Royal Australasian College of Surgeons

Western Australian Audit of Surgical Mortality (WAASM)

2015 Report

ANZASM

WAASM
Western Australian Audit of Surgical Mortality

The Royal Australian and New Zealand College of Obstetricians and Gynaecologists

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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, as part of the Australian and New Zealand Audit of Surgical Mortality is a declared quality assurance activity under the *Health Insurance Act 1973 (Cth)*, Part VC.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAIRMAN'S REPORT

During the last year the Western Australia Audit of Surgical Mortality (WAASM) has, like the rest of the world, transitioned further into the digital age. The interface between the WAASM office and the Western Australian (WA) surgeons is increasingly electronic and 50% of forms are now completed online. This is much more efficient for all.

The move to the digital age also includes an ANZASM App which contains a compendium of national case notes reviews, all extensively cross referenced and thus an instantly accessible education tool. It is free to download from Apple App store or Google Play and search for “RACS National Case Note Reviews”.

Other enhancements are in advanced stages of development and WAASM would encourage those who are not yet online to become so, just as with your bank, airline and doubtless many other personal matters! The WAASM team are very available and will help smooth your transition.

WAASM is documenting an increasing number of patients who have been transferred before death (from 23% to approximately 30%; a 7% increase). WAASM will be considering this important matter in some detail over the next six months and will be emphasising the various issues in this Annual Report, a themed Case Note Review Booklet and a symposium. As the demand for specialist tertiary care rises, both the number and acuity of transferring patients is increasing and WAASM has observed a number of unsatisfactory and recurring themes. The problems are multi-factorial and examples include patients being sent to a hospital that will predictably not be able to manage them, complex patients being managed by isolated junior staff, a sense that once a patient is referred the responsibility has been transferred, failure of communication within the teaching hospitals, delay in assessment by the teaching hospital team and a failure of tests undertaken in the referring hospital to reach the second centre.

Many of these issues revolve around the lack of a robust referral pathway, poor communication and resultant delay between the parties involved. Importantly, these transfers are a weekly, often daily event, and have general applicability in both surgical and non-surgical cases. There is every incentive to get this right.

As WAASM matures there is an opportunity to assess longitudinal changes. In this report WAASM has presented data on the comorbidities that surgeons felt contributed to death. Of note, there has been a progressive, almost fourfold, increase in the citing of obesity. This observation needs to be seen against the increasing public health issue of obesity. Patients dying after an emergency laparotomy are a significant part of WAASM’s work. The recently published United Kingdom National Emergency Laparotomy Audit (NELA – http://www.nela.org.uk) was a national review of over 20,000 patients with 83% completeness. Many of the problems noted in this massive, national audit have been repeatedly highlighted by WAASM; e.g. direct consultant supervision of emergencies and adequate 24 hour access to emergency theatres. While WA has addressed some of the structural problems noted in the NELA, the report contains many lessons for WA. I would urge all to at least read the abbreviated Executive Summary (13 well-spaced pages).

Whilst WA surgeons can take considerable satisfaction from establishing WAASM and its subsequent rollout across the country, there is no doubt that in audit overall Australia remains a long way behind the UK. Detailed, high quality audits like NELA provide clinicians, hospitals and government with compelling data they can use to effect change. Such detailed audits are well overdue in Australia.

Although failure to achieve full WAASM participation was an issue for many years, changes to the College’s Continuing Professional Development (CPD) requirements now means that all WA surgeons sign up for fear of not obtaining their CPD certificate. However, this problem is not fully resolved. Some WA surgeons do not return all their forms and so do not meet the definition of participation. This is despite knowing the College will not give them a CPD certificate with all that implies. By the time of this year’s CPD submission deadline, a number of WA surgeons had not returned all of their forms. It is pleasing that after follow-up by WAASM staff that this situation has been rectified. Please participate in a timely manner! WAASM also encourages you to be a first-line assessor. Being a small state means that WA needs as many first-line assessors as possible to spread the work. It is not an onerous burden if many take part and it is an important educational opportunity.

RJ Aitken

Chairman, WAASM

SHORTENED FORMS

AE	adverse event
AHPRA	Australian Health Practitioner Regulation Agency
AIHW	Australian Institute of Health and Welfare
BMJ	British Medical Journal
ANZASM	Australian and New Zealand Audit of Surgical Mortality
ASA	American Society of Anaesthesiologists
CPD	Continuing Professional Development
CT	computed tomography
BAS	Bi-national Audit System
DVT	deep vein thrombosis
ERCP	endoscopic retrograde cholangiopancreatography
HDU	high dependency unit
ICU	intensive care unit
ITU	intensive therapy unit
NHS	National Health Service
NOS	not otherwise specified
RACS	Royal Australasian College of Surgeons
RTT	return to theatre
WAASM	the Western Australian Audit of Surgical Mortality

EXECUTIVE SUMMARY

Background

The Western Australian Audit of Surgical Mortality (WAASM) is an external, independent, peer-reviewed audit of the process of care associated with surgically-related deaths in Western Australia (WA). WAASM was established in 2001, is funded by the Western Australian Department of Health and has protection under Federal legislation. This report covers the period from 2010 to 2014.

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 surgical case form to the surgeon for completion. Once returned, the surgical case form is anonymised and then peer-reviewed by another consultant surgeon (this process is referred to as 'first-line assessment'). The reviewing surgeon uses the information in the surgical case form to decide whether the case warrants detailed case note review (second-line assessment). Cases are referred for second-line assessment if there are areas of concern, adverse events may have occurred, or where it is thought a more detailed review could usefully draw attention to lessons to be learned. WAASM provides feedback from the assessors to the treating surgeon.

Notification of deaths

From 2010 to 2014, 2,935 deaths were reported to WAASM from 29 hospitals. In 2014, 578 deaths were reported to WAASM from 19 hospitals. The number of deaths per 100,000 population reported to WAASM has decreased from 26 in 2010 to 22 in 2014, a decrease of 15%.

Consultant participation

The WAASM database indicates that there are 474 surgeons participating in the audit. Of the participating surgeons, 91% (432) have agreed to be first-line assessors and 91% (431) have agreed to be second-line assessors.

Analysis of completed cases

Data analysed for this report covers cases reported to WAASM from 1 January 2010 to 31 December 2014 which had completed the audit processes by 31 March 2015. It is important to note that the numbers reported for 2013 in this report vary from those detailed in last year's report. This is due to the ongoing nature of cases at the census date. Cases remain open for two years, after which any case that has not completed the entire audit process is classified as "lost to follow up". Cases are considered "lost to follow up" if forms have not been returned for two years following the date of death or where cases are associated with surgeons who are no longer working in WA and did not complete the cases prior to moving, or if cases were not able to be completed due to lack of access to medical records (i.e. held up in Coroner enquiries or that cannot be found in the medical records archives).

Areas of concern or adverse events ascribed to cases by first- or second-line assessors were analysed. Where cases were associated with more than one incident, the most serious incident was included in the analysis.

By 31 March 2015, 46% (259/561) of the cases presented in 2014 had completed the entire audit process. A further 35% (177/510) of the completed WAASM surgical case forms have been returned and are awaiting completion of a first- or second-line assessment. These 436 cases account for 78% (436/561) of deaths reported in 2014.

Patient sample demographics

Of the 2,935 cases reported between 2010 and 2014, the median age was 77 years, with an interquartile range of 64–85. A total of 54% (1,577) of cases were male and 46% (1,351) were female. Multiple comorbidities contributed to the death of over 70% (1,266/1645) of patients (Figure 9).

Areas of concern and adverse events

The proportion of cases associated with areas of concern or adverse events has decreased since 2010. Overall, assessors indicated that an adverse event caused the death of a patient in 1% (29) of the 1,994 completed cases.

Admissions: public and private hospitals

Higher proportions of cases were emergency rather than elective admissions and were admitted to public rather than private hospitals. The proportion of emergency patients admitted to private hospitals who underwent an operation 85%, 92/108) was greater than the proportion of emergency patients admitted to public hospitals that underwent an operation (56%, 803/1,443). Nineteen per cent (221/1,184) of all operative cases were associated with areas of concern or adverse events.

Operative and non-operative deaths

In 37% (745) of the 1,994 audited deaths from 2010 to 2014, no operation was performed. In 4% (49), operative procedures were abandoned upon finding a terminal situation. Sixty-two per cent (1,228) of cases underwent at least one operation , and 9% (134) underwent three or more operations. In 14% (172/1,228) of cases from 2010 to 2014, surgeons reported an unplanned return to theatre.

RECOMMENDATIONS

WAASM makes the following recommendations:

Audit management

- Actively pursue consultant recruitment to the online system (Fellows Interface) such that 60% of WA Fellows will consistently be using Fellows Interface by the end of 2015. Recruitment strategies will include mail outs, electronic and telephone communications.
- Facilitate ANZASM processes to test and develop the Fellows Interface to include capabilities for surgeon-reported notifications of death and the ability to delegate cases to a third party (such as a trainee or registrar) for completion.

Reporting and audit data

- Undertake data cleaning exercises on a monthly basis to ensure that data quality is maintained as surgical case and assessment forms are modified and upgraded.
- Roll out hospital site level reports for private hospitals in second half of 2015.
- Amalgamate feedback on hospital site level reports from safety and quality representatives to improve the level of targeted information required by accreditation bodies.

Clinical management

- Investigate and highlight communication and handover issues during inter- and intra-hospital transfers. The information obtained will be collated and a symposium will be held on clinical handover and transfers in the second half of 2015. Feedback from the evaluation forms will be analysed.

1. INTRODUCTION

KEY POINTS

- WAASM is an external, independent, peer-reviewed audit of the process of care associated with all surgically-related deaths in Western Australia (WA).
- This report covers the period 1 January 2010 to 31 December 2014, as audited on 31 March 2015.
- WAASM's main role is to provide information to surgeons to educate, facilitate change and improve quality of practice.

1.1 Background

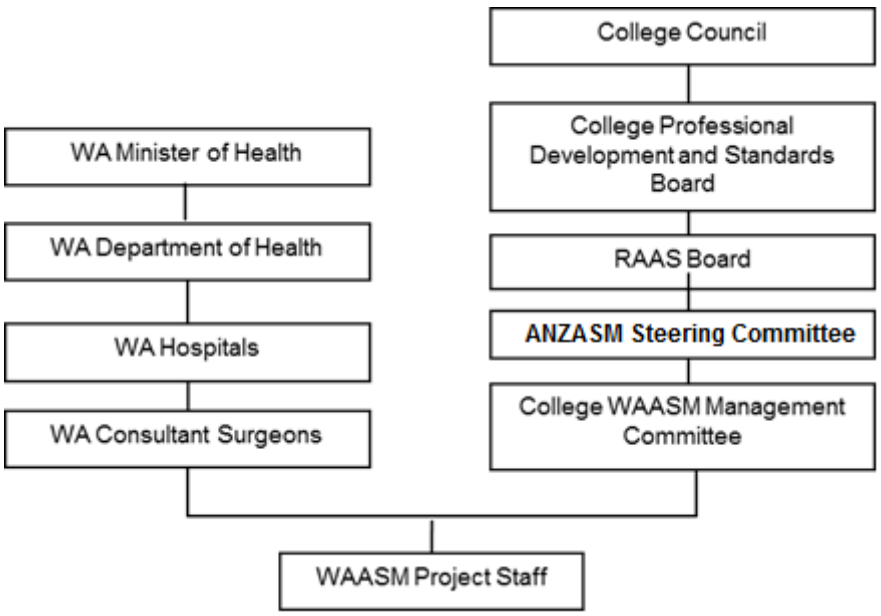
The WAASM is an external, independent, peer-reviewed audit of the process of care associated with surgically-related deaths in WA. The project is funded by the WA Department of Health and its methodology is based on the Scottish Audit of Surgical Mortality.[1]

WAASM commenced in June 2001 as a pilot project under the management of the University of Western Australia. In 2005, WAASM's management was transferred to the Royal Australasian College of Surgeons, within the Research, Audit and Academic Surgery (RAAS) division. In the same year, the College formed the Australian and New Zealand Audit of Surgical Mortality (ANZASM), with the purpose of establishing similar mortality audits in other states and territories. All Australian states and territories are now participating.

1.2 Project governance

The project governance structure is illustrated in Figure 1. ANZASM (including WAASM) has protection under the Commonwealth Qualified Privilege Scheme, under Part VC of the *Health Insurance Act 1973* (gazetted 23 August 2011).

Figure 1 Project governance structure



2. THE AUDIT PROCESS

2.1 Methodology

Detailed methodology of the WAASM audit process is contained in the WAASM reports[2-10] which are available on the College website at www.surgeons.org/waasm

In brief, WAASM is notified of all in-hospital deaths through either The Open Patient Administration System (TOPAS), the web-based Patient Administration System (webPAS), or directly via medical records departments. All cases in which a surgeon was involved in the care of a patient are included in the audit, whether or not the patient underwent a surgical procedure.

The consultant surgeon associated with the case is sent a structured surgical case form for completion. The completed surgical case form is returned to WAASM where it is de-identified and then assessed by a first-line assessor. This assessor will be another surgeon working in the same specialty (peer review) but not the same hospital. The first-line assessor will either complete the review and close the case or recommend that the case undergo further assessment, that is, a second-line assessment or case note review.

Cases may be referred for a second-line assessment if:

- there is insufficient detail or lack of information in the surgical case form
- areas of concern or adverse events arising from clinical care of the patient are thought to warrant further investigation
- a report could usefully draw attention to lessons learned, either for clinicians involved in the case or as part of a collated assessment (case note review book) for wider distribution.

Second-line assessors are different consultant surgeons to first-line assessors, but they work in the same specialty. Like the first-line assessors, these surgeons work in a different hospital to that in which the death occurred.

2.2 Providing feedback

One of the main aims of WAASM is to provide feedback to inform, educate, facilitate change and improve practice.

2.3 Reporting conventions

2.3.1 Reporting clinical incidents

In the structured surgical case form, the surgeon is asked to document whether there were any clinical incidents during the care of the patient. If so, the surgeon is also asked to:

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

First- and second-line assessors also complete the same assessment matrix.

2.3.2 Analysis of clinical incidents

WAASM primarily focuses on areas of concern and adverse events. Data regarding areas for consideration are collected, but they are considered ‘less serious events’ as they have little impact on the overall care of the patient; they are generally excluded from the analysis because they make no difference to the outcome.

2.4 Data analysis

WAASM audits all deaths occurring in WA hospitals while the patient is under the care of a surgeon; however, terminal care cases are excluded from the full audit process. The 2015 Report covers deaths

reported to WAASM from 1 January 2010 to 31 December 2014, audited on 31 March 2015. Due to a time lag in reporting, 2014 cases are still under review and the numbers documented in this report do not represent a complete data set for the year. 2014 cases are due to be closed on the 31 March 2016 and the complete data set will be reported in the 2016 report. Numbers in previous reports may vary from this report because some cases have been completed after the audit dates of the previous reports.

Data is entered and stored in the Bi-national Audit System database version 3.3.5 and analysed using the Statistical Package for Social Sciences versions 19.0 and 22.0, and Microsoft Office Excel (2010). The number of cases analysed is represented in parentheses in the text (n). The total number of cases used in the analyses varies as each data point may not have been completed in every case reported. The total number of cases included in the analyses are provided in all tables and figures in the report.

2.5 Performance review

Recommendations were included in the WAASM 2014 Report.[13] An important measure of the success of WAASM is whether these recommendations have been addressed or achieved. A list of recommendations and improvements against these are listed in Section 6 of this report.

3. AUDIT PARTICIPATION AND ASSESSMENT

3.1 Deaths reported to WAASM

KEY POINTS

- Participation in WAASM is a mandatory College requirement for Continuing Professional Development (CPD).
- There has been a decrease in the number of deaths reported between 2010 and 2014.

Tables 1 and 2 and Figure 2 summarise the deaths reported to WAASM from 1 January 2010 to 31 December 2014.

Table 1 Deaths reported to WAASM between 1 January 2010 and 31 December 2014

Year	Number of Cases					
	2010	2011	2012	2013	2014	Total
Total deaths reported	592	571	601	593	578	2,935
Excluded error [a]	0	1	9	27	17	54
Total deaths falling within WAASM criteria	592	570	592	566	561	2,881

[a] Cases reported as WAASM deaths but that do not fall within WAASM inclusion criteria are labelled as 'excluded error'. Refer to Appendix B.2 for further information on data.

