# The Western Australian Audit of Surgical Mortality (WAASM)

# 2019 REPORT

Royal Australasian College of Surgeons

The Royal Australian and New Zealand College of Obstetricians and Gynaecologists

*Excellence in Women's Health*

WAASM Western Australian Audit of Surgical Mortality

ANZASM Australian and New Zealand Audit of Surgical Mortality

# Western Australian Audit of Surgical Mortality

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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 (gazetted 2nd May, 2017).

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## CLINICAL DIRECTOR'S REPORT

This report of the Western Australian Audit of Surgical Mortality (WAASM) is different to previous reports, in that it incorporates data from the commencement of the audit in 2002, some 17 years ago. The aim was to determine if the WAASM has impacted on care, and if so, how and where.

In 2012, the WAASM reviewed its first ten years of data and noted a statistically significant fall of 30% in the number of deaths under a surgeon [1]. Since then, national and other state mortality data have also shown a fall in the number of deaths under a surgeon [2].

This 17-year analysis shows that since 2012, there has been a further 12% fall in the number of deaths under a surgeon, despite an increasingly aging population and the relentless increase in high-risk emergency admissions.

Audit is not research, and the Royal Australasian College of Surgeons (RACS) mortality audit has not been able to convince all that it has demonstrated cause and effect. This is despite there being many other surgical audits where it is accepted that changed practice and improved outcome can be directly attributed to their activities.

In 2012, the WAASM did not consider in depth how it might have influenced this fall. There had, of course, been many changes over the same period and the WAASM had difficulty convincing its doubters that it was responsible for reducing mortality, rather than merely recording the result of these many changes. So in this report, some of the changes underlying the fall in mortality have been demonstrated.

The primary aim of the WAASM is to reduce the number of cases where care could, or even should, have been different. The definition of such 'clinical management issues' is often not precise, but surgeons and assessors know when care has not been ideal. This report has considered various specific aspects of care that have been of interest to the WAASM.

The analysis in this report has shown that over 17 years, the number of clinical management issues has progressively fallen in an almost uncanny parallel to the rate of surgical deaths per 100,000 Western Australian (WA) population. It is difficult to arrive at any conclusion other than that the decrease in the number of deaths is secondary to the reduced number of clinical management issues, that have in a large part been driven by the WAASM.

It would now seem reasonable to conclude that, to paraphrase legal parlance, the weight of evidence for this association now exceeds the balance of probability and is beyond reasonable doubt.

This longitudinal analysis has highlighted several areas that merit future enquiry, but two merit specific comment. The first is the risk of obesity as a specific comorbidity in the patient's death. In the elective setting, the number of deaths where obesity was cited as a comorbidity has remained unchanged and is likely to reflect a degree of patient selection. In emergency settings, the opportunity for patient selection does not exist and the number of deaths where the surgeons cited obesity as a comorbidity has increased. This suggests that in the elective setting, surgeons should specifically discuss the additional risks consequent to obesity with patients and, if necessary, defer surgery until the patient has lost weight. In the emergency setting, obesity should be considered a high-risk comorbidity and patients given additional support. The second relates to transfers. In its last report [3], the WAASM stated that greater attention to transfers was long overdue and this analysis fully endorses its robust stand on this issue.

Despite best care, some deaths are inevitable and there will be a nadir below which the number of deaths will not fall. Whilst the data might suggest that point is getting closer, the assessors, and indeed the surgeons themselves, still acknowledge that the care for some patients could or should have been different. The observed decline in deaths over the period covered by this report suggests that some deaths in earlier years are no longer occurring and so arguably were preventable. This continues to be the case, as assessors report that a small number of deaths are still associated with potentially preventable suboptimal care. Studies from other state mortality audits have shown a high degree of concordance between the reflective opinion of the surgeon and the assessor [4], so this is likely to be a true observation.

Be that as it may, it is evident that in terms of mortality, surgery in WA has never been safer.

Hitherto, data capture in the RACS mortality audit has focused on operative care. It is important that the audit adapts to reflect changing interests. There are two matters that have not previously been a focus for the audit but that has more recently become important. It would seem appropriate for the mortality audit to capture data that will improve care in these areas. The first is end-of-life care. Although the principal focus of the WAASM since its commencement has been directed towards deaths related to operations, its reports have always included data on the non-operation rate and the importance of avoiding so-called 'futile' surgery. In 2016, the WAASM hosted a very well attended symposium on end-of-life care. End-of-life care and the avoidance of futile surgery is now a mainstream issue, as is limiting postoperative care when progress is not as expected. The evidence is that the entire medical profession, not just surgeons, manage this poorly.

An important traditional measurement of surgical outcome has been 30-day mortality. There is now an increasing awareness that mortality at 90 days or 180 days is much greater than at 30 days and may be a more relevant benchmark [5]. A further consideration is that quality of life beyond 30 days is frequently very poor. This is reflected in studies reporting the often small number of 'days out of hospital' between surgery and death, especially for those over 80 years [6].

