	0	16	18	34	(9)
	No events	283	0	0	0	283	(74)
	Total (2003)	283	37	43	19	382	(100)
2004	Consideration	0	51	21	2	74	(16)
	Concern	0	19	24	1	44	(9)
	Adverse event	0	3	18	14	35	(80)
	No events	312	0	0	0	312	(67)
	Total (2004)	312	73	63	17	465	(100)
2005	Consideration	0	24	18	0	42	(8)
	Concern	0	12	30	2	44	(9)
	Adverse event	0	1	18	15	34	(7)
	No events	377	0	0	0	377	(76)
	Total (2005)	377	37	66	17	497	(100)
2006	Consideration	0	17	12	1	30	(7)
	Concern	0	6	12	2	20	(5)
	Adverse event	0	0	11	7	18	(4)
	No events	375	0	0	0	375	(85)
	Total (2006)	375	23	35	10	443	(100)
Total	Consideration	0	137	57	3	197	(9)
	Concern	0	59	118	6	183	(8)
	Adverse event	0	4	101	78	183	(8)
	No events	1635	0	0	0	1635	(74)
	Total (2002–2006)	1635	200	276	87	2198	(100)

Appendix 3 Assessors' views of the reported areas of concern to WAASM (2002–2006)

Table A3.1 WAASM reported areas of concern and adverse events — in the assessors view, was the event preventable (2002–2006)?

		Definitely	Probably	Probably not	Definitely not	Total
2002 (n=411)	Concern	22	15	5	0	42
	Adverse event	16	15	19	12	62
	Total (2002)	38	30	24	12	104
2003 (n=382)	Concern	16	13	4	0	33
	Adverse event	11	14	7	2	34
	Total (2003)	27	27	11	2	67
2004 (n=465)	Concern	19	19	6	0	44
	Adverse event	13	12	9	1	35
	Total (2004)	32	31	15	1	79
2005 (n=497)	Concern	20	17	7	0	44
	Adverse event	12	6	11	5	34
	Total (2005)	32	23	18	5	78
2006 (n=443)	Concern	6	11	3	0	20
	Adverse event	3	4	6	5	18
	Total (2006)	9	15	9	5	38
Total (n=2198)	Concern	83	74	25	0	182
	Adverse event	55	51	52	25	183
	Total (2002–2006)	138	126	77	25	366

Table A3.2 WAASM reported areas of concern and adverse events where assessors considered the event caused death — in the assessors view, was the event preventable (2002–2006)?

		Definitely	Probably	Probably not	Definitely not	Total
2002 (n=411)	Adverse event	8	3	6	7	24
	Total (2002)	8	3	6	7	24
2003 (n=382)	Concern	1	0	0	0	1
	Adverse event	4	8	4	2	18
	Total (2003)	5	8	4	2	19
2004 (n=465)	Concern	0	0	1	0	1
	Adverse event	3	5	5	1	14
	Total (2004)	3	5	6	1	15
2005 (n=497)	Concern	1	1	0	0	2
	Adverse event	6	2	5	2	15
	Total (2005)	7	3	5	2	17
2006 (n=443)	Concern	1	1	0	0	2
	Adverse event	2	2	1	2	7
	Total (2006)	3	3	1	2	9
Total (n=2198)	Concern	3	2	1	0	6
	Adverse event	23	20	21	14	78
	Total (2002–2006)	26	22	22	14	84

Appendix 4 WAASM assessor report details of adverse events and areas of concern (2002–2006)

Table A4.1 Details of adverse events and areas of concern as reported by assessors in 366 of 4182 cases reported to WAASM (2002–2006)

Related to open surgery (80 cases)	No.
Anastomotic leak after open surgery	29
Related to open surgery	13
Post operative bleeding after open surgery	12
Injury to organ during open surgery	6
Infection of hip prosthesis	5
Wound infection after open surgery	3
Cerebrovascular accident following open surgery	2
Air embolism after surgery	1
Fistula from colon after open surgery	1
Splenic complication of open surgery	1
Failed arterial reconstruction after open surgery	1
Bowel infarction after open vascular operation	1
Extension of ischaemia after open surgery	1
Central vein thrombosis related to open surgery	1
Blood clot dislodged	1
Ureteric complication of open surgery	1
Dislocated hip prosthesis	1
Delays (62 cases)	
Delay to surgery — earlier operation desirable	13
Delay in transfer to surgical unit	11
Delay in diagnosis	9
Delay starting DVT prophylaxis	6
Delay in transfer to surgeon by physicians	5
Delay in recognising complications	4
Delay to operation caused by missed diagnosis	2
Delay to endoscopic retrograde cholangiopancreatography	2
Delay to surgery whilst obtaining a computed tomography scan	2
Delay starting medical treatment	2
Delay to blood transfusion	1
Delay in recognising anastomotic leak	1
Delay in recognising a bleeding complication	1
Delay in transferring patient to intensive care unit	1
Delay to re operation	1
Delay to starting ventilation	1