Figure 2 Reported deaths and surgical mortality rate per 100,000 population

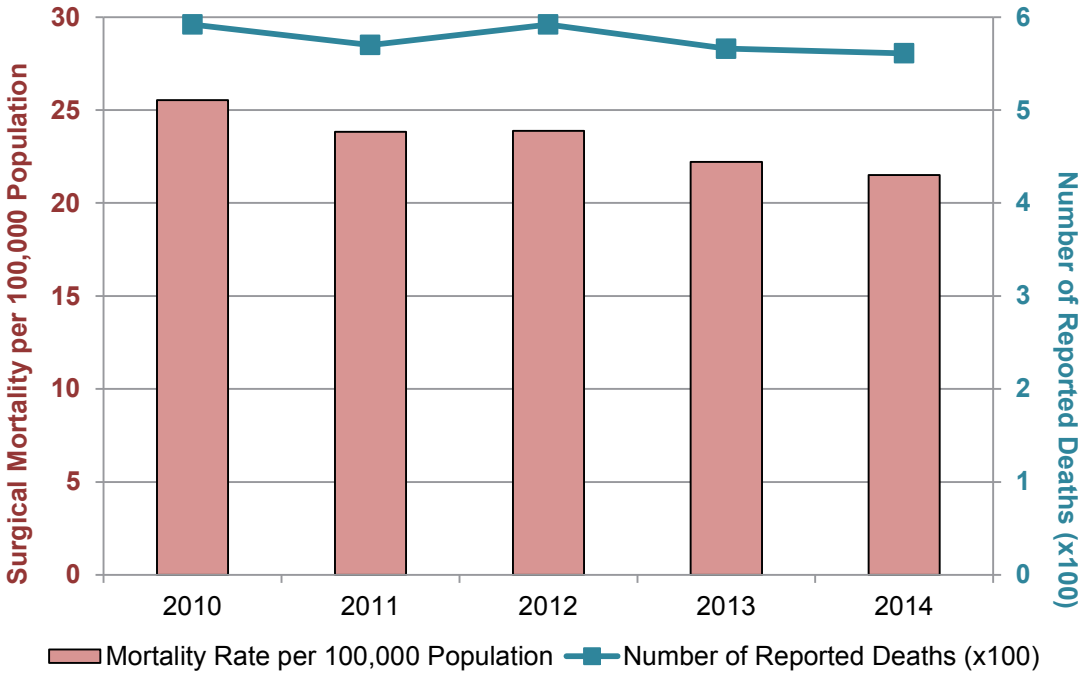


Table 2 Number of deaths under a surgeon per 100,000 population

Year	Number of deaths reported to WAASM per year [a]	Estimated WAASM-reported surgical mortality rate per 100,000 population [b]
2010	592	26
2011	570	24
2012	592	24
2013	566	22
2014	561	22

[a] Only surgically-related deaths that meet WAASM selection criteria were used in this analysis.
[b] Population data compiled from the Australian Bureau of Statistics[14]. Refer to Appendix B.2 for further information on data.

Comment:

Deaths under the care of a surgeon are reported to WAASM by the hospitals and the WA Department of Health. It is entirely independent of the surgeon and their participation in the audit. WAASM has observed a decrease in the number of deaths under a surgeon and the number of deaths per 100,000 population has decreased from 26 in 2010 to 22 in 2014 (Figure 2; Table 2); this is a decrease of 15%. This has occurred in a population that is progressively ageing and by implication will include a greater number with medical comorbidities.

The increase in the number of cases that have been excluded from the audit due to error ("excluded error"; Table 1) is due to information in WebPAS extracts that has not been accurate in relation to the discharge speciality and whether or not there has been surgeon involvement in the case. As such, WAASM must verify the information directly from medical records which increases the length of time taken to send out a notification of death or, as highlighted, increases the number of cases that must be labelled as errors due to being included in the audit under the guise of being surgical cases.

3.2 Surgeon participation in WAASM

KEY POINTS

- Surgical case form returns have increased from 76% (448) in 2010 to 90% (510) in 2013, indicating greater engagement and participation of consultants in the WAASM program. The increase in form returns has been compared against 2013 numbers as 2014 cases are not yet closed and may represent an incomplete data set.
- The increase in surgical case form returns is further highlighted in the number of cases associated with non-participants, whereby due to the compulsory participation in WAASM for CPD purposes, there were no cases associated with non-participants in 2013 and 2014.

Table 3 Surgeon participation and surgical case form returns

	Number of Cases (%)				
Year	**2010**	**2011**	**2012**	**2013**	**2014**
Reported deaths	592	571	601	593	578
Deaths falling within WAASM criteria	592	570	592	566	561
Number of surgeons associated with reported deaths	152	162	165	177	171
Surgical case form returns [a]	448 (76)	447 (78)	475 (80)	510 (90)	420 (75)

[a] Includes terminal care cases; percentages refer to total deaths as per WAASM criteria.
Refer to Appendix B.2 for further information on data.

Table 4 Case statistics of surgeons associated with three or more deaths

	Number of Cases (%)				
Year	**2010**	**2011**	**2012**	**2013**	**2014**
Number of surgeons associated with three or more deaths [a]	71 (47)	73 (45)	75 (45)	68 (38)	69 (40)
Cases related to surgeons associated with three or more deaths [b]	478 (81)	460 (81)	486 (82)	443(78)	432 (77)

[a] Percentages are calculated based on numbers in Table 3 for "Number of surgeons associated with reported deaths".
[b] Percentages are calculated based on numbers in Table 3 for "Deaths falling within WAASM criteria".
Refer to Appendix B.2 for further information on data.

Comment:

Table 3 shows the number of surgeons associated with deaths reported to WAASM. The number of surgeons having a death reported to WAASM has steadily increased from 2010 to 2013, with a slight decrease in 2014.

Surgical case form returns have increased from 76% in 2010 to 90% in 2013 (Table 3). The 75% returns for 2014 do not necessarily indicate a change in this pattern as there are still a number of 2014 cases that are currently open and therefore some surgical case forms are yet to be returned.

The WAASM office can offer assistance to facilitate surgical case form completion and appreciate any information relating to delayed cases. This is also important in order that any relevant system-related issues delaying surgical case form return are identified and resolved, so that the audit process can be improved for participants.

3.3 Hospital participation in WAASM

KEY POINT
• Between 1 January 2010 and 31 December 2014, 29 hospitals were associated with the 2,935 cases reported.

Figure 3 shows the number of reported deaths between 2010 to 2014 of patients admitted for surgery in WA hospitals and the current status of the WAASM forms (returned, not returned, no response and refused) for each hospital. Figure 3 refers to the completion status of cases relating to the treating surgeon. Hospitals where cases are classified as 'refused' indicate that one or more non-participants worked in those hospitals between 2010 and 2012.

Figure 3 Reported deaths of patients admitted for surgery in WA hospitals

3.4 Case completion

KEY POINTS

- Overall, 68% (1994) of cases for the 2010 to 2014 period completed the entire audit process.
- In 2013 and 2014, there were no cases associated with non-participation as participation in WAASM became compulsory for CPD purposes in 2013.

Percentage participation is calculated on the completion and return of the surgical case forms by 31 March 2015. The audit process is completed when the surgical case form has been assessed by the first- and, if required, the second-line assessor.

Table 5 Surgical case form status

Year	Number of Cases (%) 2010	2011	2012	2013	2014	Total
Deaths falling within WAASM criteria	592	570	592	566	561	2,881
Audit process complete [a]	420 (71)	429 (75)	452 (76)	434 (77)	259 (46)	1,994 (69)
Surgical case form complete, awaiting assessment [b]	0 (0)	0 (0)	5 (1)	51 (9)	140 (25)	195 (7)
Surgical case form not returned [c]	0 (0)	0 (0)	7 (1)	18 (3)	140 (25)	165 (6)
Terminal care cases	28 (5)	18 (3)	18 (3)	26 (5)	21 (4)	111 (4)
Lost to follow-up [d]	101 (17)	90 (16)	88 (15)	37 (7)	1 (<1)	317 (11)
Cases associated with non-participation [e]	43 (7)	33 (6)	22 (4)	0 (0)	0 (0)	98 (3)

[a] Percentages refer to total deaths falling within WAASM criteria.
[b] Case awaiting first- or second-line assessment.
[c] Surgical case forms are considered 'not returned' if they have not been received by the WAASM office within two years of the notification of death, however the consultant still works in WA.
[d] Cases are considered 'lost to follow-up' if forms have not been returned two years after the date of death or are associated with surgeons who are no longer working in WA and did not complete cases prior to moving, or if cases were not able to be completed due to lost medical records.
[e] Non-participants are surgeons who have indicated that they do not wish to participate in the WAASM prior to the Audit becoming compulsory.
Refer to Appendix B.2 for further information on data.

Table 6 First-line assessments (FLA)

Year	Number of Cases (%) 2010	2011	2012	2013	2014	Total
Deaths falling within WAASM inclusion criteria	592	570	592	566	561	2,881
Number of cases completed	420 (71)	429 (75)	452 (76)	434 (77)	259 (46)	1,994 (69)
FLA pending	0 (0)	0 (0)	1 (<1)	18 (3)	92 (16)	111 (4)

Comment:

The number of first-line assessments returned is included in the number of cases completed as each completed case must undergo a first-line assessment.

The overall proportion of first-line assessments returned to the WAASM office has remained consistent at an average of 75% from 2010 to 2013.

Table 7 Second-line assessments (SLA)

	Number of Cases (%)					
Year	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Deaths falling within WAASM inclusion criteria	592	570	592	566	561	2,881
Number of cases completed	420 (71)	429 (75)	452 (76)	434 (77)	259 (46)	1,994 (69)
Number of cases referred to SLA	63 (11)	66 (12)	69 (12)	69 (12)	52 (9)	319 (11)
Cases referred to SLA where the audit process has been completed	56 (89)	63 (95)	61 (88)	39 (57)*	12 (23)	227 (71)
Cases referred to SLA that were lost to follow up	6 (10)	4 (6)	5 (7)	0 (0)	0 (0)	15 (5)

*Cases referred to SLA where the audit process has been completed were lower in 2013 than in other years. This may be due to the migration of WAASM data to the BAS system. During the process of migration, the SLA process was delayed until the new tracking system was operational.

Comment:

The proportion of cases referred to SLA has remained relatively stable over the last five years. On average 5% of cases referred to SLA are "lost to follow up" every year. Second-line assessments may be labour intensive, which may be a contributing factor to the smaller number of cases referred to SLA where the audit process has been completed. There is also a shortage of assessors available in the smaller surgical specialities which leads to a significant backlog in the cases that need to be sent out for review and which then take longer to achieve audit completion.

To alleviate the need for SLA, consultants are encouraged to fill out surgical case forms with a high level of detail so that first line assessors can make an appropriate decision on the case without having to refer the case to SLA due to lack of information.

Figure 4 Case completion rates

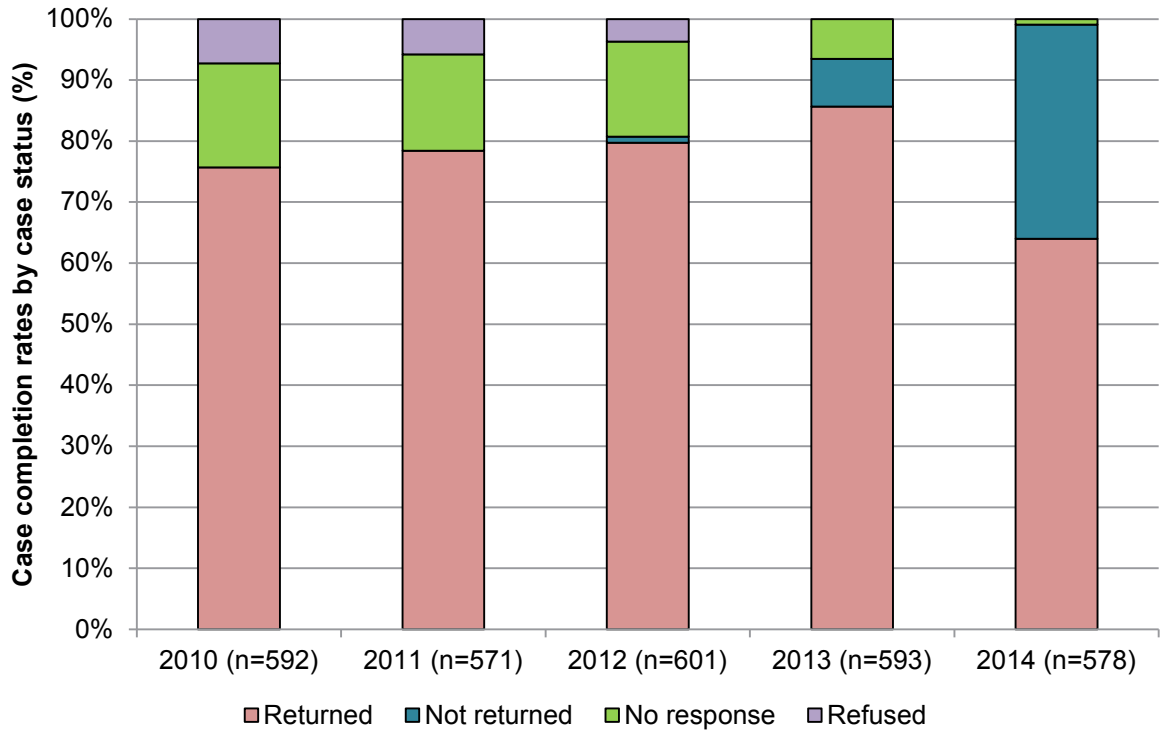
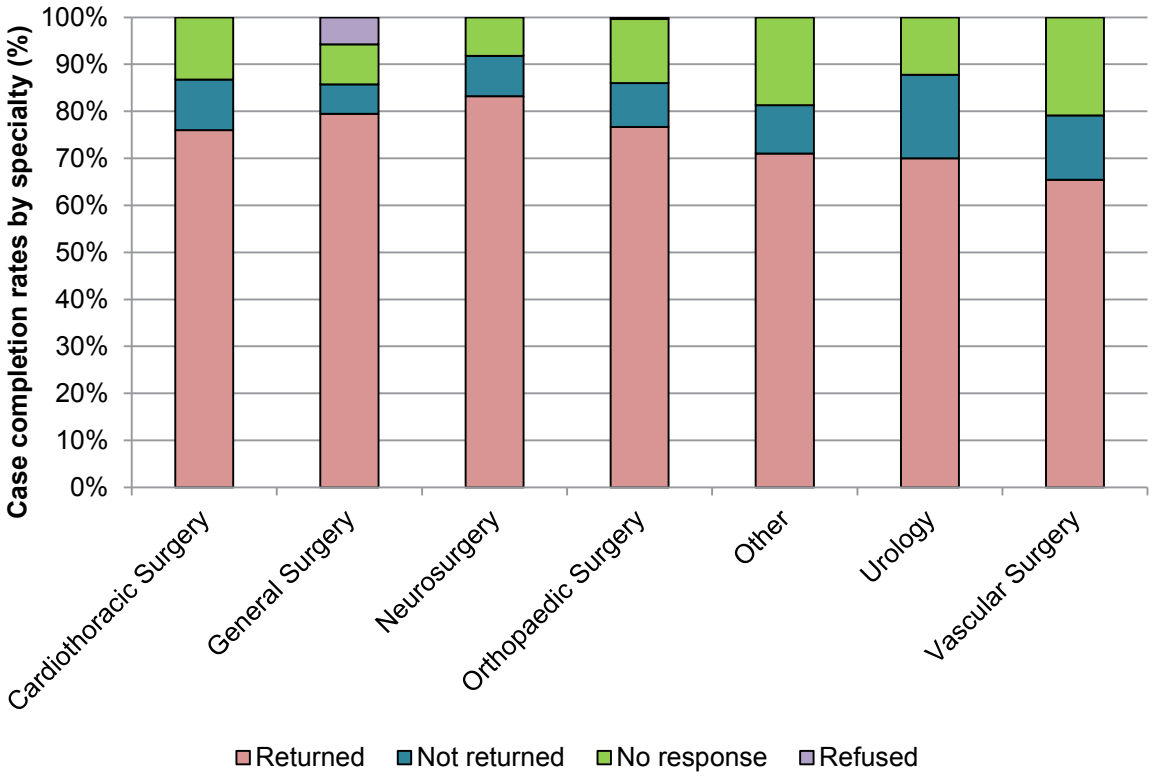


Figure 5 Case completion rates by specialty



Note: 'Other' surgery includes the specialties of Otolaryngology, Head and Neck Surgery, Ophthalmology, Paediatric Surgery, Gynaecology, and Plastic Surgery. Refer to Appendix B.3 for further information on data.

Comment:

Figure 4 represents a summary of the case completion rates by the status of the cases in the audit process. Figure 5 gives a breakdown of the overall case status by surgical specialty. Neurosurgery and General Surgery have the highest rates of surgical case form returns while Vascular Surgery has the lowest rate (Figure 5).

4. ANALYSIS OF AUDIT DATA

4.1 Overview of patient demographics

KEY POINTS
• 54% (1,577/2,933) of all patients were male and the median age of patients was 77 years (75 and 79 years for males and females respectively). • Cases of surgical mortality were most frequent for males and females between 81 and 90 years of age respectively.