Looking to the future, the RACS mortality audit needs to consider how it can capture data that will improve the care of those in whom the value of surgery is limited. Not least because, as studies consistently show, many patients value quality of life above quantity of life [7]. The RACS mortality audits are in a position to make a unique contribution to this discussion.

There is a clear need for discussion between patients, their relatives and their medical carers as to patients' end-of-life wishes, and for clear, written documentation of 'Goals of Care'. This involves more than just surgeons, because deterioration is often very predictable and should be anticipated. The emergency setting is a bad time to initiate discussions that should, and indeed could, have commenced well before the patient became unwell. The mortality audit could usefully initiate the collection of relevant data.

The second issue for the future relates to assessing and documenting the preoperative risk for all patients. Assessors frequently comment on the failure to optimise preoperative care. Critical Care and Perioperative Medicine is now an anaesthetic sub-specialty and in the elective setting, risk assessment can be determined in the preoperative clinic. Although preoperative clinics are well established in the public sector, this is not the case in the private sector. In the emergency setting, there is often little or no time to optimise care, but there is an opportunity to assess the patient's risk and to escalate care in cases at greater risk – for example, ensuring timely access to theatre, consultant presence and enhanced postoperative care.

Frailty is now recognised to have a potent impact on outcome and may yet be proven to be the most important risk factor in the elderly [8]. Frailty should be assessed in all surgical patients using an internationally accepted frailty score. Input from 'Care of the Elderly' physicians has been shown to reduce mortality [9].

In December 2018, the Royal College of Surgeons of England updated its 2011 document, *High-Risk General Surgical Patient: Raising the Standard.* Although directed towards emergency general surgery, it has wide, general application and is worthy of study by all.

I would again like to acknowledge the substantial work by the WAASM staff over the year, not least for their work in retrieving, analysing and presenting the data in this report.

RJ Aitken
Clinical Director
Western Australian Audit of Surgical Mortality

## SHORTENED FORMS

| | |
|---|---|
| **ALoS** | average length of stay |
| **ANZASM** | Australian and New Zealand Audit of Surgical Mortality |
| **ASA** | American Society of Anesthesiologists |
| **CCU** | critical care unit |
| **CNR** | case note review |
| **DVT** | deep vein thrombosis |
| **EL** | emergency laparotomy |
| **FLA** | first-line assessment |
| **HDU** | high dependency unit |
| **ICU** | intensive care unit |
| **LoS** | length of stay |
| **NELA** | National Emergency Laparotomy Audit |
| **PELA** | Perth Emergency Laparotomy Audit |
| **RAAS** | Research, Audit and Academic Surgery |
| **RACS** | Royal Australasian College of Surgeons |
| **SCF** | surgical case form |
| **SLA** | second-line assessment |
| **SPSS** | Statistical Package for Social Sciences |
| **WA** | Western Australia/n |
| **WAASM** | Western Australian Audit of Surgical Mortality |