Incorrect or inappropriate therapy (47 cases)	
Fluid balance unsatisfactory	14
Better to have done different operation or procedure	6
Decision to operate	6
Wrong surgical approach used	3
Better not to have been treated laparoscopically	2
Operation should have been done	2
Operation should not have been done or was unnecessary	2
Duration of operation too long	2
Tracheostomy problems	2
Incorrect or inappropriate therapy	1
Better to have had more extensive surgery	1
Operation would have been better delayed	1
Operating following recent cessation of anticoagulant drug	1
Post operative care unsatisfactory	1
More aggressive treatment of infection needed	1
Over transfusion of blood	1
Too early removal of nasogastric tube	1
General complications (41 cases)	
Aspiration pneumonia	16
Septicaemia	5
Pulmonary embolus	4
Wound infection	5
Cerebrovascular accident	2
Sepsis related to an intravenous line	2
Peri operative intracranial infection	1
Post operative intracranial haematoma	1
Peri operative cerebral ischaemia or infarction	1
Abdominal Abscess	1
Post operative pancreatitis	1
Wound skin necrosis	1
Post operative bleeding due to coagulopathy	1
Failure to use facilities (29 cases)	
Failure to use DVT prophylaxis	19
Failure to use high dependency unit	5
Failure to use a drug for treatment or prophylaxis	2
Failure to use intensive care unit	1
Failure to use antibiotic prophylaxis	1
Failure to obtain a postmortem	1
Patient-related factors (23 cases)	
Injury caused by fall in hospital	17
Patient refused treatment	4
Patient related factors	2

Drug-related problems (13 cases)	
Anticoagulation causing post operative bleeding	3
Under anticoagulation	3
Drugs related complication	1
Reaction to drugs	1
Anaphylactic shock related to drug treatment	1
Wrong drug used	1
Wrong dose of drug used	1
Over anticoagulation	1
Over anticoagulation before admission	1
Problems related to diagnoses (12 cases)	
Diagnosis missed by surgeons	5
Diagnosis missed by medical unit	4
Diagnosis missed unspecified	1
Diagnosis missed by referring hospital	1
Diagnosis missed by radiologist	1
Communication failures (11 cases)	
Poor documentation	5
Communication failures	2
Failure in communication between x-ray department and clinicians	1
Poor communication between physician and surgeon	1
No protocol for DVT prophylaxis	1
Poor communication in emergency department	1
Assessment problems (10 cases)	
Pre operative assessment inadequate	8
Assessment problems	1
Failure to recognise severity of illness	1
Related to endoscopic surgery (8 cases)	
Injury to duodenum during endoscopic operation	4
Related to endoscopic surgery	1
Operation induced acute pancreatitis after endoscopic operation	1
Bladder complication of endoscopic operation	1
Post operative bleeding related to endoscopic operation	1
Staff problems (6 cases)	
Surgeon too junior	2
Failure of junior surgeon to seek advice	1
Surgeon operating without specialty	1
Anaesthetist should have been involved in preparation and resuscitation	1
Fatigue of surgeon operating	1
Related to radiological surgery (5 cases)	
Arterial bleeding after radiological operation	2
Bile leakage from liver after radiological operation	1
Heart complication of radiological operation	1
Distal arterial embolism after radiological procedure	1

Related to anaesthesia (5 cases)	
Technique not ideal during general anaesthetic	1
Premature extubation	2
Pneumothorax complication general anaesthetic	1
Intubation failed for general anaesthetic	1
Related to laparoscopic surgery (3 cases)	
Anastomotic leak related to laparoscopic operation	2
Arterial bleeding after laparoscopic operation	1
Transfer problems (4 cases)	
Transfer should not have occurred	2
Transfer necessary due to bed shortage	1
Problems during transfer	1
Resuscitation problems (3 cases)	
Resuscitation inadequate	2
Fluid and electrolyte resuscitation inadequate	1
Monitoring problems (2 cases)	
CVP insertion failed	1
Inadequate metabolic monitoring	1
Related to equipment (1 case)	
Failure of equipment	1
Problems with blood or blood products (1 case)	
Blood products complication	1

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