Age and gender distribution

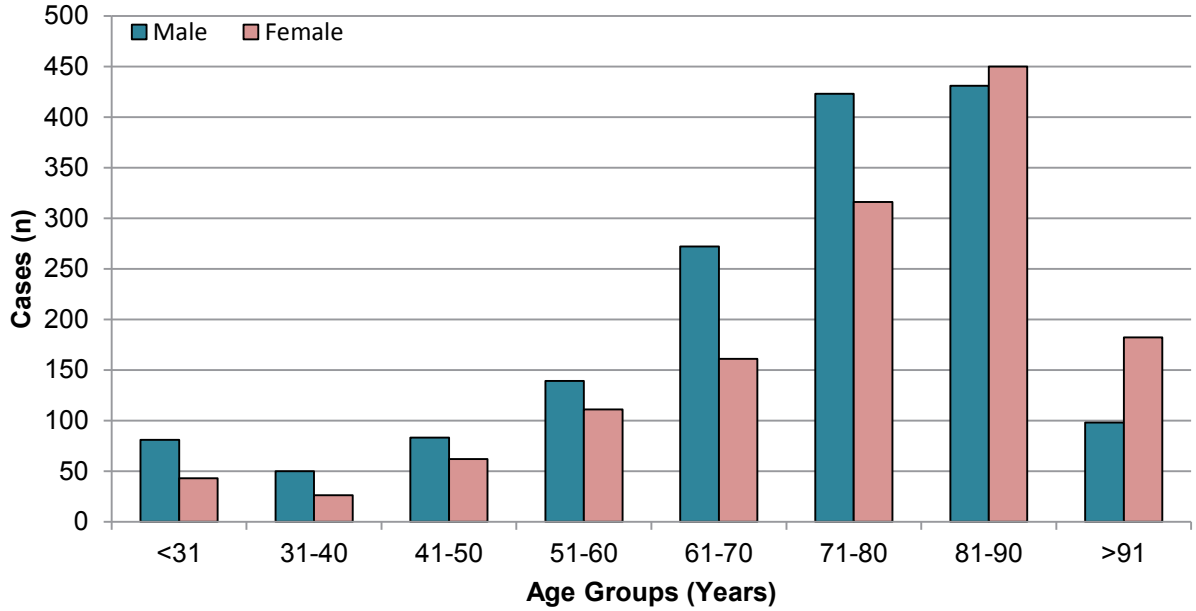
Table 8 shows the median age by gender of audited patients. Figures 6 and 7 look at the distribution of age by gender. Figure 8 reports on age by specialty.

Table 8 Median age by gender

	Number of Cases	Median Age (Years)	Interquartile Range (Years)
All patients	2,933	77	64-85
Male	1,577	75	63-84
Female	1,351	79	67-87

Refer to Appendix B.2 for further information on data.

Figure 6 Age group by gender



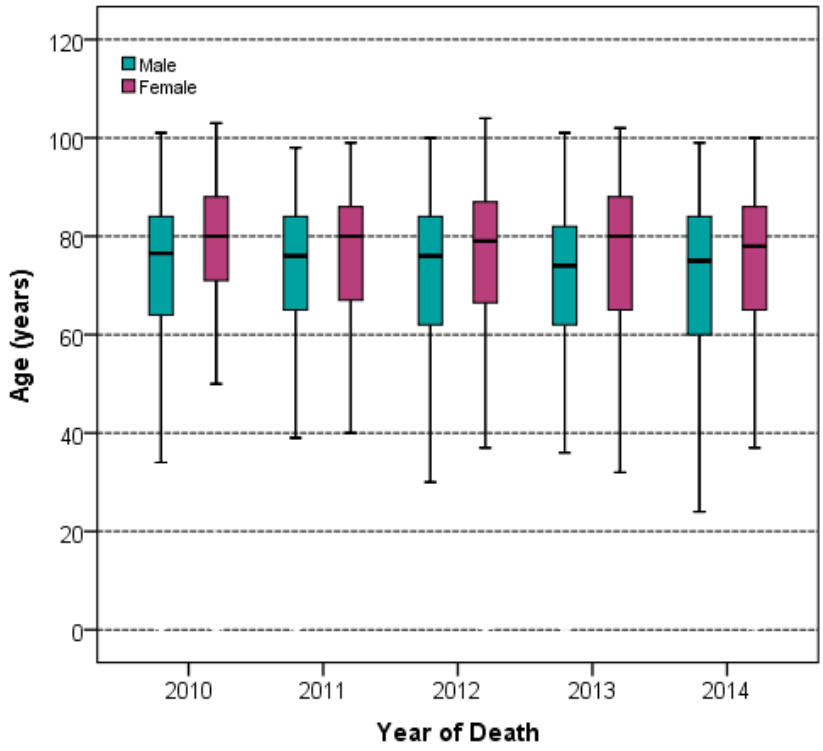
Comment:

Figure 6 shows that the gender trend changes as age increases. Males predominate in the first six age categories, while females predominate in the 81-90 and >91 year age ranges. This is likely due to the longer average life expectancy of women.

Figures 7 and 8 (below) are box-and-whisker plots, in which:

- the central box represents the values from the lower to upper quartile (25th–75th percentiles);
- the middle line represents the median value;
- the vertical line extends from the minimum value to the maximum value, excluding extreme values.

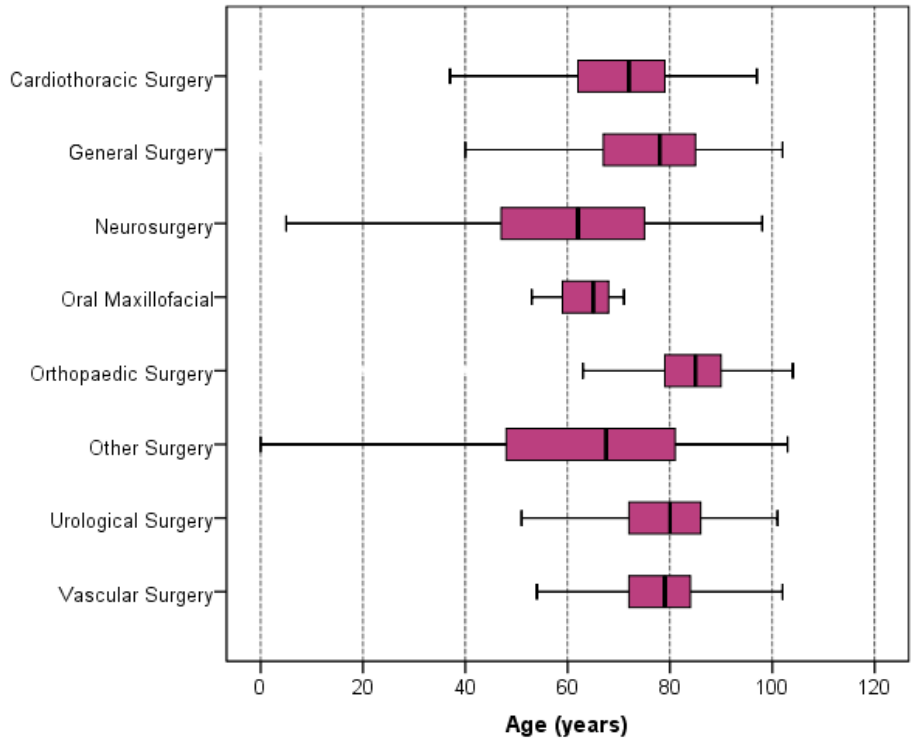
Figure 7 Age distribution by gender and year of death



Comment:

The median age of females is higher than that of males in cases of surgical mortality in each year from 2010 to 2014 (Figure 7).

Figure 8 Age distribution by surgical specialty



Note: 'Other surgery' includes Ophthalmology, Otolaryngology Head and Neck Surgery, Plastic Surgery, Paediatric Surgery and Gynaecology.

Comment:

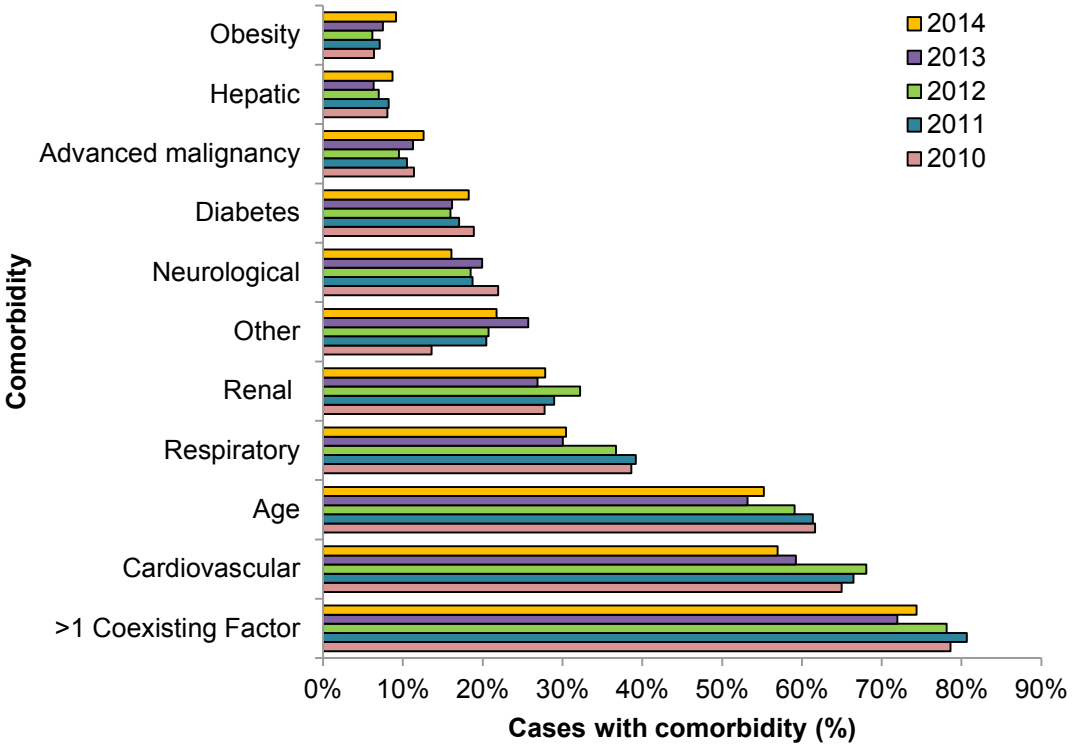
The age distribution of patients in different surgical specialties shows that the orthopaedic cases predominantly involved patients over the age of 80. The largest distribution of ages occurs in neurosurgical cases. As 'other surgery' includes several different specialties, the age distribution has a large range and the data is skewed for this category (Figure 8).

4.2 Overview of patient clinical information

4.2.1 Comorbidity

Surgeons are asked to indicate if there are any significant comorbidities associated with each case (see Figure 9). Neurosurgeons do not complete this question in their form and are therefore excluded from this analysis.

Figure 9 Comorbidity status in completed cases



Refer to Appendix B.3 for additional information.
'Other' refers to comorbidities other than the ones listed on the surgical case form and may include the presence of other chronic illnesses, haematological or drug-related conditions, vasculopathy, hypertension, dementia, malnutrition, alcoholism and cachexia.

Comment:

Overall, from 2010 to 2014, the percentage of patients with more than one coexisting comorbidity has decreased from 79% in 2010 to 74% in 2014 (Figure 9). Surgical risk increases based upon the pre-existing patient condition.

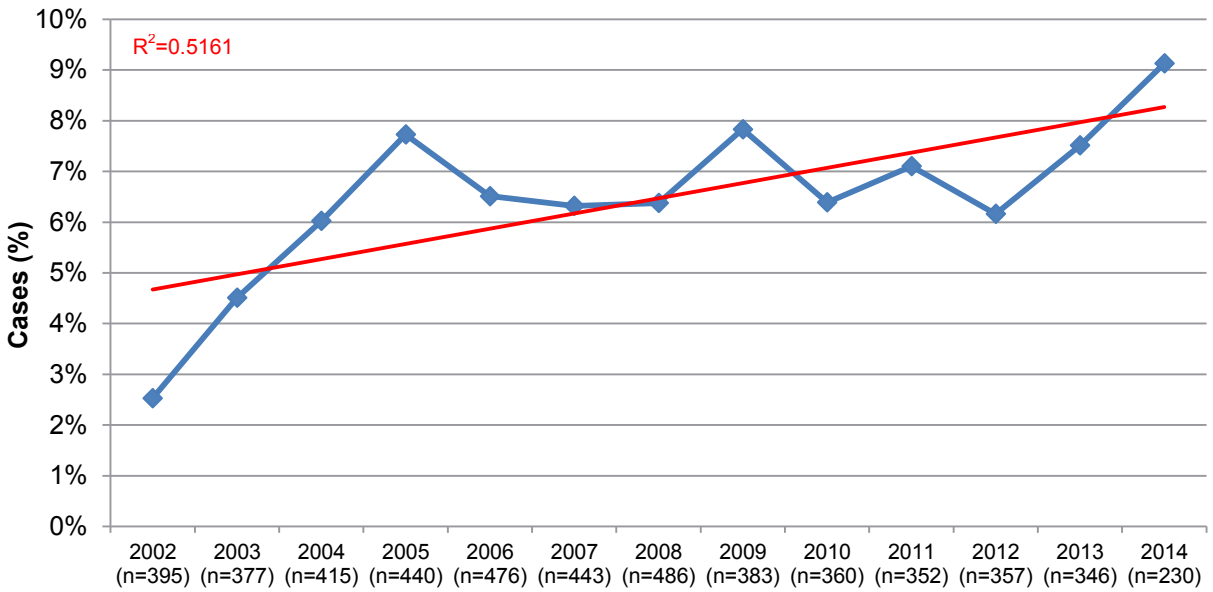
The limited number of previous studies that have assessed the impact of obesity on outcome in patients undergoing non–bariatric surgery have observed an increased morbidity. An increase in mortality has not been consistently reported with a Body Mass Index (BMI) up to 35 kg/sq metre being apparently protective – the so called 'obesity paradox' [31-33]. However, all these studies assessed obesity using BMI. Whilst BMI as a measure of obesity is a convenient tool, its value is being increasingly challenged. Studies that have assessed visceral adiposity have noted an association with adverse morbidity but the impact on mortality remains unknown [31-33]

4.2.1.1 Obesity and diabetes comorbidities

Analysis in this section includes audit data from 2002 to 2014 for the purposes of highlighting trends observed in comorbidities which have changed slowly over time.

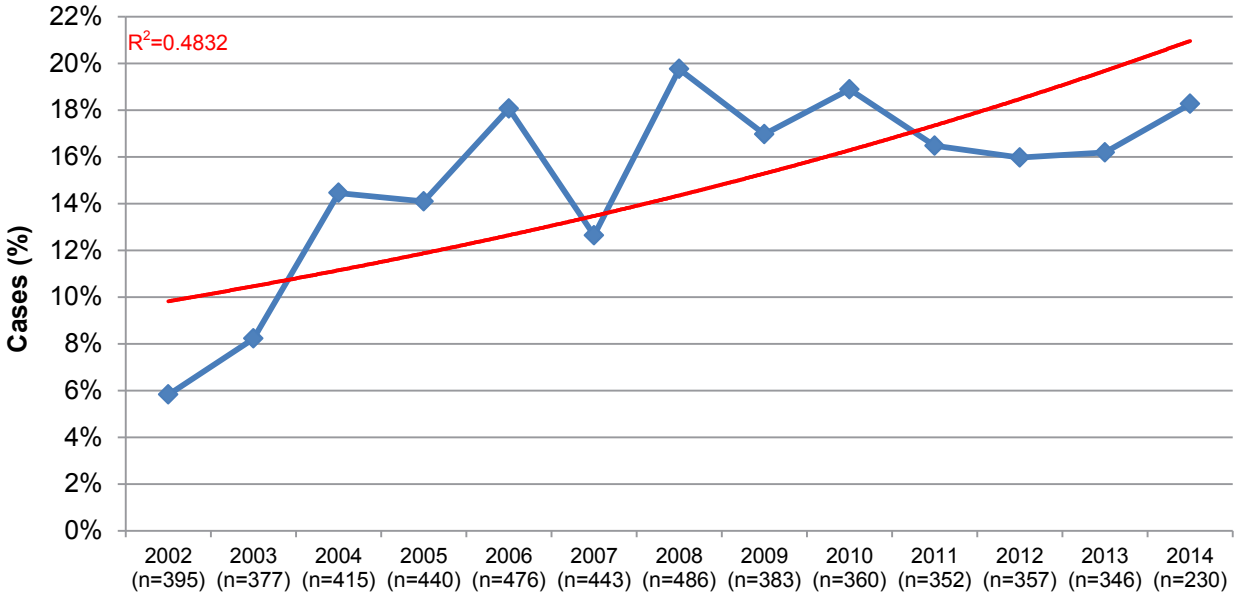
The trend for obesity and diabetes comorbidities in cases of surgical mortality were further analysed.

Figure 10 Obesity as a comorbidity in cases of surgical mortality



The trend line (in red) is a visual representation of a trend over a period of time . The trend line indicates that there has been a significant increase (P=0.00331) in obesity as a comorbidity over the audit period.