## EXECUTIVE SUMMARY

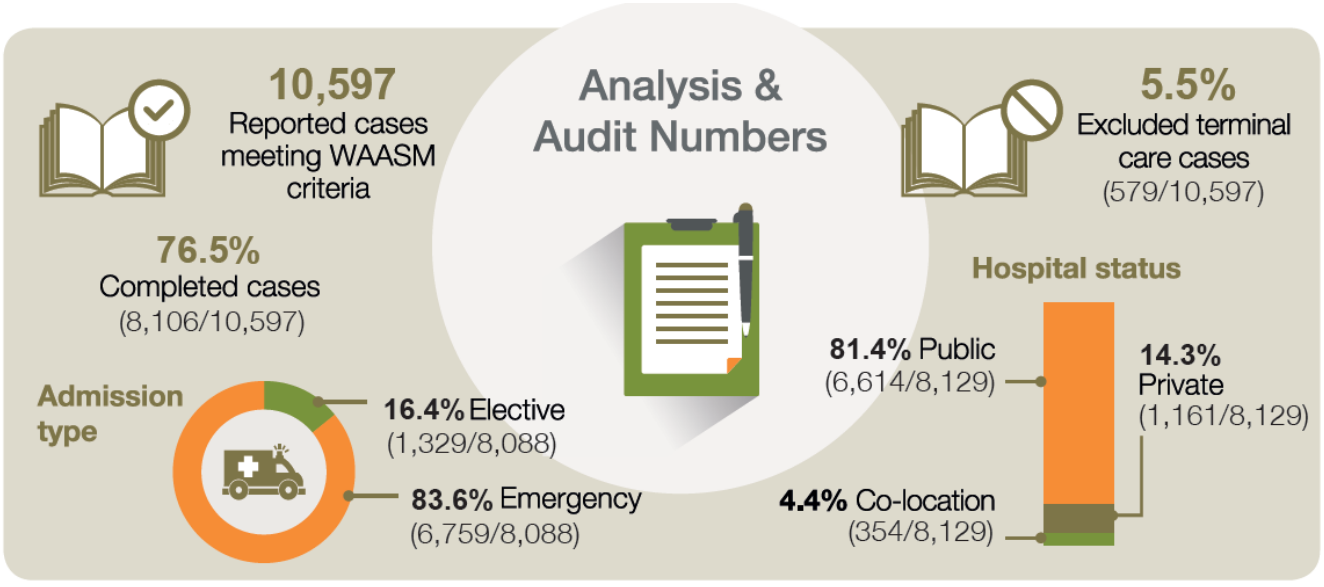
### Background

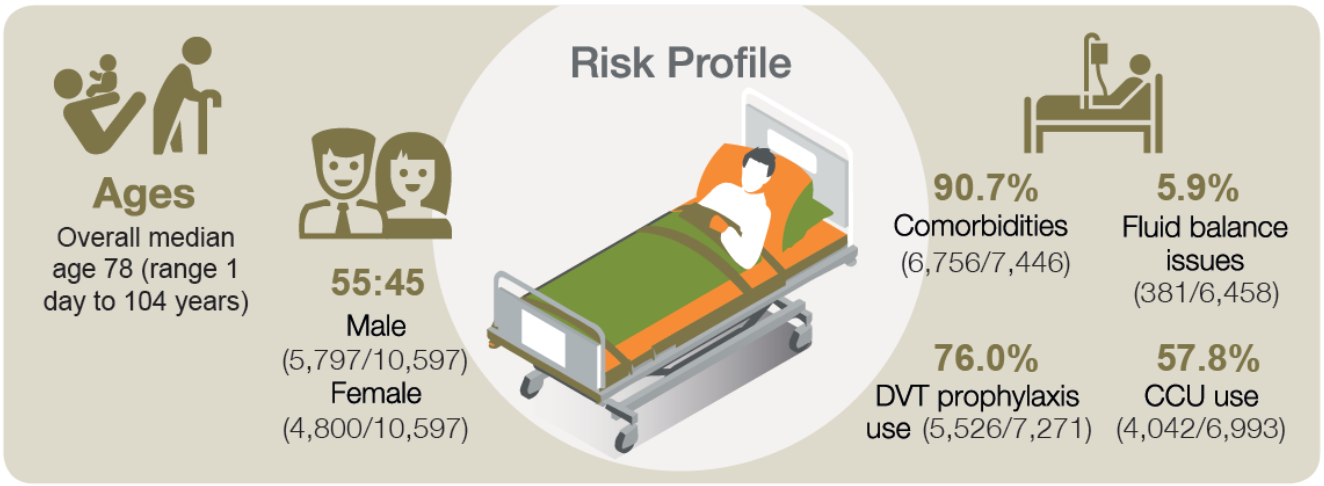
The Western Australian Audit of Surgical Mortality (WAASM) is an external, independent, peer reviewed audit of the process of care associated with surgically-related deaths in WA. The WAASM was established in 2001. It is funded by the WA Department of Health and has protection under federal legislation.

### Reporting period

This report covers cases reported to the WAASM from **1 January 2002 to 31 December 2018**. Please note that for the data analysed, the denominator may sometimes change in this report. This is mainly due to incomplete information provided in the surgical case and assessment forms, which results in missing data.

As of 31 December 2018, 100% of WA surgeons and hospitals were participating in the audit.



## Patient Transfers

**27.1%** Patients transferred (1,994/7,354)

**10.4%** Delay in transfer (192/1,844)

**7.3%** Inappropriate transfer (135/1,855)

**2.5%** Inappropriate level of care (44/1,753)

**6.2%** Insufficient clinical information (108/1,751)

## Operations

**69.5%** Patients that had surgery (5,659/8,137)

**15.8%** Unplanned returns to theatre (731/4,636)

**5.8%** Operations abandoned on finding a terminal situation (345/5,942)

**73.9%** Consultant surgeons who made the decision to operate (6,601/8,935)

**51.5%** Consultant surgeons who performed surgery (4,599/8,935)

## Infection

**31.2%** Patients with clinically significant infection (872/2,791)

**Most common infections**

**39.2%** Pneumonia (341/869)

**25.0%** Septicaemia (217/869)

**20.9%** Intra-abdominal sepsis (182/869)

## Peer Review Outcomes

**22.3%** Cases with one or more clinical management issues (1,808/8,106)

**32.7%** Number of clinical management issues (2,653/8,106)

**20.1%** Adverse events (533/2,653)

**28.6%** Definitely preventable adverse events that caused death (79/276)

**52.3%** Adverse events that caused death (276/528)

## RECOMMENDATIONS

The WAASM makes the following recommendations:

### Hospitals

- Put in place robust, consultant-based protocols for all transferred patients.
- Develop a clinical pathway for patients presenting with an acute abdomen.

### Australian and New Zealand Audit of Surgical Mortality (ANZASM)

- Modify its surgical case form (SCF) and commence data collection in areas that have now become part of contemporary practice. Examples are:
  - The formal documentation for end-of-life care
  - Preoperative assessments in both elective and emergency settings
  - The assessment and documentation of sepsis on admission and the administration of antibiotics.
- Modify its database to ensure key fields have to be completed before the SCF can be submitted.

### WAASM

- Undertake a study to determine the concordance between first-line assessors, using two independent assessors per case in a representative sample of specialties.

### Research

- Undertake a longitudinal inter-state comparison of the number of deaths under a surgeon per 100,000 population to determine the national impact of the ANZASM.
- The WAASM to publish a peer reviewed publication on the key observations in this report.

# 1. INTRODUCTION

## 1.1 Background

The WAASM is an external, independent, peer reviewed audit of the process of care associated with all surgically-related deaths that occur in WA. The project is funded by the WA Department of Health.

The WAASM is now in its 18th year, having commenced in June 2001 as a pilot study under the management of the University of Western Australia. In 2005, the WAASM management was transferred to Research, Audit and Academic Surgery (RAAS) of the RACS. In the same year, the RACS formed the ANZASM, with the purpose of establishing similar mortality audits in other states and territories. All Australian states and territories are now participating.

## 1.2 Objectives

The objective of the audit is to improve the safety and quality of surgical care through a peer review process. A vital part of the process is the provision of feedback and information to surgeons, with the aim of educating, facilitating change and, ultimately, improving practice. The audit is a patient safety and quality improvement initiative designed to highlight emerging trends in outcomes from surgical care and system errors. Its focus is on education and performance improvement.

## 1.3 Structure and governance

The WAASM project falls under the governance of the ANZASM; its governance structure is illustrated in Figure 1. The WAASM receives legislative protection under the Commonwealth Qualified Privilege Scheme, under part VC of the *Health Insurance Act 1973* (gazetted 2 May, 2017).

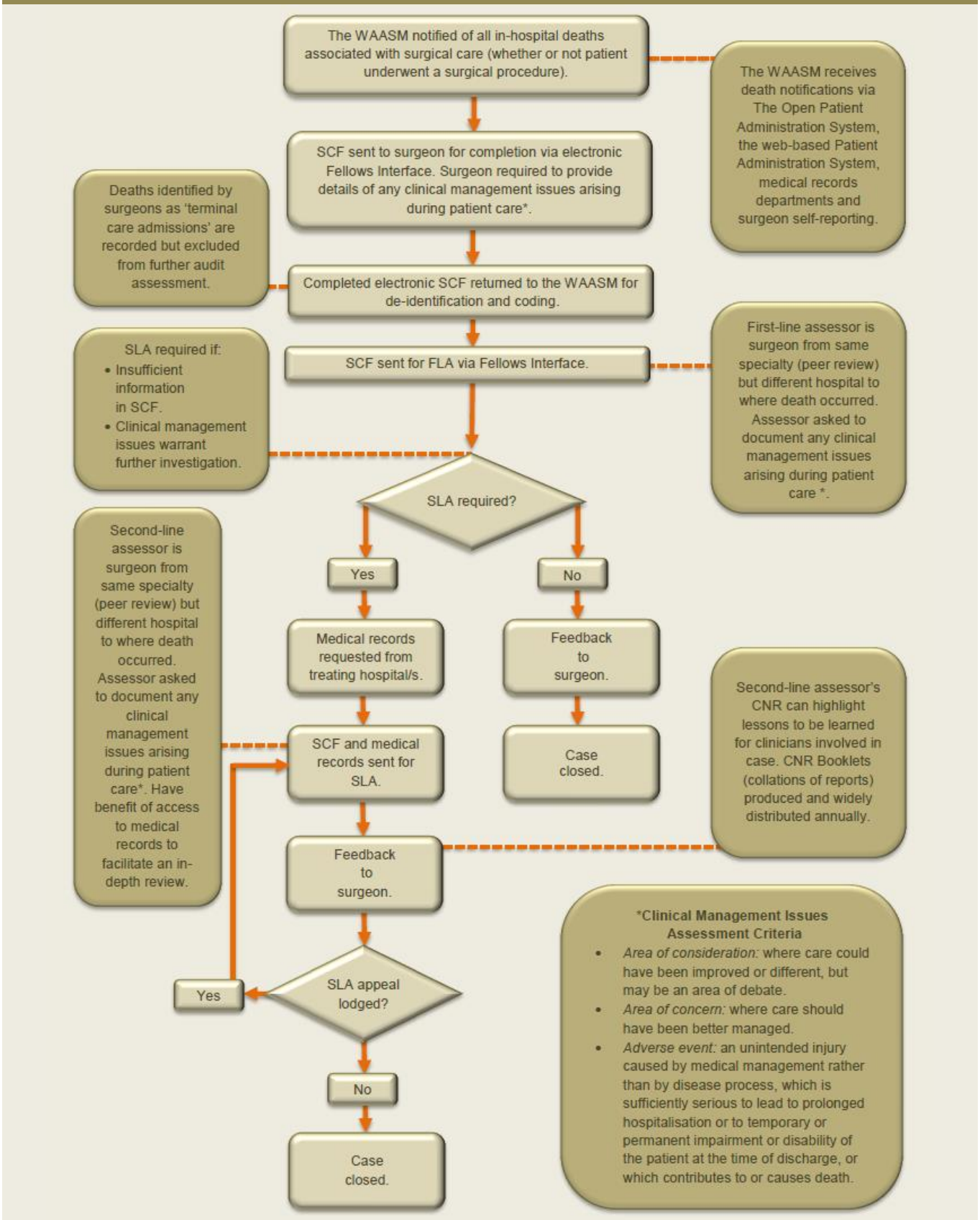
**Figure 1: WAASM governance structure**


RACS: Royal Australasian College of Surgeons; WA: Western Australian; ANZASM: Australian and New Zealand Audit of Surgical Mortality; WAASM: Western Australian Audit of Surgical Mortality.