Figure 11 Diabetes as a comorbidity in cases of surgical mortality

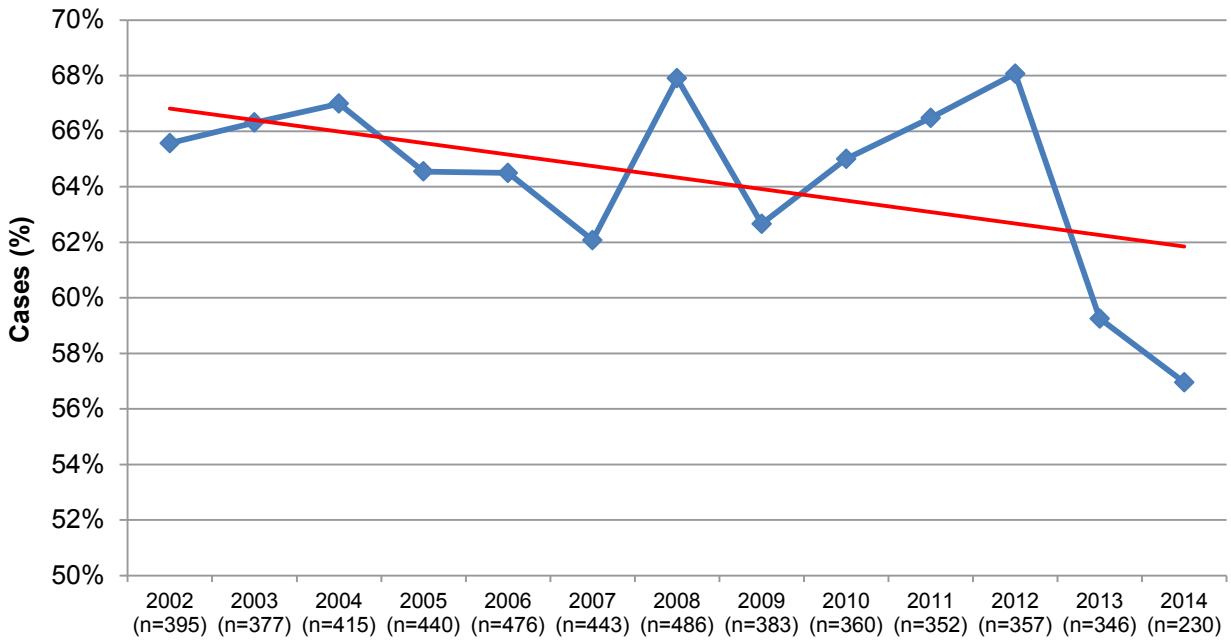


The trend line (in red) is a visual representation of a trend over a period of time . The trend line indicates that there has been a significant increase ($P=1.2E^{-07}$) in diabetes as a comorbidity over the audit period.

Comment:
There is an increasing trend of obesity and diabetes comorbidities in cases of surgical mortality, strongly suggesting that lifestyle issues contribute to riskier surgery[31-33]. The percentage increase in obesity and diabetes comorbidities in cases of surgical mortality was found to be significant. The P-values for the trend increases are shown in red at the top left hand corner of each graph.

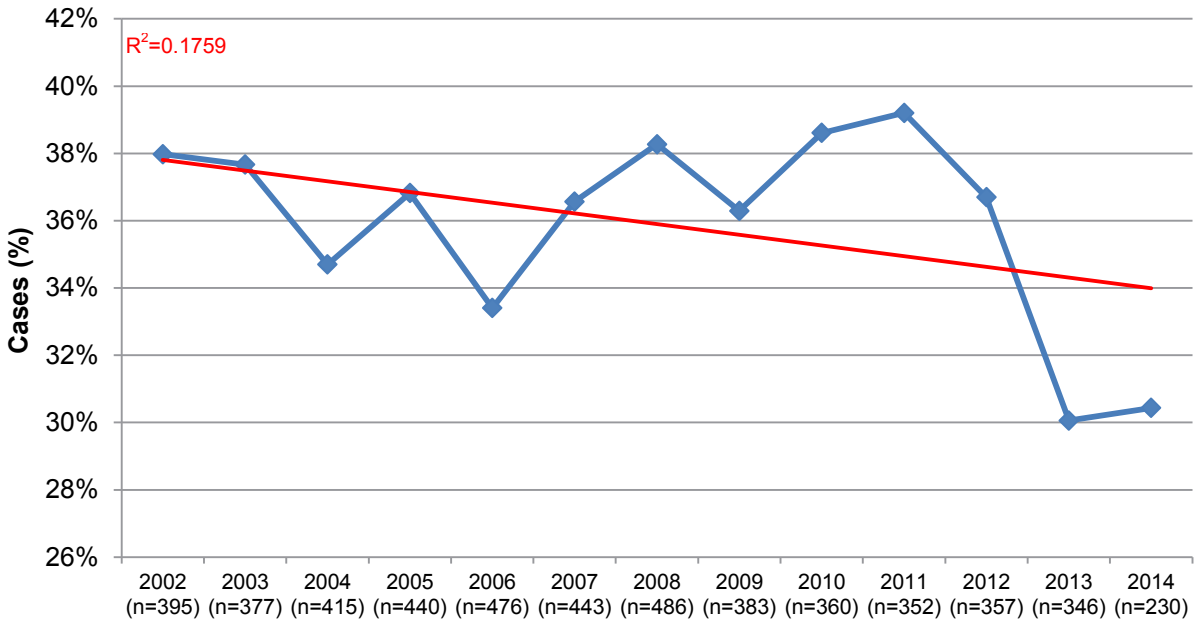
4.2.1.2 Cardiovascular, respiratory, renal and hepatic comorbidities

Figure 12 Cardiovascular comorbidity in cases of surgical mortality



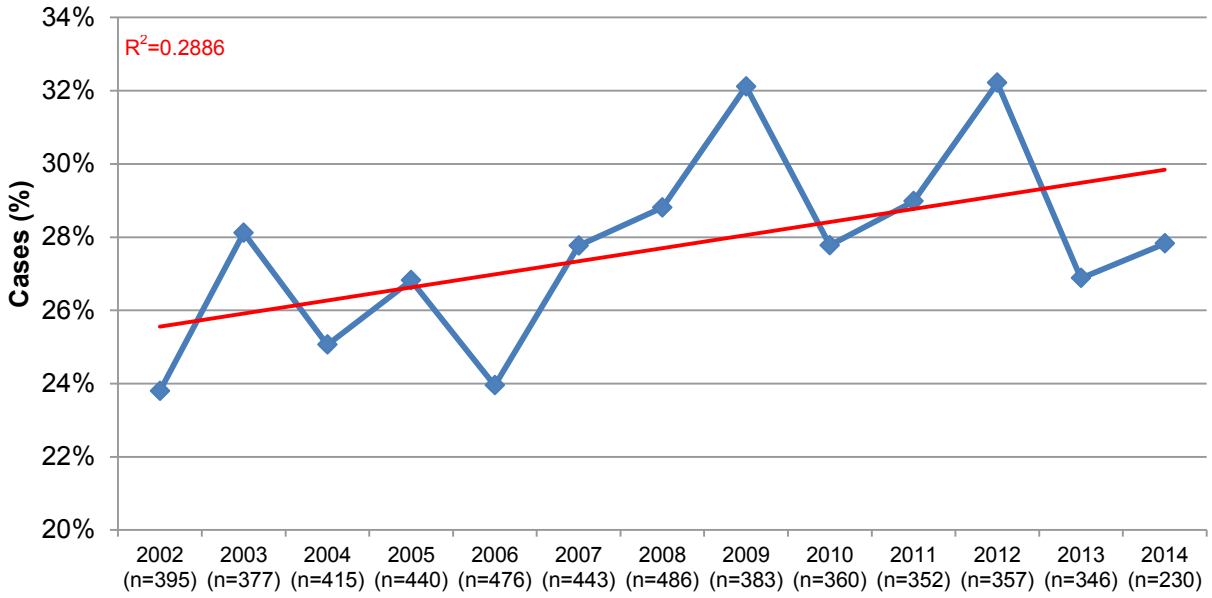
The trend line (in red) is a visual representation of a trend over a period of time . The trend line indicates that there has been a decrease (P=0.07464) in cardiovascular comorbidities over the audit period.

Figure 13 Respiratory comorbidity in cases of surgical mortality



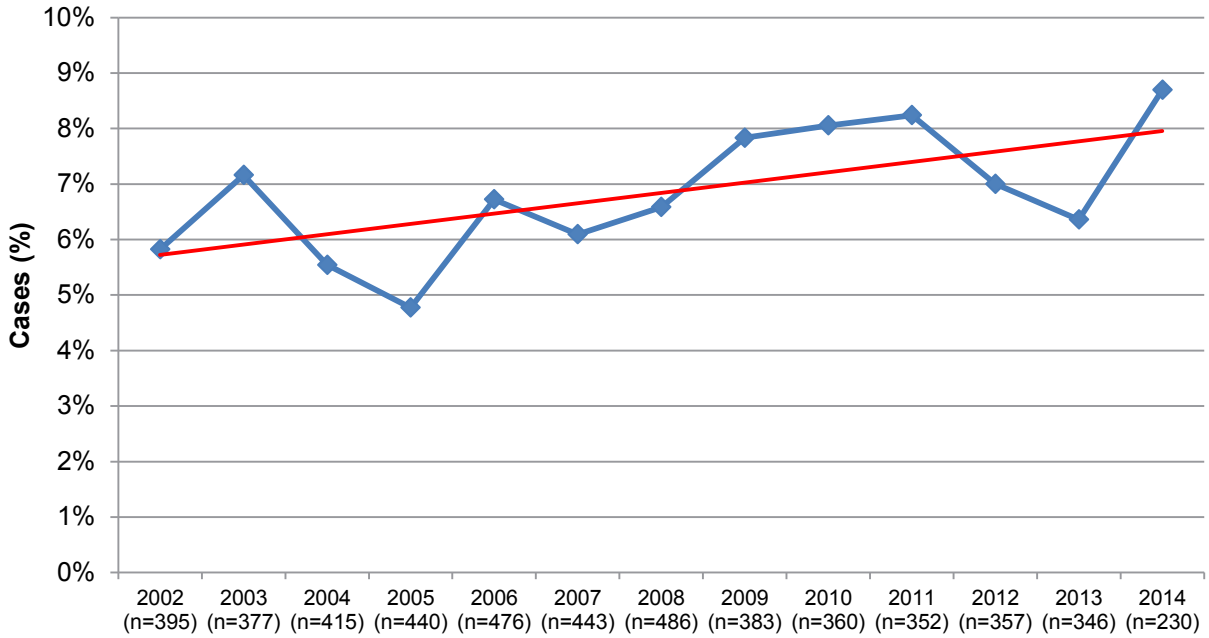
The trend line (in red) is a visual representation of a trend over a period of time . The trend line indicates that there has been a decrease (P=0.18769) in respiratory comorbidities over the audit period.

Figure 14 Renal comorbidity in cases of surgical mortality



The trend line (in red) is a visual representation of a trend over a period of time . The trend line indicates that there has been a significant increase (P=0.02291) in renal comorbidities over the audit period.

Figure 15 Hepatic comorbidity in cases of surgical mortality



The trend line (in red) is a visual representation of a trend over a period of time . The trend line indicates that there has been an increase (P=0.06645) in hepatic comorbidities over the audit period.

Comment:
A decreasing trend in cardiovascular and respiratory comorbidities and increasing trends in renal and hepatic comorbidities are observed over time.

Analysis on the changes observed in cardiovascular (decreasing trend) and hepatic (increasing trend) comorbidities in cases of surgical mortality indicate that there is some evidence of change over time, however it is not yet significant (as P-values are slightly greater than 0.05).

There is a significant increase in renal comorbidities over time, while the decrease in respiratory comorbidities was not significant.

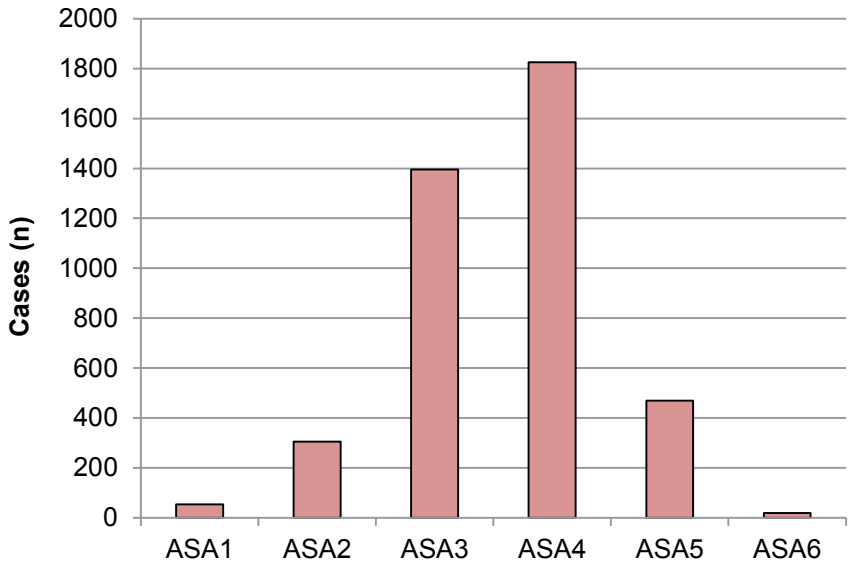
4.2.2 American Society of Anaesthesiologists (ASA) grades

The ASA grades are an internationally recognised classification of preoperative physical status. The definition of ASA grades can be found in Appendix B.1.

This section on ASA grades includes data from 01 January 2004 to 31 December 2014.

ASA grade is a simple but important measure of comorbidity and is routinely recorded on the anaesthetic record.

Figure 16 Frequencies of ASA grades assigned to WAASM cases by treating surgeons 2004-2014

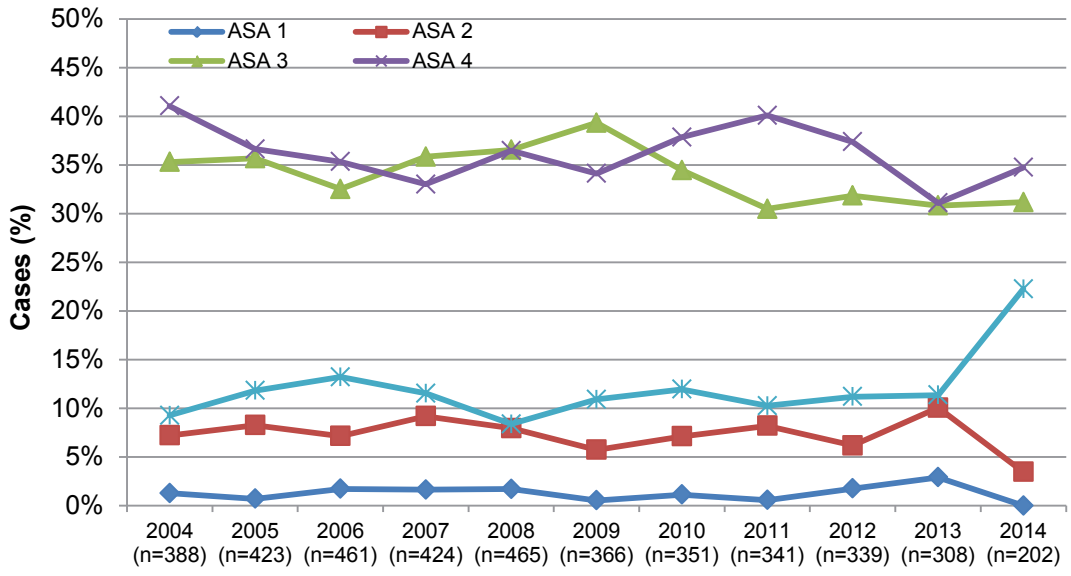


Refer to Appendix B.3 for further information on data.
Data on ASA grades was not well collected until 2004; as such data for 2002 and 2003 was not included.

Comment:

Seventy-eight per cent of patients were assigned an ASA grade 3 or 4, that is they had a moderate or severe degree of systemic disease on admission (see Figure 17).

Figure 17 ASA grades (by year)



Data on ASA grades was not well collected until 2004, as such data for 2002 and 2003 was not included.

Comment:

The trends with ASA grade over time have not markedly changed, suggesting that the trends observed in comorbidities are not due to a changing patient profile.

4.2.3 Prophylaxis of thromboembolism

Surgeons are asked on the surgical case form whether deep vein thrombosis (DVT) prophylaxis was used and, if not, the reason why it was withheld. During case review, assessors indicate whether they think that the decision was appropriate (see Table 9).

Table 9 Use of DVT prophylaxis in cases of surgical mortality

Surgeon-reported use of DVT Prophylaxis (%)						
Year of death	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Number of completed cases	420	429	452	434	259	1,994
Cases where DVT prophylaxis was stated as used or not used in surgical case form	354 (84)	344 (80)	350 (77)	357 (82)	256 (99)	1,661 (83)
Cases in which DVT prophylaxis was used	278 (66)	267 (62)	284 (63)	260 (60)	199 (77)	1,288 (65)
Peer reviewed analysis of use of DVT Prophylaxis and appropriateness of use (%)						
Year of death	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Cases in which the use of DVT prophylaxis was stated in the surgical case form	305 (86)	304 (88)	315 (90)	334 (94)	250 (98)	1,508 (91)
DVT prophylaxis use appropriate (assessor reported)	283 (80)	283 (82)	291 (83)	283 (79)	222 (87)	1,362 (82)

Comment:

The importance of DVT prophylaxis has consistently been highlighted in previous reports and symposia. Use of DVT prophylaxis remained relatively consistent across the audit period with treating surgeons reporting use of prophylaxis in 65% of WAASM cases (Table 9). Through the peer review process assessors indicated that DVT prophylaxis was used appropriately in 82% of cases. The use of DVT prophylaxis in surgical cases and appropriateness as reported by assessors remains consistently high.

4.2.4 Critical care allocations in cases of surgical mortality

Table 10 shows the actual use of critical care units ((high dependency unit (HDU) or intensive care unit (ICU)), as well as cases where HDU or ICU were not used but, in the assessor's opinion, should have been used.