## 1.4 Audit process

The WAASM audit process is outlined below (Figure 2).

**Figure 2: WAASM audit process**




*See Clinical Management Issues Assessment Criteria
WAASM: Western Australian Audit of Surgical Mortality; SCF: Surgical Case Form; FLA: First-line Assessment; SLA: Second-line Assessment; CNR: Case Note Review.

## 1.5 Data analysis

The WAASM audits all surgical deaths occurring in WA hospitals. Patients admitted for terminal care are excluded from the full audit process. The 2019 Report covers deaths reported to the WAASM from 1 January 2002 to 31 December 2018, censored on 1 April 2019. The full audit process can take three months or longer from notification of death to completion. Some 2018 cases were still under review as of the census date, and these case outcomes were not available for this report. Numbers in previous reports may vary from this report because some cases were completed after the census dates of these reports.

Data is entered and stored in the Bi-national Audit System database and analysed using the Statistical Package for Social Sciences (SPSS version 24), and Microsoft Office Excel (2010). The total number of cases used in the analyses may vary as each data point may not have been completed for every case reported.

## 1.6 Hospital and Hospital Performance Summary Reports

The WAASM and the ANZASM monitor trends and identify clinical management issues via independent peer review assessments in order to assist and inform improvements in patient safety.

The Hospital Reports are released annually to hospitals that have three or more operating surgeons and where there have been five or more deaths (with the audit process complete). The Hospital Report can assist hospital accreditation for certain National Safety and Quality Health Service Standards.

The report can also be used to monitor clinical management issues within a hospital, and provides comparisons with other participating peer-grouped hospitals both within the state and nationally.

The Hospital Performance Summary Report shows individual hospital performance on potentially preventable clinical management issues. It gives the percentage of potentially preventable clinical management issues within the state, as well as nationally.

This year, the Hospital Report included the Hospital Performance Summary Report detailing the preventable clinical management issues. This combined report can assist the audit team, the WA Department of Health and WA hospitals to identify and address potentially preventable errors and clinical management issues.

## 2. AUDIT DATA OVERVIEW

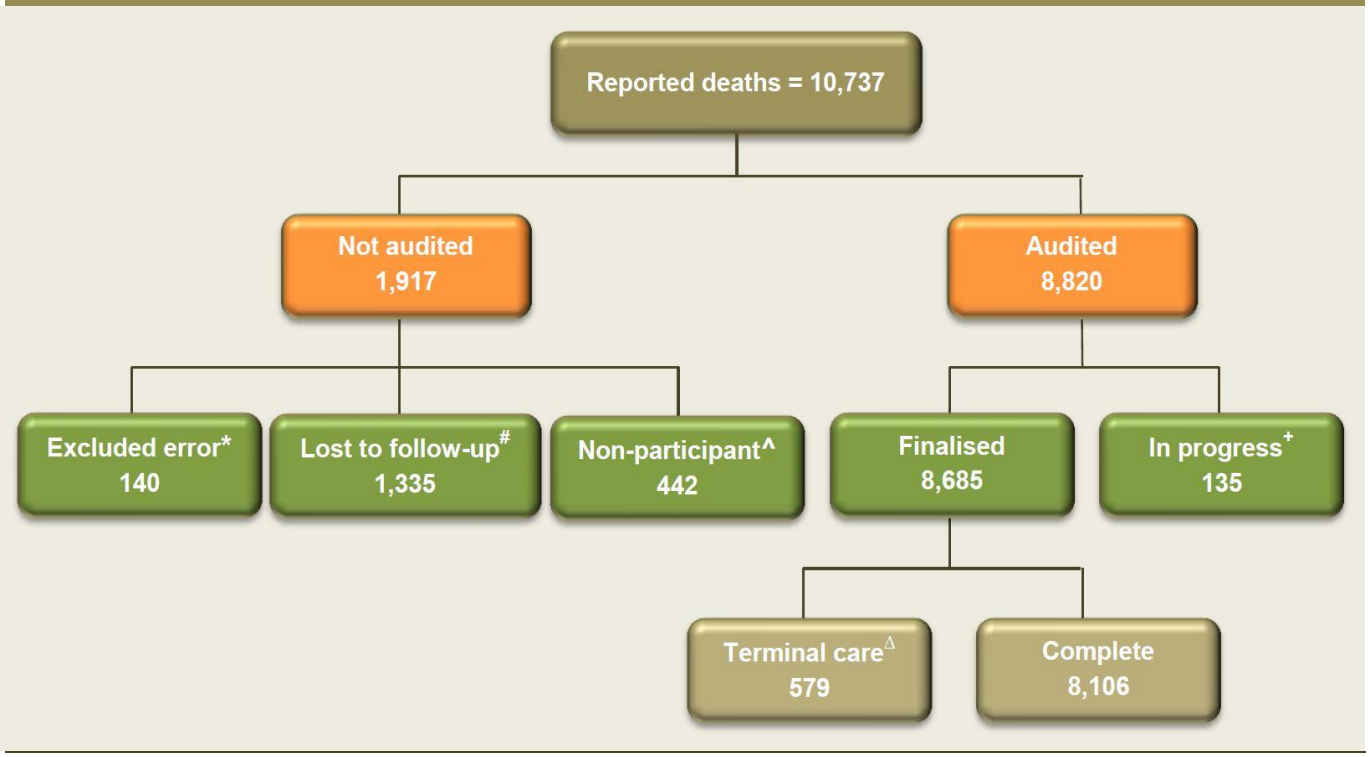
**Over the 17 year reporting period (2002-2018):**