Table 10 Actual use, and assessor opinion of use, of a critical care unit

Number of cases (%)						
Year of death	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Number of completed cases	420	429	452	434	259	1,994
Cases where treatment in critical care units was stated in surgical case form	328 (78)	318 (74)	317 (70)	356 (82)	257 (99)	1,576 (79)
Cases in which critical care was used	178 (42)	172 (40)	168 (37)	181 (42)	154 (59)	853 (43)
Assessor's opinion on usage of critical care facilities (ICU or HDU)						
Year of death	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Cases in which ICU should have been used	9 (2)	11 (3)	6 (1)	5 (1)	1 (<1)	32 (2)
Cases in which HDU should have been used	13 (3)	12 (3)	9 (2)	13 (3)	5 (2)	52 (3)

Comment:

Critical care (HDU and ICU) facilities were used in 43% of surgical deaths reported to WAASM (see Table 10). As outlined in previous reports, there continues to be a proportion of cases (5%) that would have potentially benefited from HDU or ICU (in the assessor's opinion) but were not admitted to such a unit. This data has been consistent over many years.

4.2.5 Causes of death

Table 11 Most common causes of death in cases of surgical mortality

Most common causes of death (n=1,992)	
Read Code Description	**n (%)**
Septicaemia	145 (7)
Multiple organ failure	143 (7)
Acute myocardial infarction	102 (5)
Pneumonia due to unspecified organism	89 (4)
Respiratory failure	81 (4)
Aspiration pneumonia	71 (3)
Vascular insufficiency of the intestine	66 (3)
Heart failure	64 (3)
Cardiac arrest	55 (3)
Intracerebral haemorrhage	51 (3)

Comment:

Only the top 10 leading causes of death are listed by frequency from a total of 1992 cases overall.
The three most common causes of death among audited cases between 2010 and 2014 are septicaemia, multiple organ failure and acute myocardial infarction (Table 11).

4.3 Admissions

KEY POINTS

- Between 2010 and 2014, 85% of cases were admitted to public hospitals, 10% to private hospitals and 5% to co-location hospitals.
- Of the 1,614 deaths occurring in public hospitals, 11% were elective admissions.
- Of the 189 cases of deaths occurring in private hospitals, 43% were elective admissions.

The audit data, with regards to admission, covers:

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

Table 12 Elective and emergency admissions to public and private hospitals

		Number of Cases (%)		
	Hospital admissions	**Elective**	**Emergency**	**Total**
All audited cases [a]	**Private**	81 (43)	108 (57)	189 (10)
	Public	171 (11)	1,443 (89)	1,614 (85)
	Co-location	6 (6)	95 (94)	101 (5)
	Total	258 (14)	1,646 (86)	1,904 (100)
Cases that underwent an operation [b]	**Private**	79 (98)	92 (85)	171 (90)
	Public	146 (85)	803 (56)	949 (59)
	Co-location	5 (83)	59 (62)	64 (63)
	Total	230 (89)	954 (58)	1,184 (62)

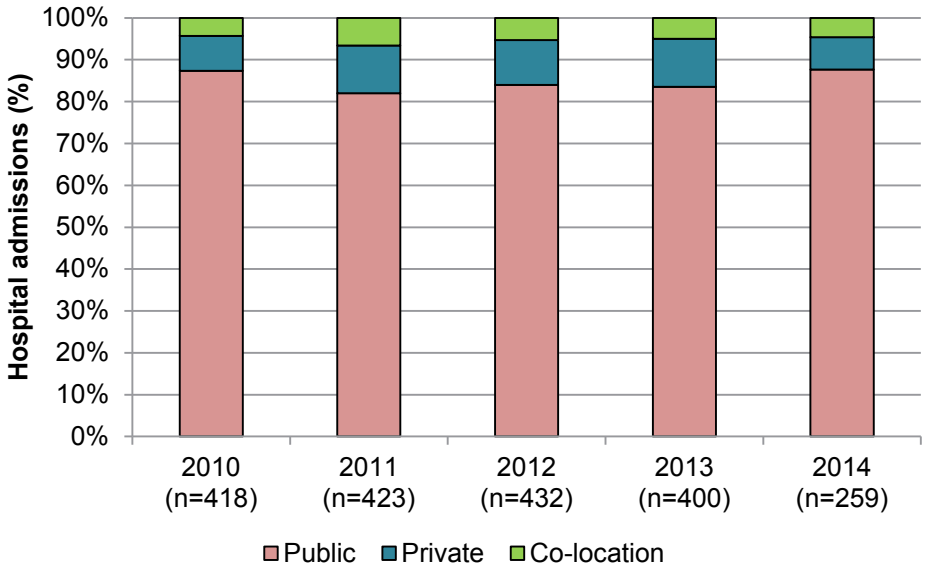
Percentages in [b] relate to figures in [a]. Refer to Appendix B.2 for further information on data.

Comment:

An analysis of relationships between admissions data was undertaken using Pearson's Chi-Squared Test. The significance of relationships between hospital status, admission type and the operative status of cases was tested. It was found that:

- Of emergency cases admitted to public hospitals, 56% underwent an operation compared to 85% of emergency cases admitted to private hospitals ($p<0.0001$) (Table 12[b]).
- Of elective cases admitted to public hospitals, 85% underwent an operation compared to the number undergoing operations in private hospitals of 98% ($p=0.002$) (Table 12[b]).

Figure 18 Cases admitted to public or private hospitals



Comment:

Eighty-five per cent of audited deaths occurred in public hospitals, 10% of audited deaths in private hospitals and 5% of audited deaths involved co-locations (see Figure 18). This is in keeping with WAASM's previous observation[13] that emergency and high risk patients are being increasingly managed in public hospitals.

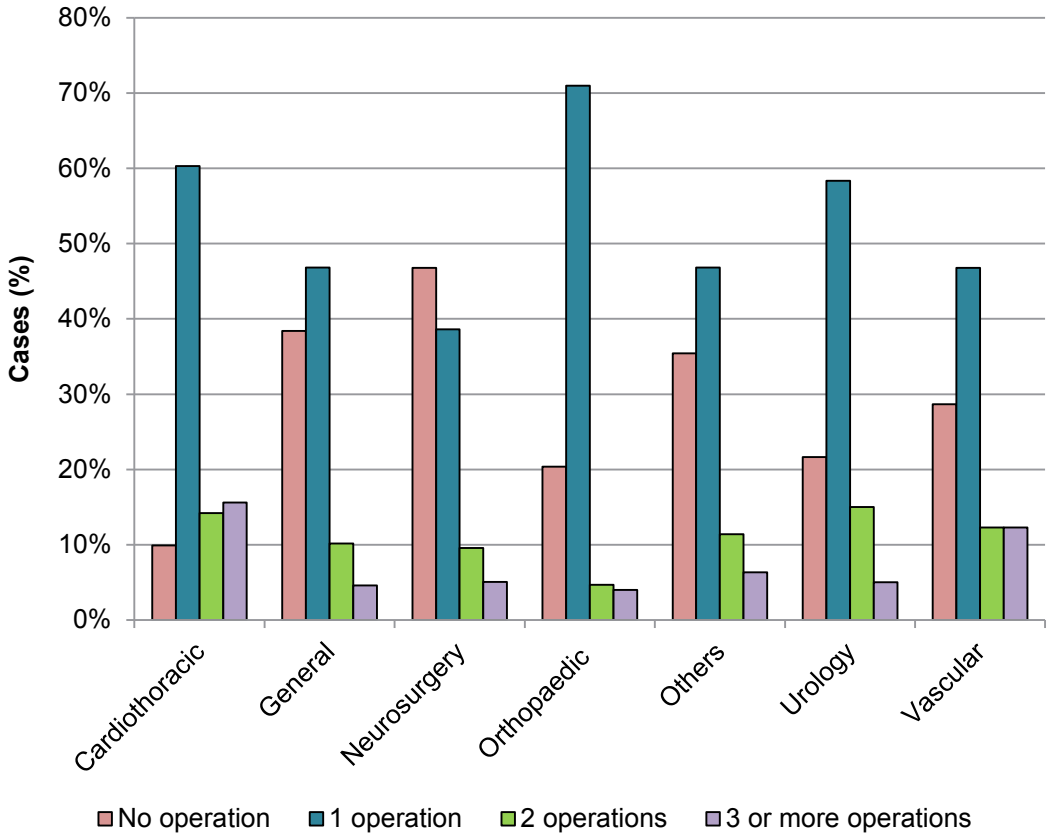
4.4 Operative and non-operative cases

KEY POINTS

- Orthopaedic Surgery and Neurosurgery were the specialties with the highest and lowest rates of single operations performed, respectively.
- Neurosurgery and Cardiothoracic Surgery were the specialties with the highest and lowest rates of no operation performed, respectively.
- Of the 1,228 cases in which an operation was performed, 4% were abandoned.

4.4.1 Operative cases

Figure 19 Operations by specialty



Refer to Appendix B.3 for further information on data. Surgical specialty 'Others' included Otolaryngology, Head and Neck Surgery, Opthalmology, Paediatric Surgery, Gynaecology and Plastic Surgery.

Table 13 Operations abandoned

	Number of Cases (%)					
Year	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Number of operative cases	262	278	271	259	158	1,228
Cases in which an operation was abandoned due to a terminal situation	14 (5)	8 (3)	9 (3)	13 (5)	5 (3)	49 (4)

Comment:

The proportion of operative cases abandoned upon finding a terminal situation has decreased overall between 2010 and 2014. Over this reporting period, a total of 4% of operations were abandoned upon finding a terminal situation (Table 13).

Table 14 Unplanned returns to theatre

Unplanned returns to theatre	Year 2010	2011	2012	2013	2014	Total
Number of cases in which at least one operation was performed	262	278	271	259	158	1,228
Cases where surgeons reported an unplanned return to theatre (%)	39 (15)	39 (14)	35 (13)	32 (12)	27 (17)	172 (14)

Comment:

The proportion of unplanned returns to theatre has been relatively stable, but there was a slight increase in 2014. The increase observed in 2014 will be confirmed once more cases are closed; this will be reported in the 2016 report.

4.4.1.1 Consultant involvement in operative cases

When completing the WAASM surgical case form, surgeons are asked to indicate the grade of surgeon making the operative decision, performing the operation or directly assisting during the operation. Table 15 and Table 16 examine consultant involvement in operative cases.

Table 15 Consultant deciding, operating and assisting in theatre in all WA hospitals

Year	Number of Cases (%) 2010	2011	2012	2013	2014	Total
Number of operative cases	262	278	271	259	158	1,228
Consultant deciding	219 (84)	223 (80)	220 (81)	208 (80)	142 (90)	1,012 (82)
Consultant deciding, also operating	131 (50)	163 (59)	161 (59)	138 (53)	97 (61)	690 (56)
Consultant deciding, also assisting or in theatre	53 (20)	48 (17)	59 (22)	60 (23)	48 (30)	268 (22)

Table 16 Consultant deciding, operating and assisting in theatre in all WA teaching hospitals

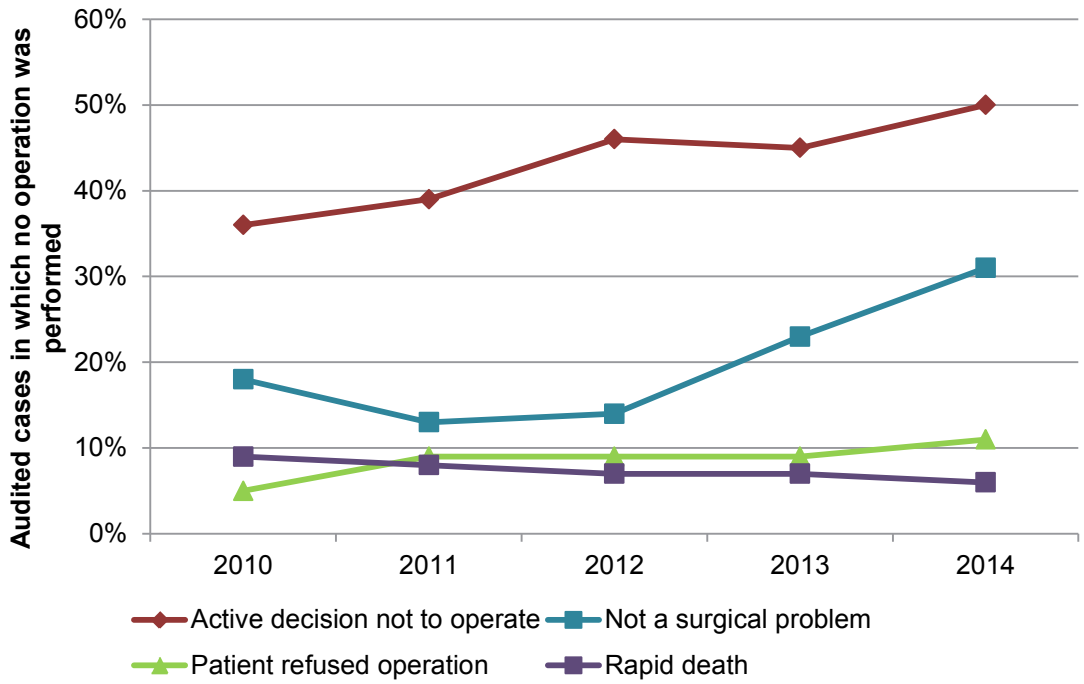
Year	Number of Cases (%) 2010	2011	2012	2013	2014	Total
Number of operative cases in teaching hospitals	211	201	205	190	122	929
Consultant deciding	168 (80)	149 (74)	15 (76)	140 (74)	110 (90)	722 (78)
Consultant deciding, also operating	89 (42)	102 (51)	101 (49)	83 (44)	74 (61)	449 (48)
Consultant deciding, also assisting or in theatre	43 (20)	40 (20)	42 (20)	40 (21)	41 (34)	206 (22)

Comment:

The number of consultants involved in decision-making has increased from 84% in 2010 to 90% in 2014. The number of consultants who operated as well as made decisions increased from 50% in 2010 to 61% in 2014 (Table 15). These upward trends are also reflected in cases of surgical mortality in teaching hospitals (Table 16). Earlier WAASM reports have documented the lack of consultant supervision; the current data suggests that highlighting the issue has brought awareness to it and it is encouraging to note that it has improved.

4.4.2 Non-operative cases

Figure 20 Reasons for no operation



Comment:

The proportion of cases in which an active decision was made not to operate has increased steadily and by 14% from 2010 (36%, 54/151) to 2014 (50%, 51/101). This illustrates a consistent trend towards an active decision on the part of the surgeon, patient and/or next of kin not to operate. The proportion of patients refusing an operation also increased over the reporting period from 5% (8/151) in 2010 to 11% (11/101) in 2014.

Additionally, the proportion of cases in which the rapid death of a patient was reported has decreased from 9% (14/151) in 2010 to 6% (6/101) in 2014 (Figure 20).

The proportion of cases where treating surgeons have reported the case as 'not a surgical problem' has increased by 13% from 2010 (18%, 27/151) to 2014 (31%, 31/101).

Table 17 Reasons for non-operative cases in emergency admissions

Reason for no operation*	Admissions to private hospitals (n=14)**	Admissions to public hospitals (n=625)**	Admissions at co-location (n=36)**
Active decision not to operate	10	273	14
Not a surgical problem	2	121	6
Patient refused operation	2	48	8
Rapid death	2	47	2

Refer to Appendix B.2 for further information on data.
* More than one reason for no operation could be given in the surgical case form, as such the total number of cases for each hospital status will be less than the total number of reasons given for no operation.
** (n) is the total number of emergency admissions where no operations were performed in private, public or co-located hospitals.

Comment:

In cases where an operation was not undertaken in emergency admissions, the primary reason for no operation was an active decision not to operate, this occurred in 71% of admissions in private hospitals, 44% of admissions in public hospitals and 39% at hospitals with both private and public facilities (co-location) (Table 17).

4.5 Clinical management issues

KEY POINT
• A decrease in the proportion of clinical management issues that caused death was seen from 2010 and 2014.

Areas for consideration, areas of concern, and adverse events related to audited cases are compared in Table 18.

Table 18 Audited deaths associated with areas for consideration, areas of concern or adverse events, as reported by assessors

	Number of cases (%)					
Year of death	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Total number of cases completed	420	429	452	434	259	1,994
Clinical management issues reported by assessors	91 (21)	95 (23)	85 (19)	72 (17)	44 (17)	387 (19)
Area for consideration	48 (11)	62 (14)	57 (13)	51 (12)	29 (11)	247 (12)
Area for concern	24 (6)	17 (4)	16 (4)	15 (3)	10 (4)	82 (4)
Adverse event (AE)	18 (4)	14 (30	8 (2)	6 (1)	5 (2)	51 (3)
AE that caused death	11 (3)	10 (2)	4 (1)	2 (<1)	2 (1)	29 (1)
AE that caused death, considered definitely preventable	1 (<1)	4 (1)	1 (<1)	0 (0)	0 (0)	6 (<1)

Refer to Appendix B.1.2 for definitions of clinical management issues, areas of consideration, concern and adverse events.

Comment:

Areas of concern or adverse events were reported by assessors in 167 (8%) cases since 2010. Two cases (1%) in 2014 were associated with an adverse event that caused death'. Table 18 shows a decrease in the percentage of audited cases associated with a clinical management issue between 2010 and 2014. In the same time period there was no real change observed in the percentage of clinical management issues that caused death but were considered preventable (Table 18).

Table 19 Areas of concern or adverse events by admission type and hospital status

		Number of cases (%)		
	Hospital admissions	**Elective**	**Emergency**	**Total**
All audited cases [a]	**Private**	81 (43)	108 (57)	189 (10)
	Public	171 (11)	1,443 (89)	1,614 (85)
	Co-location	6 (6)	95 (94)	101 (5)
	Total	258 (14)	1,646 (86)	1,904 (100)
Cases associated with an area of concern or adverse event [b]	**Private**	19 (23)	14 (13)	33 (17)
	Public	44 (26)	166 (12)	210 (13)
	Co-location	2 (33)	17 (18)	19 (19)
	Total	65 (25)	197 (12)	262 (14)

Percentages in [b] relate to figures in [a]

Comment:

Between 2010 and 2014, overall, there was a greater proportion of cases associated with an area of concern or adverse event in elective admissions (25%) than in emergency admissions (12%), with elective admissions being associated with approximately double the proportion of clinical management issues compared to emergency admissions (Table 19).

Table 20 Areas of concern or adverse events associated with an operation by admission type and hospital status

		Number of Cases (%)		
	Hospital admissions	**Elective**	**Emergency**	**Total**
Cases that underwent an operation [a]	**Private**	79 (98)	92 (85)	171 (90)
	Public	146 (85)	803 (56)	949 (59)
	Co-location	5 (83)	59 (62)	64 (63)
	Total	230 (89)	954 (58)	1184 (62)
Cases that underwent an operation that were associated with an area of concern or adverse event [b]	**Private**	19 (24)	14 (15)	33 (19)
	Public	41 (28)	130 (16)	171 (18)
	Co-location	2 (40)	15 (25)	17 (27)
	Total	62 (27)	159 (17)	221 (19)

Percentages in [b] relate to figures in [a]

Comment:

A greater proportion of cases underwent an operation in elective admissions (89%) compared to emergency admissions (58%).

There were a greater proportion of operative cases associated with an area of concern or adverse event in elective admissions (27%) than in emergency admissions (17%) (Table 20).This is consistent with WAASM's previous observations[12,13].

Table 21 Clinical management issues associated with elective admissions

Elective admissions associated with clinical incidents (n=91) Clinical management issue descriptions (from READ codes)	n (%)
Decision to operate	14 (15)
Preoperative assessment inadequate	7 (8)
Better to have done different operation or procedure	6 (7)
Septicaemia cause unspecified	3 (3)
Delay in recognising anastomotic leak	3 (3)
Postoperative care unsatisfactory	3 (3)
Pulmonary embolus	2 (2)
DVT	2 (2)
Postoperative bleeding after open surgery	2 (2)
Delay to surgery i.e. earlier operation desirable	2 (2)
Care unsatisfactory not otherwise specified	2 (2)
Postoperative fluid balance unsatisfactory	2 (2)
Postoperative bleed after laparoscopic operation	1 (1)
General complications of treatment	1 (1)
Aspiration pneumonia	1 (1)
Arterial or venous complication	1 (1)
Cerebrovascular accident following open surgery	1 (1)
Injury to small bowel during open surgery	1 (1)
Technical complications of recent ileostomy	1 (1)
Anastomotic leak from colon after open surgery	1 (1)
Anastomotic leak from pancreas after open surgery	1 (1)
Arterial complication of open surgery	1 (1)
Tension vascular anastomosis related to open surgery	1 (1)
Wound infection after open surgery	1 (1)
Anastomotic leak after open surgery	1 (1)
Perforation of small bowel during laparoscopic operation	1 (1)
Anastomotic leak from small bowel after laparoscopic operation	1 (1)
Cardiac preoperative assessment inadequate	1 (1)
Preoperative respiratory assessment inadequate	1 (1)
Laboratory preoperative assessment inadequate	1 (1)
Inadequate postoperative assessment	1 (1)
Vascular opinion not sought post operatively	1 (1)
Failure to investigate or assess patient fully	1 (1)
Patient unfit for surgery and anaesthesia	1 (1)
Injury caused by fall in hospital	1 (1)
General anaesthetic complications	1 (1)
Intubation difficult at general anaesthetic	1 (1)
Anticoagulation causing post-operative bleeding	1 (1)
Over anticoagulation during admission	1 (1)
Diagnosis missed	1 (1)
Delay in recognising complications	1 (1)
Delay in recognising a bleeding complication	1 (1)
Delay in transfer to ICU postoperatively	1 (1)

Elective admissions associated with clinical management issues continued (n=91) Clinical management issue descriptions (from READ codes)	n (%)
Surgeon too junior	1 (1)
Poor communication from transferring to receiving hospital	1 (1)
Failure to use HDU	1 (1)
Failure to use HDU postoperatively	1 (1)
HDU not used postoperatively admission refused	1 (1)
Failure to use DVT prophylaxis	1 (1)
Operation should not have been done or was unnecessary	1 (1)
Unsatisfactory medical management	1 (1)
Too early removal of nasogastric tube	1 (1)
Displacement of tracheostomy tube	1 (1)
Assessment problems	1 (1)
Adverse events related to treatment guidelines/protocols	1 (1)
Total	91 (100)

Note: DVT= Deep vein thrombosis: ICU= Intensive Care Unit: HDU=High Dependency Unit

Table 22 Clinical management issues associated with emergency admissions

Emergency admissions associated with clinical management issues (n=247) Clinical management issue descriptions (from READ codes)	n (%)
Decision to operate	29 (11)
Delay to surgery (i.e. earlier operation desirable)	25 (10)
Better to have done different operation or procedure	14 (6)
Delay in diagnosis	10 (4)
Care unsatisfactory not otherwise specified	9 (4)
Failure to investigate or assess patient fully	6 (2)
Injury caused by fall in hospital	6 (2)
Poor documentation	6 (2)
Unsatisfactory medical management	6 (2)
Delay in transfer to tertiary hospital	6 (2)
Postoperative care unsatisfactory	5 (2)
Other Incorrect or inappropriate therapy	4 (2)
Aspiration pneumonia	3 (1)
Postoperative bleeding after open surgery	3 (1)
Anastomotic leak after open surgery	3 (1)
Perforation of colon during endoscopic operation	3 (1)
Delay in transfer to surgical unit	3 (1)
Delay starting medical treatment	3 (1)
Failure to use DVT prophylaxis	3 (1)
Premature discharge from hospital	3 (1)
Operation should not have been done or was unnecessary	3 (1)
Fluid balance unsatisfactory	3 (1)
General complications of treatment	2 (1)
Patient related factors	2 (1)
Patient refused treatment	2 (1)
Diagnosis missed unspecified	2 (1)
Diagnosis missed by medical unit	2 (1)
Delay in transfer to surgeon by physicians	2 (1)
Delay in investigating the patient	2 (1)
Failure to use ICU Postoperatively	2 (1)
Better to have performed more limited surgery	2 (1)
Operation should have been done	2 (1)
Transfer should not have occurred	2 (1)
Assessment problems	2 (1)
Postoperative bleed after laparoscopic operation	1 (<1)
Adverse factors in management	1 (<1)
Pulmonary embolus	1 (<1)
Pneumonia as a general complication of treatment	1 (<1)
Other abdominal complication	1 (<1)
DVT	1 (<1)
Renal failure	1 (<1)
Failure of wound healing	1 (<1)
Sepsis related to an intravenous line	1 (<1)

Emergency admissions associated with clinical management issues continued (n=247) Clinical management issue descriptions (from READ codes)	n (%)
Septicaemia cause unspecified	1 (<1)
Open surgery organ related, technical	1 (<1)
Lung complication of open surgery	1 (<1)
Perforation of small bowel during open surgery	1 (<1)
Dislocated hip prosthesis	1 (<1)
Perforation of oesophagus during laparoscopic operation	1 (<1)
Small bowel complication of laparoscopic operation	1 (<1)
Injury to small bowel during laparoscopic operation	1 (<1)
Injury to heart during endoscopic operation	1 (<1)
Arterial bleeding after endoscopic operation	1 (<1)
Inadequate postoperative assessment	1 (<1)
Failure to recognise severity of illness	1 (<1)
Resuscitation inadequate	1 (<1)
Fluid and electrolyte resuscitation inadequate	1 (<1)
Patient unfit for surgery and anaesthesia	1 (<1)
Pneumothorax complicating general anaesthetic	1 (<1)
Cardiac arrhythmia complicating general anaesthetic	1 (<1)
Failure of equipment	1 (<1)
Other equipment related complication	1 (<1)
Equipment not available	1 (<1)
Anticoagulation causing post-operative bleeding	1 (<1)
Over anticoagulation before admission	1 (<1)
Under anticoagulation	1 (<1)
Diagnosis missed by surgeons	1 (<1)
Diagnosis missed by referring hospital	1 (<1)
Diagnosis missed by radiologist	1 (<1)
Delays	1 (<1)
Earlier operation desirable no theatre available	1 (<1)
Delay to ERCP	1 (<1)
Delay to surgery whilst obtaining a CT scan	1 (<1)
Delay in recognising complications	1 (<1)
Delay in transferring patient to ICU	1 (<1)
Delay to reoperation	1 (<1)
Problems with appropriate staffing	1 (<1)
Failure of junior surgeon to seek advice	1 (<1)
Surgeon too junior	1 (<1)
Inadequate anaesthetic assistance	1 (<1)
Communication failures	1 (<1)
Failure of communication due to poor case notes	1 (<1)
Failure to communicate with senior staff	1 (<1)
Poor communication between physician and surgeon	1 (<1)
No protocol for DVT prophylaxis	1 (<1)
Failure to use HDU postoperatively	1 (<1)

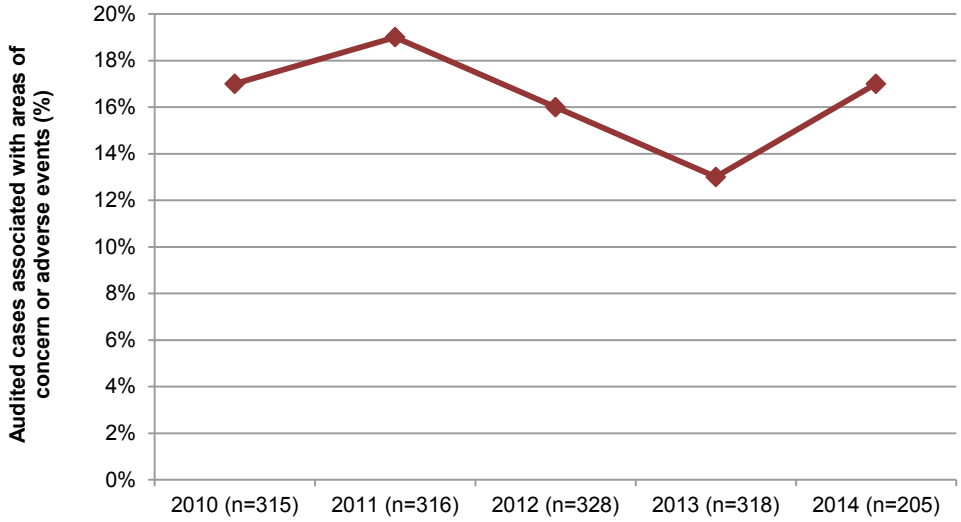
Emergency admissions associated with clinical management issues continued (n=247) Clinical management issue descriptions (from READ codes)	n (%)
Incorrect/inappropriate therapy	1 (<1)
Better to have had more extensive surgery	1 (<1)
Postoperative fluid balance unsatisfactory	1 (<1)
Lack of hospice beds	1 (<1)
Unsatisfactory management of coagulopathy	1 (<1)
Inappropriate treatment prior to surgical referral	1 (<1)
Hospital admission to wrong ward or specialty	1 (<1)
Inappropriate surgical admission	1 (<1)
Reoperation should have been done	1 (<1)
Duration of operation too long	1 (<1)
Transfer problems	1 (<1)
Transfer should have occurred	1 (<1)
Transfer necessary to obtain ICU bed	1 (<1)
Preoperative assessment inadequate	1 (<1)
Treatment did not conform to guidelines/protocols	1 (<1)
Totals	**247 (100)**

Note: DVT= Deep vein thrombosis: ICU= Intensive Care Unit: HDU=High Dependency Unit; CT= Computed Tomography: ERCP= Endoscopic Retrograde Cholangiopancreatogram

Comment:

For elective admissions, the most common areas of clinical management issues were related to decisions to operate, inadequate preoperative assessment and the suitability of the operation or procedure (Table 21). In emergency admissions, decisions to operate, delay to surgery and the suitability of the operation or procedure were the most common areas of clinical management issues recorded in audited cases (Table 22).

Figure 21 Areas of concern or adverse events in WA teaching hospitals



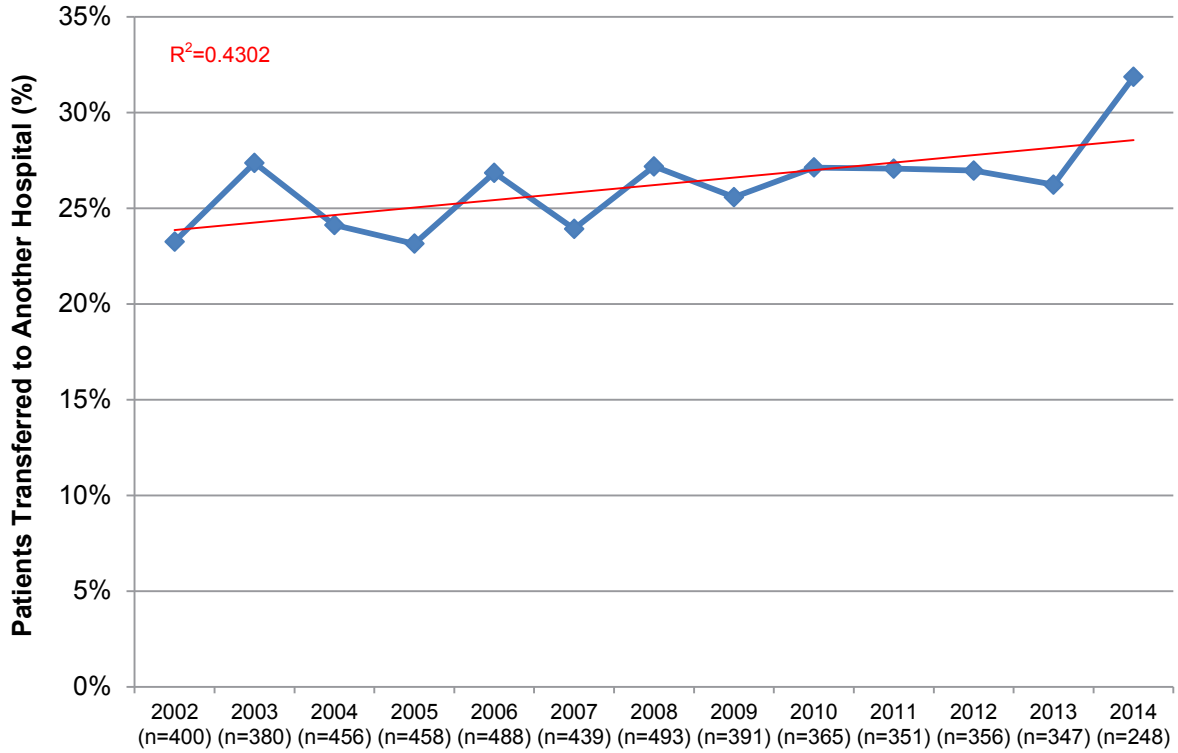
Comment:

In tertiary teaching hospitals the proportion of cases associated with an area of concern or adverse event, regardless of whether an operation was performed, was 17% in both 2010 (55/315) and 2014 (34/205). However in the intervening years there were some variations as indicated in Figure 21.

5. CLINICAL FOCUS: HOSPITAL TRANSFERS

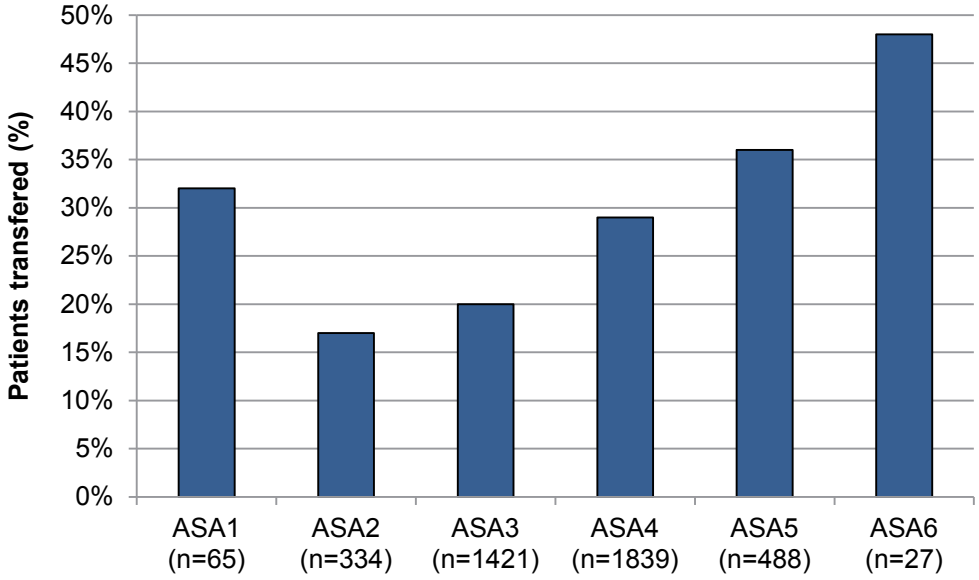
There has been a steady increase in the number of transferred patients (Figure 22). Between 2002 and 2013 the proportion of patients increased by 3% (from 23% to 26%). .