- **10,597 deaths met the WAASM criteria**
- **There was a 38.9% relative decrease in deaths per 100,000 population**
- **There was a 37.1% increase in the returns of SCFs (2002-2017)**
- **76.5% of cases completed the audit process**
- **Emergency admissions accounted for 83.6% of deaths**
- **Males comprised 54.7% of deaths**

### 2.1 Deaths reported to WAASM

An overview of deaths reported to the WAASM is shown in Figure 3 below. Of the 10,737 reported deaths, 140 were excluded due to an error in reporting, resulting in 10,597 deaths meeting the WAASM reporting criteria (Table 1).

**Figure 3: Deaths falling within WAASM criteria**




*Excluded error: Cases reported as WAASM deaths that do not fall within the WAASM inclusion criteria.
#Lost to follow up: Cases lost to follow-up after remaining incomplete for a period of two years.
^Non-participant: Surgeons not participating in the audit prior to 2013.
+In progress: Cases that have not completed the full audit process.
△Terminal care: Patients admitted specifically for terminal care are excluded from the full audit process.
Refer to Appendix A, Table 1 for further information on data.

Prior to 2010, participation in the WAASM was not mandatory. Some surgeons therefore elected not to take part in the audit, so their cases were not included ('non-participant', 4.2%; 442/10,597). Participation in the WAASM has been a mandatory requirement of the RACS Continuing Professional Development Program [10] since 2010.

**Table 1: Deaths reported to WAASM**

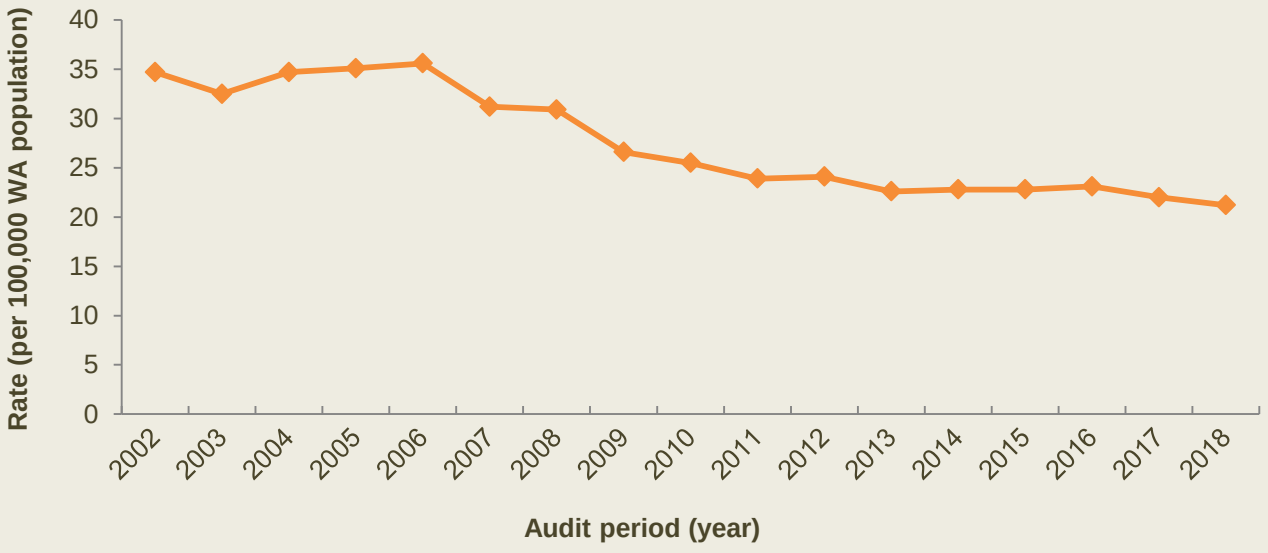
| Audit period (year) | Number of deaths reported | Deaths not falling within WAASM criteria | Deaths falling within WAASM criteria |
|---|---|---|---|
| 2002[#] | 672 | 0 | 672 |
| 2003[#] | 639 | 0 | 639 |
| 2004[#] | 692 | 0 | 692 |
| 2005[#] | 713 | 0 | 713 |
| 2006[#] | 740 | 0 | 740 |
| 2007[#] | 667 | 0 | 667 |
| 2008[#] | 682 | 0 | 682 |
| 2009[#] | 602 | 0 | 602 |
| 2010[^] | 592 | 0 | 592 |
| 2011[^] | 571 | 1 | 570 |
| 2012[^] | 601 | 9 | 592 |
| 2013[+] | 593 | 27 | 566 |
| 2014[+] | 598 | 20 | 578 |
| 2015[+] | 596 | 15 | 581 |
| 2016[+] | 604 | 13 | 591 |
| 2017[+] | 595 | 27 | 568 |
| 2018[+] | 580 | 28 | 552 |
| **Total** | **10,737** | **140** | **10,597** |