Figure 22 Patients transferred to another hospital



The trend line (in red) is a visual representation of a trend over a period of time . The trend line indicates that there has been an increase in inter-hospital transfers over the audit period. Analysis on the changes observed in transfers (increasing trend) indicate that there is some evidence of change over time, however it is not yet significant (as the P-value (0.06410) is slightly greater than 0.05).

Figure 23 Patients transferred by ASA grade



Comment:

As would be expected, patients with a higher ASA were transferred more frequently. Many of the transferred ASA 1 patients were neurosurgical patients with head injuries. ASA grade is a predictor of postoperative outcome for some types of surgery [15, 16].

Table 23 Inter-hospital transfers classified by AIHW peer groups

Transferred from	Hospitals transferred to (in peer group classification)										
	A1	A2	B1	B2	C1	C2	D1	D3	D2	Unclassified	Total
A1	156 (15)	4 (<1)			1 (<1)				2 (<1)	51 (5)	214 (20)
A2	7 (1)	2 (<1)									9 (1)
B1	278 (26)									7 (1)	285 (27)
B2	235 (22)		1 (<1)	2 (<1)						9 (1)	247 (23)
C1	24 (2)										24 (2)
C2	27 (3)					2 (<1)				3 (<1)	32 (3)
D1	11 (1)									1 (<1)	12 (1)
D2	27 (3)								2 (<1)	1 (<1)	30 (3)
D3	57 (5)				1 (<1)			4 (<1)		3 (<1)	65 (6)
E2	17 (2)			2 (<1)			1 (<1)				20 (2)
E4	3 (<1)										3 (<1)
G	1 (<1)										1 (<1)
Unclassified	94 (9)	1 (<1)								22 (2)	117 (11)
Total	937 (89)	7 (1)	1 (<1)	4 (<1)	2 (<1)	2 (<1)	1 (<1)	4 (<1)	4 (<1)	97 (9)	1,059

AIHW: Australian Institute for Health and Welfare. For more information on AIHW peer group classifications please refer to Appendix B.4

Table 24 Inter-hospital transfers by area health service grouping

Transferred from	Hospital transferred to (area health service) (%)				
	North metro	South metro	Country	Private	Total
North metro	85 (9)	91 (10)	1 (<1)	41 (4)	218 (24)
South metro	51 (6)	306 (33)		20 (2)	377 (41)
Country	61 (7)	121 (13)	11 (1)	12 (1)	205 (22)
Private	35 (4)	59 (6)		22 (2)	116 (13)
Total	232 (25)	577 (63)	12 (1)	95 (10)	916

Table 25 Transfers within the south metropolitan area health service by peer group classification

Transferred to	Number of cases in the south metropolitan area health service (%) Peer group classification transferred from				
	A1	B1	B2	C1	Total
A1	39 (10)	191 (51)	117 (31)	8 (2)	355 (94)
A2	1 (<1)				1 (<1)
B1			1 (<1)		1 (<1)
C1	1 (<1)				1 (<1)
Unclassified	11 (3)	5 (1)	4 (1)		20 (5)
Total	52 (14)	196 (52)	122 (32)	8 (2)	378

Comment:

Since WAASM's inception the number of surgical patients who die following transfer from another hospital has increased, and continues to do so (Figure 22). Given that these patients subsequently die, they are by definition high risk and a deep understanding of this data would seem essential.

Australian Institute of Health and Welfare (AIHW) latest hospital statistics (2012-13) reported that WA had the highest public hospital transfer rate (6.1%). This was 62% greater than Queensland (3.8%) that has the lowest transfer rate of the larger (WA, SA, NSW, VIC and QLD) states [17].

The AIHW groups public hospitals for the purpose of national comparison[17]. A link to the allocation of WA hospitals is shown in Appendix B.4 and for the purposes of this report has been grouped (Table 24) [17]. Any WA public hospitals that AIHW did not classify, and/all private hospitals, are shown separately.

WAASM data shows that almost half the transferred patients originated from B1 (26%; major non-referral metropolitan) or B2 (22%; major rural) hospitals (Table 23). These critically ill patients are being transferred at a rate of almost one a week. Presumably there are many other surgical patients, some critically ill, who do not die. Given this frequency, the transfer processes need to be clearly thought through, robust and streamlined. As numerous case note reviews testify, this is not always so.

About 15% of transfers documented by WAASM were between A1 (principal referral) hospitals. It is only supra-specialist surgical services that are not available at all teaching hospitals and consideration needs to be given to decisions underlying the initial referral process that for some patients required a subsequent transfer.

WAASM only reviews a small subset of data, that is, patients under the care of a surgeon who die. However, the principles of effective transfer are the same for all specialties. This was reflected in Gillman's detailed review of all transfers in WA between 2003 and 2006 which found, for example, that delay in the referring hospital Emergency Department was associated with a 12.5% increase in mortality[26].

The relationship of surgeon and/or hospital volume to outcome has been extensively studied and debated [27-30]. Recent studies have suggested that volume *per se* is not related to the initial complication rate, but the ability to rescue patients who have had a complication is much greater in high volume hospitals [29, 30]. WAASM has previously suggested this may be a factor in the observed shift of high risk patients to the teaching hospitals. Implicit to this is the necessity of timely transfer of these often sick patients

Common elements for effective transfers in the national and international literature include improved communication between referring and receiving hospitals [19,20], the use of checklists, protocols and standardised responses[19,21,22,23] and streamlining transfer procedures to improve the timeliness of the process, which is a universally reported requirement to improving clinical outcomes [24]. The central co-ordination of transfers through a specified department or person, as demonstrated in the Ochsner Medical Center Transfer Center in the United States [25] and the Adult Retrieval Coordinators of Critical Care Services in Victoria, Australia has several advocates.

6. PERFORMANCE REVIEW

This section reviews progress made on each of the recommendations in the 2014 WAASM report.

Audit Management

Actively pursue consultant recruitment to Fellows Interface with a view to move towards a paperless audit process for surgical case form and first-line assessment completion. WAASM aims to have recruited at least 50% of WA Fellows to Fellows Interface by the start of 2015. Recruitment strategies included mail outs, electronic and telephone communications.

WAASM achieved recruitment of 50% of WA Fellows to Fellows Interface at the start of 2015. The team is now aiming to improve this proportion further with a view to move towards a paperless audit in the next couple of years. This will require a number of enhancements to the Fellows Interface system which are currently in the process of being developed.

Encourage high level of surgical case form completion to reduce the amount of missing data, improve assessment process and data integrity in line with ANZASM initiative of completion of compulsory fields in surgical case form.

WAASM has communicated with surgeons the need for full completion of surgical case forms. The team is in the process of analysing completion rates for surgical case forms to determine if the amount of missing data has improved in key questions in the surgical case forms.

Reporting and Audit Data

Continue to collate data on communication issues, clinically significant infections and trauma to ensure that sufficient data is available for a two-year trend analysis in the 2015 WAASM report.

Data on communication issues and clinically significant infections has been collated below; however more data will need to be collected over time to determine how these areas of clinical interest impact on surgical mortality trends. Communication issues were reported by treating surgeons in 6% of WAASM cases (Table 26). Clinically significant infections were reported in 34% of cases between 2013 and 2014 (Table 27).

Table 26 Communication issues reported by surgeons

Year of death	Number of cases (%) 2013	2014	Total
Number of surgical case forms completed	357	341	698
Communication issue reported	21 (6)	20 (6)	41 (6)
No communication issues reported	329 (92)	314 (92)	643 (92)
Unsure if a communication issue occurred	7 (2)	7 (2)	14 (2)

Table 27 Data on clinically significant infections reported by surgeons

Year of death	Number of cases (%) 2013	2014	Total
Number of surgical case forms completed	369	403	772
Clinically significant infection reported	131 (36)	128 (32)	259 (34)
No clinically significant infection reported	238 (64)	275 (68)	513 (66)

Table 28 Data on acquired clinically significant infections

Year of death	Number of cases (%) 2013	2014	Total
Infection acquired before admission	53 (42)	52 (43)	108 (43)
Infection acquired during admission	73 (58)	70 (57)	146 (57)
Total	126	122	254

Evaluate data quality and completeness following one year of use of Fellows Interface.

The WAASM team is currently in the process of preparing a study to analyse the quality and completeness of data following one year use of Fellows Interface.

Develop Hospital site level reports to support patient safety initiatives and the reporting of adverse events to safety and quality representatives and stakeholders in WA hospitals.

Hospital site level reports were developed throughout the course of 2014 and were distributed to all public hospital Executive Directors in April 2015. A roll out for private hospital reports will occur in the second half of 2015.

7. ACKNOWLEDGMENTS

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- second-line assessors
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- Royal Australasian College of Surgeons for their infrastructure and oversight of this project
- College ANZASM Steering Committee

- College WAASM Management Committee:

Mr James Aitken	Clinical Director, WAASM Chair and General surgical representative
Mr Tom Bowles	Consultant General Surgeon, Rural surgical representative
Mr Ian Gollow	Consultant Paediatric Surgeon, Paediatric surgical representative
Mr Stuart Salfinger	Consultant Obstetrician and Gynaecologist, Obstetrics & Gynaecology representative
Mr Rasa Subramaniam	Consumer representative

- WAASM staff:

Dr Diana Azzam	WAASM Project Manager
Dr Franca Itotoh	WAASM Senior Project Officer
Ms Natalie Zorbas-Connell	WAASM Project Officer

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Professor Guy Maddern	Chair ANZASM Steering Committee
A/Prof Wendy Babidge	Director, RAAS Division
Ms Pip Coleman	Business and Development Manager, RAAS Division
Mr Gordon Guy	ANZASM Manager

APPENDIX A: WAASM assessor-reported adverse events

Details of adverse events as reported by assessors, in 345 of 2,425 cases reported to WAASM between 2010 and 2014

DECISION TO OPERATE	(n=76)
Decision to operate	45
Better to have done different operation or procedure	20
Operation should not have been done or was unnecessary	4
Better to have performed more limited surgery	2
Operation should have been done	2
Better to have had more extensive surgery	1
Reoperation should have been done	1
Duration of operation too long	1

DELAYS	(n=68)
Delay to surgery i.e. earlier operation desirable	28
Delay in diagnosis	10
Delay in transfer to tertiary hospital	6
Delay in transfer to surgical unit	3
Delay in recognising anastomotic leak	3
Delay starting medical treatment	3
Delay in transfer to surgeon by physicians	2
Delay to ERCP	2
Delay in recognising complications	2
Delay in investigating the patient	2
Delays	1
Earlier operation desirable no theatre available	1
Delay to surgery whilst obtaining a CT scan	1
Delay in recognising a bleeding complication	1
Delay in transferring patient to ICU	1
Delay in transfer to ICU postoperatively	1
Delay to reoperation	1

Note: ERCP= Endoscopic Retrograde Cholangiopancreatogram; CT= Computed tomography: ICU= Intensive Care Unit

UNSATISFACTORY MEDICAL MANAGEMENT	(n=57)
Care unsatisfactory not otherwise specified	11
Postoperative care unsatisfactory	8
Unsatisfactory medical management	7
Injury caused by fall in hospital	7
Failure to use DVT prophylaxis	4
Other incorrect/inappropriate therapy	4
Premature discharge from hospital	3
Fluid balance unsatisfactory	3
Postoperative fluid balance unsatisfactory	3
Incorrect/inappropriate therapy	1
Unsatisfactory management of coagulopathy	1
Inappropriate treatment prior to surgical referral	1
Too early removal of naso-gastric tube	1
Hospital admission to wrong ward or specialty	1
Inappropriate surgical admission	1
Adverse factors in management	1

GENERAL COMPLICATIONS OF TREATMENT	(n=28)
Aspiration pneumonia	4
Septicaemia cause unspecified	4
General complications of treatment	3
Pulmonary embolus	3
DVT	3
Pneumonia as a general complication of treatment	1
Other abdominal complication	1
Arterial or venous complication	1
Renal failure	1
Failure of wound healing	1
Sepsis related to an intravenous line	1
Dislocated hip prosthesis	1
Reaction to drugs	1
Displacement of tracheostomy tube	1
Resuscitation inadequate	1
Fluid and electrolyte resuscitation inadequate	1

ASSESSMENT ISSUES	(n=26)
Preoperative assessment inadequate	9
Failure to investigate or assess patient fully	7
Assessment problems	3
Inadequate postoperative assessment	2
Cardiac preoperative assessment inadequate	1
Preoperative respiratory assessment inadequate	1
Laboratory preoperative assessment inadequate	1
Vascular opinion not sought post operatively	1
Failure to recognise severity of illness	1

OPEN SURGERY RELATED	(n=21)
Postoperative bleeding after open surgery	5
Anastomotic leak after open surgery	5
Open surgery, organ related - technical	1
Cerebrovascular accident following open surgery	1
Lung complication of open surgery	1
Perforation of small bowel during open surgery	1
Injury to small bowel during open surgery	1
Technical complications of recent ileostomy	1
Anastomotic leak from colon after open surgery	1
Anastomotic leak from pancreas after open surgery	1
Arterial complication of open surgery	1
Tension vascular anastomosis related to open surgery	1
Wound infection after open surgery	1

APPENDIX B: Data definitions

Appendix B.1 Definitions

Appendix B.1.1 Definitions of 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

Appendix B.1.2 Definitions of clinical management issues

Term	Definition
Clinical management issue	Issues of patient management that may have contributed to the death of the patient that have been identified by an independent assessor. Clinical management issues are classified as an “areas of consideration”, “areas of concern” and or “adverse events”
Area of consideration	An area of consideration is defined as an area of care that could have been improved or different, but that may be a current area of peer debate.
Area of concern	An area of concern is defined as an area of care that should have been better managed.
Adverse event	An adverse event is defined as an unintended injury or event that was caused by the medical management of the patient rather than by the disease process, and which was sufficiently serious to lead to prolonged hospitalisation or to temporary or permanent impairment or disability of the patient at the time of discharge, or which contributed to or caused death.

Appendix B.2 Tables

Table 1: Deaths reported to WAASM between 1 January 2010 and 31 December 2014	
Definition:	Count of deaths reported to WAASM.
Data Notes:	Total number of deaths reported to WAASM, including 'excluded error' cases.
Data Included:	All data collected between 2010 and 2014.
Data Excluded:	No exclusions.

Table 2: Number of deaths under a surgeon per 100,000 population	
Definition:	Number of deaths reported to WAASM per year as a function of surgical mortality rates per 100,000 population.
Data Notes:	Population data compiled from the Australian Bureau of Statistics (based on projected data as population data is only available for up until September 2014).
Data Included:	Total number of cases reported to WAASM from between 2010 and 2014.
Data Excluded:	No exclusions.

Table 3: Surgeon participation and surgical case form returns	
Definition:	Counts of surgical mortality data in relation to surgeon involvement in cases.
Data Notes:	Table 3 is made up of composite data collected by WAASM in surgical case forms.
Data Included:	Data used in Table 1 on reported deaths and surgical case forms returned. Counts of surgeons associated with deaths reported. Terminal care cases included in counts of surgical case forms returned as indicated in Table 3.
Data Excluded:	No exclusions.

Table 4: Case statistics of surgeons associated with three or more deaths	
Definition:	Counts of surgeons associated with three or more deaths.
Data Notes:	Table 4 is made up of composite data collected by WAASM.
Data Included:	Counts of surgeons associated with deaths reported.
Data Excluded:	No exclusions.

Table 5: Surgical case form status	
Definition:	Counts of death reported to WAASM and surgical case form status.
Data Notes:	Total number of deaths reported to WAASM.
Data Included:	All data collected between 2010 and 2014.
Data Excluded:	No exclusions.

Table 6: First-line assessments (FLA)	
Definition:	All cases are referred to first-line assessments. Table provides counts and percentages of first-line assessments that have been completed, are pending or have been lost to follow-up.
Data Included:	Data on first-line assessments from cases between 2010 and 2014.
Data Excluded:	No exclusions.

Table 7: Second-line assessments (SLA)	
Definition:	Counts and percentages of cases referred to second-line assessments and a breakdown of cases referred to second-line assessments that have completed the audit process or that have been lost to follow-up.
Data Notes:	Table 7 includes data from Table 5.
Data Included:	Total number of deaths that fall within the WAASM criteria and data on second-line assessment referrals between 2010 and 2014.
Data Excluded:	No exclusions.

Table 8: Median age by gender	
Definition:	Average age separated by gender for all cases from 2010 to 2014.
Data Included:	All data collected between 2010 and 2014.
Data Excluded:	No exclusions; in 2 cases age was unknown and in 5 cases the gender was unknown.

Table 9: Use of DVT prophylaxis in cases of surgical mortality	
Definition:	Counts and percentages of cases in which the use and the appropriateness of use of DVT prophylaxis was reported.
Data Notes:	Table 9 is made up of several different variables. Surgeon-reported use of DVT prophylaxis and assessor-reported appropriateness of use of DVT prophylaxis in closed cases are indicated in this table.
Data Included:	Closed cases in which use of DVT prophylaxis was reported (n=1,661) and closed cases in which DVT prophylaxis use was assessed (n=1,508).
Data Excluded:	Cases in which DVT prophylaxis was not used (n=373) and data missing for surgeon-reported use of DVT prophylaxis (n=333). Data missing for assessor-reported appropriateness of use of DVT prophylaxis (n=486)

Table 10: Actual use, and assessor opinion of use, of a critical care unit	
Definition:	Counts and percentages of use of critical care facilities (consisting of intensive care and high dependency units).
Data Notes:	Table 10 is made up of data from a number of different variables. Percentage total does not include individual percentage rounding.
Data Included:	All cases which have completed the audit process between 2010 and 2014 (n=1,645).
Data Excluded:	Neurosurgical cases (n=344); data missing for 134 cases.

Table 11: Most common causes of death in cases of surgical mortality	
Definition:	Ten most common causes of death in patients aged <70 and those ≥70 in cases of surgical mortality.
Data Notes:	Only the ten most common causes of death are displayed in table.
Data Included:	All data collected from completed cases between 2010 and 2014.
Data Excluded:	No exclusions.

Table 12: Elective and emergency admissions to public and private hospitals	
Definition:	Counts and percentages of elective or emergency admissions as grouped by hospital status (i.e. public, private or co-location).
Data Notes:	Table 12 is made up of two different tables with different variables from data collected in surgical case forms. Percentages in [b] relate to figures in [a].
Data Included:	[a] includes all cases that have completed the audit process between 2010 and 2014. [b] includes all cases that have completed the audit process in which an operation was performed.
Data Excluded:	Missing data will account for differences in numbers. Missing data is as follows: [a] (n=90); [b] (n=44).

Table 13: Operations abandoned	
Definition:	Counts and percentages of cases in which an operation was abandoned on the finding of a terminal situation.
Data Included:	Completed cases between 2010 and 2014 in which an operation was performed.
Data Excluded:	Non-operative cases (n=745). Data missing for 21 cases.

Table 14: Unplanned returns to theatre	
Definition:	Counts and percentages of reported unplanned returns to theatre in cases of surgical mortality.
Data Included:	All cases which have completed the audit process between 2010 and 2014 in which an operation was undertaken.
Data Excluded:	Non-operative cases (n=745).

Table 15: Consultant deciding, operating and assisting in theatre in all WA hospitals	
Definition:	Counts and percentages of consultants making decisions, operating, assisting and supervising in theatre in cases of surgical mortality.
Data Included:	All cases completed between 2010 and 2014 in which an operation was performed.
Data Excluded:	Non-operative cases (n=745). Data missing for 21 cases.

Table 16: Consultant deciding, operating and assisting in theatre in all WA teaching hospitals	
Definition:	Counts and percentages of consultants making decisions, operating, assisting or present in theatre in operative cases in teaching hospitals.
Data Included:	Completed cases in which an operation was performed in teaching hospitals between 2010 and 2014.
Data Excluded:	Non-operative cases (n=654) and cases in non-teaching hospitals (n=390).

Table 17: Reasons for non-operative cases in emergency admissions	
Definition:	Counts of emergency admissions in public and private hospitals and reasons for non-operative cases.
Data Included:	All cases which have completed the audit process between 2010 and 2014, where an emergency admission to a hospital was made.
Data Excluded:	No exclusions.

Table 18: Audited deaths associated with areas for consideration, areas of concern or adverse events, as reported by assessors	
Definition:	Counts and percentages of cases in which clinical incidents were reported.
Data Notes:	Data in this table is compiled from multiple data sets. In cases where a clinical incident was recorded, only the most significant event was counted.
Data Included:	All cases which have completed the audit process between 2010 and 2014.

Table 19: Areas of concern or adverse events by admission type and hospital status	
Definition:	Counts and percentages of admission type (elective or emergency) as grouped by hospital status (i.e. public, private or co-location) in which areas of concern or adverse events were identified.
Data Notes:	Table 19 is made up of two different tables with different variables from data collected in surgical case forms. Percentages in [b] relate to figures in [a].
Data Included:	[a] includes all cases that have completed the audit process between 2010 and 2014. [b] includes all cases that have completed the audit process in which an area of concern or adverse event was identified.
Data Excluded:	Missing data will account for differences in numbers. Missing data is as follows: [a] (n=90); [b] (n=13).

Table 20: Areas of concern or adverse events associated with an operation by admission type and hospital status	
Definition:	Counts and percentages of admission type (elective or emergency) as grouped by hospital status (i.e. public, private or co-location) in which areas of concern or adverse events were identified in operative cases.
Data Notes:	Table 20 is made up of two different tables with different variables from data collected in surgical case forms. Percentages in [b] relate to figures in [a].
Data Included:	[a] includes all cases that have completed the audit process between 2010 and 2014. [b] includes all cases that have completed the audit process in which an area of concern or adverse event was identified in operative cases.
Data Excluded:	Missing data will account for differences in numbers. Missing data is as follows: [a] (n=44); [b] (n=11).

Table 21: Clinical management issues associated with elective admissions	
Definition:	Counts, percentages and descriptions of all clinical incidents in elective admissions
Data Included:	All cases which have completed the audit process between 2010 and 2014, which were admitted to an elective unit and were determined by assessors to involve a clinical incident.
Data Excluded:	Emergency admissions.

Table 22: Clinical management issues associated with emergency admissions	
Definition:	Counts, percentages and descriptions of the most common clinical incidents in emergency admissions.
Data Included:	All cases which have completed the audit process between 2010 and 2014, which were admitted to an emergency unit and were determined by assessors to involve a clinical incident.
Data Excluded:	Elective admissions.

Table 23: Inter-hospital transfers classified by AIHW peer groups	
Definition:	Counts and percentages of patients transferred between hospitals by AIHW peer group classifications.
Data Notes:	AIHW peer group classifications included an additional classification created by WAASM ("unclassified"). Please see Appendix B.4 for full definitions.
Data Included:	All cases which have completed the audit process between 2002 and 2014, in which a patient was transferred.
Data Excluded:	No exclusions.

Table 24: Inter-hospital transfers by area health service grouping	
Definition:	Counts and percentages of patients transferred between hospitals by area health service groupings.
Data Notes:	Area health service groups were found on the WA Health website. Private hospitals were grouped together under the group heading of "private".
Data Included:	All cases which have completed the audit process between 2002 and 2014, in which a patient was transferred.
Data Excluded:	No exclusions.

Table 26: Communication issues reported by surgeons	
Definition:	Counts and percentages of cases in which communication issues were reported by surgeons.
Data Notes:	Collection of data on communications commenced in mid-2013.
Data Included:	All closed cases between 2013 and 2014 in which the question on communications was answered.
Data Excluded:	No exclusions.

Table 27: Data on clinically significant infections reported by surgeons	
Definition:	Counts and percentages of cases in which clinically significant infections were reported by surgeons.
Data Notes:	Collection of data on clinically significant infections commenced in mid-2013.
Data Included:	All closed cases between 2013 and 2014 in which the question on clinically significant infections was answered.
Data Excluded:	No exclusions.

Table 28: Data on acquired clinically significant infections	
Definition:	Counts and percentages of cases in which clinically significant infections were reported to be acquired either before or during admission.
Data Notes:	Collection of data on clinically significant infections commenced in mid-2013.
Data Included:	All closed cases between 2013 and 2014 in which the question on clinically significant infections and at what stage they were acquired were answered.
Data Excluded:	No exclusions.

Appendix B.3 Figures

Figure 2: Reported deaths and surgical mortality rate per 100,000 population	
Definition:	Number of deaths reported to WAASM per year as a function of surgical mortality rates per 100,000 population.
Data Notes:	Population data compiled from the Australian Bureau of Statistics (based on projected data as population data is only available for up until September 2014).
Data Included:	Total number of cases reported to WAASM between 2010 and 2014.
Data Excluded:	No exclusions.

Figure 3: Reported deaths of patients admitted for surgery in WA hospitals	
Definition:	Percentages of case completion rates as allocated by case status and participating hospital. 'Returned' includes surgical case form and first-line complete, as well as closed and terminal care cases. 'Not returned' includes surgical case form, first- and second-line pending as well as surgical case form and first-line incomplete. 'No response' includes lost to follow-up, no response extended and surgical case form rejected. 'Refused' indicates a non-participating surgeon.
Data Included:	All data collected between 2010 and 2014 included.
Data Excluded:	Excluded error cases.

Figure 4: Case completion rates	
Definition:	Percentages of case completion rates as allocated by case status.
Data Notes:	'Returned' indicates a case that has been returned to the audit office complete. 'Not returned' indicates a case that is in progress. 'No response' indicates cases that have not been returned to the audit office despite multiple reminders. Cases are labelled 'no response' two years after the date of death of the patient. 'Refused' indicates a non-participating surgeon.
Data Included:	All data collected between 2010 and 2014 included.
Data Excluded:	No exclusions.

Figure 5: Case completion rates by specialty	
Definition:	Percentages of case completion rates as allocated by case status and surgical specialty.
Data Notes:	Surgical specialty 'other' includes Otolaryngology, Head andophthalmology, paediatrics, obstetrics and gynaecology and plastic surgery.
Data Included:	All data collected between 2010 and 2014 included.
Data Excluded:	Data missing for 40 cases.

Figure 6: Age group by gender	
Definition:	Count of cases allocated by age groups and gender.
Data Included:	All data collected between 2010 and 2014.
Data Excluded:	No exclusions; in 5 cases gender was unknown.

Figure 7: Age distribution by gender and year of death	
Definition:	Box and whisker plot of ages clustered by gender and year of death.
Data Included:	All data collected between 2010 and 2014.
Data Excluded:	No exclusions; in 5 cases gender was unknown.

Figure 8: Age distribution by surgical specialty	
Definition:	Box and whisker plots of age sorted by surgical specialty in cases of surgical mortality.
Data Included:	All data collected between 2010 and 2014.
Data Excluded:	Data missing for 3 cases.

Figure 9: Comorbidity status in completed cases	
Definition:	Percentage of cases associated with comorbidities, including more than one co-existing factor.
Data Notes	Figure 10 was produced by collating data from multiple variables in the surgical case form. Total number of cases for each year is as follows: 2014 (n=230); 2013 (n=346); 2012 (n=357); 2011 (n=352) and 2010 (n=360).
Data Included:	Completed cases between 2010 and 2014 in which comorbidity was indicated.
Data Excluded:	Terminal care and Neurosurgery cases.

Figure 10: Obesity as a comorbidity in cases of surgical mortality	
Definition:	Percentage of cases associated with obesity.
Data Included:	Completed cases between 2002 and 2014 in which comorbidity was indicated as obesity.
Data Excluded:	Terminal care and Neurosurgery cases.

Figure 11: Diabetes as a comorbidity in cases of surgical mortality	
Definition:	Percentage of cases associated with diabetes.
Data Included:	Completed cases between 2002 and 2014 in which comorbidity was indicated as diabetes.
Data Excluded:	Terminal care and Neurosurgery cases.

Figure 12: Cardiovascular comorbidity in cases of surgical mortality	
Definition:	Percentage of cases associated with cardiovascular comorbidities.
Data Included:	Completed cases between 2002 and 2014 in which comorbidity was indicated as relating to cardiovascular issues.
Data Excluded:	Terminal care and Neurosurgery cases.

Figure 13: Respiratory comorbidity in cases of surgical mortality	
Definition:	Percentage of cases associated with respiratory comorbidities.
Data Included:	Completed cases between 2002 and 2014 in which comorbidity was indicated as relating to respiratory issues.
Data Excluded:	Terminal care and Neurosurgery cases.

Figure 14: Renal comorbidity in cases of surgical mortality	
Definition:	Percentage of cases associated with renal comorbidities.
Data Included:	Completed cases between 2002 and 2014 in which comorbidity was indicated as relating to renal issues.
Data Excluded:	Terminal care and Neurosurgery cases.

Figure 15: Hepatic comorbidity in cases of surgical mortality	
Definition:	Percentage of cases associated with hepatic comorbidities.
Data Included:	Completed cases between 2002 and 2014 in which comorbidity was indicated as relating to hepatic issues.
Data Excluded:	Terminal care and Neurosurgery cases.

Figure 16: Frequencies of ASA grades assigned to WAASM cases by treating surgeons 2004 -2014	
Definition:	Count of ASA grades in all cases of surgical mortality.
Data Included:	All data collected between 2010 and 2014 included.
Data Excluded:	No exclusions.

Figure 17: ASA grades (by year)	
Definition:	Percentage of ASA grades associated with surgical mortality per year.
Data Included:	Completed cases between 2002 and 2014 in which an ASA grade was reported.
Data Excluded:	Terminal care and Neurosurgery cases.

Figure 18: Cases admitted to public or private hospitals	
Definition:	Proportion of cases admitted to public, private or co-location hospitals as allocated by year.
Data Notes:	'Co-location' indicates hospitals with both public and private health services.
Data Included:	All cases which have completed the audit process between 2010 and 2014.
Data Excluded:	Data missing for 62 cases.

Figure 19: Operations by specialty	
Definition:	Percentages of non-operative or operative cases allocated by surgical specialty.
Data Notes:	Surgical specialty 'others' includes Otolaryngology, Head and Neck, Ophthalmology, Paediatric surgery, Gynaecology and Plastic surgery. Cardiothoracic surgery (n=141), General surgery (n=1,044), Neurosurgery (n=355), Orthopaedics (n=427), Others (n=79), Urology (n=60), Vascular surgery (n=171).
Data Included:	All cases which have completed the audit process between 2010 and 2014.
Data Excluded:	Data missing for 26 cases.

Figure 20: Reasons for no operation	
Definition:	Percentages of audited cases in which no operation was performed, as sorted by reason for no operation.
Data Notes:	Reasons for no operation come directly from the surgical case form.
Data Included:	All cases which have completed the audit process between 2010 and 2014 in which no operation was performed.
Data Excluded:	Operative cases (n=1,228). Data missing for 21 cases.

Figure 21: Areas of concern or adverse events in WA teaching hospitals	
Definition:	Percentage of audited cases associated with a clinical incident as reported by assessors in Western Australian teaching hospitals.
Data Included:	All cases which have completed the audit process between 2010 and 2014 which were admitted to teaching hospitals (n=1,601) and in which a clinical incident was identified (n=242).
Data Excluded:	Cases associated with non-teaching hospitals (n=393) and cases in which no significant clinical incidents were identified (n=277).

Figure 22: Patients transferred to another hospital	
Definition:	Percentage of audited cases in which a patient was transferred to another hospital.
Data Included:	All cases which have completed the audit process between 2002 and 2014 in which a transfer was reported.
Data Excluded:	Cases in which transfers were not reported.

Figure 23: Patients transferred by ASA grade	
Definition:	Percentage of audited cases in which a patient was transferred to another hospital, grouped by ASA grade.
Data Included:	All cases which have completed the audit process between 2002 and 2014 in which a transfer was reported.
Data Excluded:	Cases in which transfers or ASA grades were not reported.

Appendix B.4 AIHW peer group classifications

Peer Group - Code	Peer Group Name/Description
Principal referral – A1	Principal referral hospitals are major city hospitals with more than 20,000 and regional hospitals with more than 16,000 acute (case mix-adjusted) separations per year.
Specialist Women's & Children's – A2	Specialist hospitals are specialised acute women's' and children's' hospitals with more than 10,000 (case mix-adjusted) separations per year.
Large Major City – B1	Large metropolitan hospitals are major city acute hospitals with more than 10,000 (case mix-adjusted) separations per year.
Large Regional and Remote– B2	Large rural and remote hospitals are regional acute hospitals with more than 8,000 and remote acute hospitals with more than 5,000 (case mix-adjusted) separations per year.
Medium (group 1)– C1	Medium acute hospitals in regional and major city areas treating between 5,000 and 10,000 acute (case mix-adjusted) separations per year.
Medium (group 2) – C2	Medium acute hospitals in regional and major city areas treating between 2,000 and 5,000 acute (case mix-adjusted) separations per year, and acute hospitals treating less than 2,000 (case mix-adjusted) separations per year but with more than 2,000 separations per year.
Small Regional Acute – D1	Small regional acute hospitals, treating less than 2,000 (case mix-adjusted) separations per year and with more than 40 per cent non-acute and outlier patient days of total patient days.
Remote Acute – D3	Remote acute hospitals treating less than 5,000 acute (case mix-adjusted) separations but which are not multi-purpose and not small non-acute. Most have less than 2,000 separations per year.
Subacute and Non-Acute – G	Small non-acute hospitals, treating less than 2,000 (case mix-adjusted) separations per year and with more than 40 per cent non-acute and outlier patient days of total patient days.
Unclassified	Grouping created by WAASM for other unpeered hospitals. Private hospitals are also included in this group.

Full classifications of peer groups can be found at:
http://www.ihpa.gov.au/internet/ihpa/publishing.nsf/Content/nhcdc-cost-rep-2010-2011.htm~4-appendixB
Further information on hospitals in each peer group can be found at:
http://www.ihpa.gov.au/internet/ihpa/publishing.nsf/Content/nhcdc-cost-rep-2010-2011.htm~3-appenidixA

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