[#]Participation in the WAASM was not mandatory.
^Participation in the WAASM was mandatory but not monitored by the RACS Continuing Professional Development.
[+]Participation in the WAASM was mandatory and monitored by the RACS Continuing Professional Development.
Refer to Appendix A, Table 2 for further information on data.

Surgical deaths are reported to the WAASM by the WA Department of Health or the hospital medical records department. The surgeon involved in the care of the patient can also self-report the death using the online Fellows Interface.

Based on WA population data from the Australian Bureau of Statistics [11], Figure 4 shows a relative decrease of 38.9% in the rate of surgical deaths per 100,000 WA population over the past 17 years.

**Figure 4: Surgical deaths per 100,000 WA population**



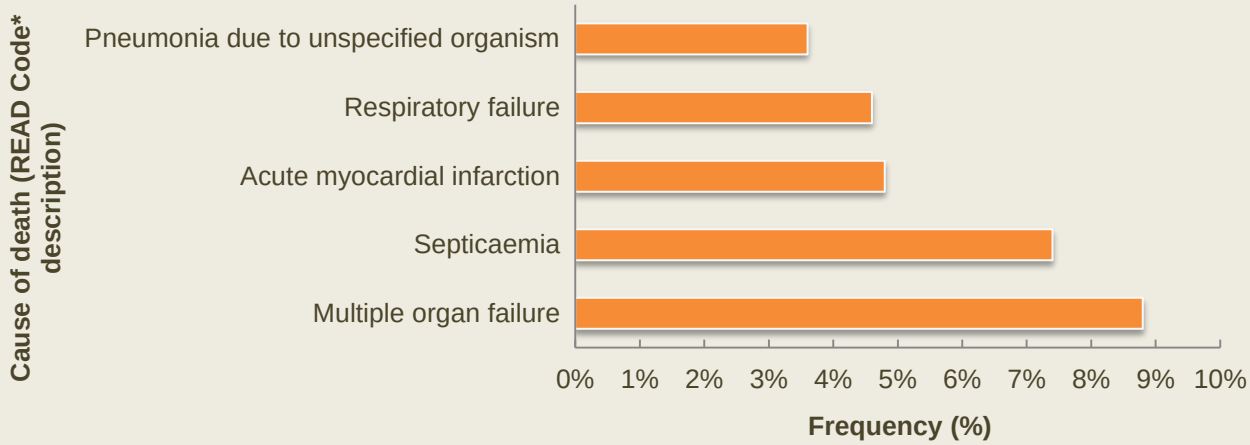

Population data compiled from the Australian Bureau of Statistics, data for 2018 available only until September.
WA: Western Australia.
Refer to Appendix A, Table 3 for further information on data.

The reasons for this progressive fall in mortality are likely multi-factorial. In 2003 [12] and 2013 (unpublished data), the WAASM surveyed WA surgeons. In both surveys, the surgeons acknowledged that the WAASM had influenced their management of patients. This graph showing the fall in deaths appears to be a reciprocal of that showing increased participation (Figure 9). This supports the argument that where audits exist, participation should be mandatory.

This report includes some of the issues that the WAASM has addressed since its inception. The fall in surgical mortality has occurred despite an increasingly elderly population [13] who (by implication) have a greater number of comorbidities. This emphasises the real improvement in care that has occurred. Despite best care, some deaths are inevitable and, not surprisingly, the rate of the decrease appears to be plateauing (Figure 4). This suggests that, as the lessons of the WAASM have been learnt, some of the deaths in previous years are now not occurring with the advantage of hindsight.

The five most frequent causes of death are shown in Figure 5. Some cases have more than one cause of death listed.

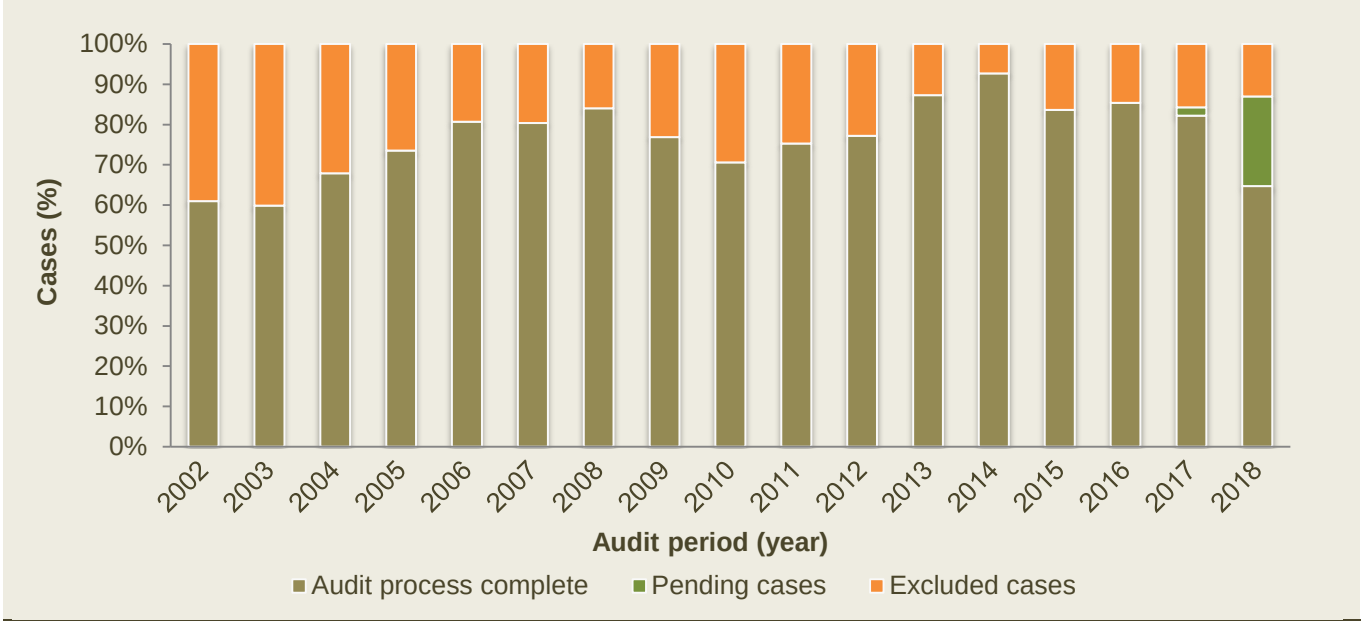
**Figure 5: Most common causes of death**




*READ Code: Surgical diagnoses categorised using coded thesaurus of clinical terms (READ Codes). READ Codes are a clinical decision tree that contains terms, synonyms, and abbreviations covering all aspects of patient care. It is a precursor to ICD9 coding.
Refer to Appendix A, Table 4 for further information on data.

As of the census date, 76.5% (8,106/10,597) of cases had completed the audit process. There were 1.3% (135/10,597) of cases where the SCF, First-Line Assessment (FLA) or Second-Line Assessment (SLA) were pending, with a large proportion relating to 2018 (1.2%; 123/10,597). This number will decrease as cases are finalised. Cases that have not been received within two years are censored ('lost to follow-up'). A total of 22.2% (2,356/10,597) of cases were excluded from the audit because of non-participating surgeons, terminal care admissions or being 'lost to follow-up' (Figure 6). In 2018, the excluded cases comprised only terminal care cases (72).

**Figure 6: Audit case status**




Refer to Appendix A, Table 5 for further information on data.

Patients admitted under the care of a surgeon specifically for terminal care are excluded from the full audit process (5.5%; 579/10,597). When patients are admitted with the intention to treat but, after assessment and investigations, this decision is changed and they are managed conservatively or palliatively, they are included in the full audit process.

The return rate for SCFs, including terminal care cases, was 82.9% (8,783/10,597).

All cases, apart from terminal care cases, are sent for FLA. Provided the treating surgeon supplied adequate information in the SCF, many cases are closed at this point. The rate of FLA returns was 99.3% (8,148/8,204).

Some cases need to undergo further review and are referred for an SLA. Of the 8,148 FLAs returned over the reporting period, 14.9% (1,212/8,148) were referred for an SLA (Table 2).

| Table 2: Second-line assessments | | | |
|---|---|---|---|
| Reporting period (year) | FLA*s returned | Cases referred for SLA# | |
| | | Number | Percentage (%) |
| 2002 | 410 | 95 | 23.2 |
| 2003 | 383 | 62 | 16.2 |
| 2004 | 470 | 70 | 14.9 |
| 2005 | 524 | 59 | 11.3 |
| 2006 | 597 | 72 | 12.1 |
| 2007 | 536 | 58 | 10.8 |
| 2008 | 573 | 85 | 14.8 |
| 2009 | 463 | 73 | 15.8 |
| 2010 | 419 | 63 | 15.0 |
| 2011 | 429 | 66 | 15.4 |
| 2012 | 457 | 70 | 15.3 |
| 2013 | 494 | 76 | 15.4 |
| 2014 | 536 | 74 | 13.8 |
| 2015 | 486 | 71 | 14.6 |
| 2016 | 505 | 74 | 14.7 |
| 2017 | 475 | 83 | 17.5 |
| 2018 | 391 | 61 | 15.6 |
| **Total** | **8,148** | **1,212** | **14.9** |

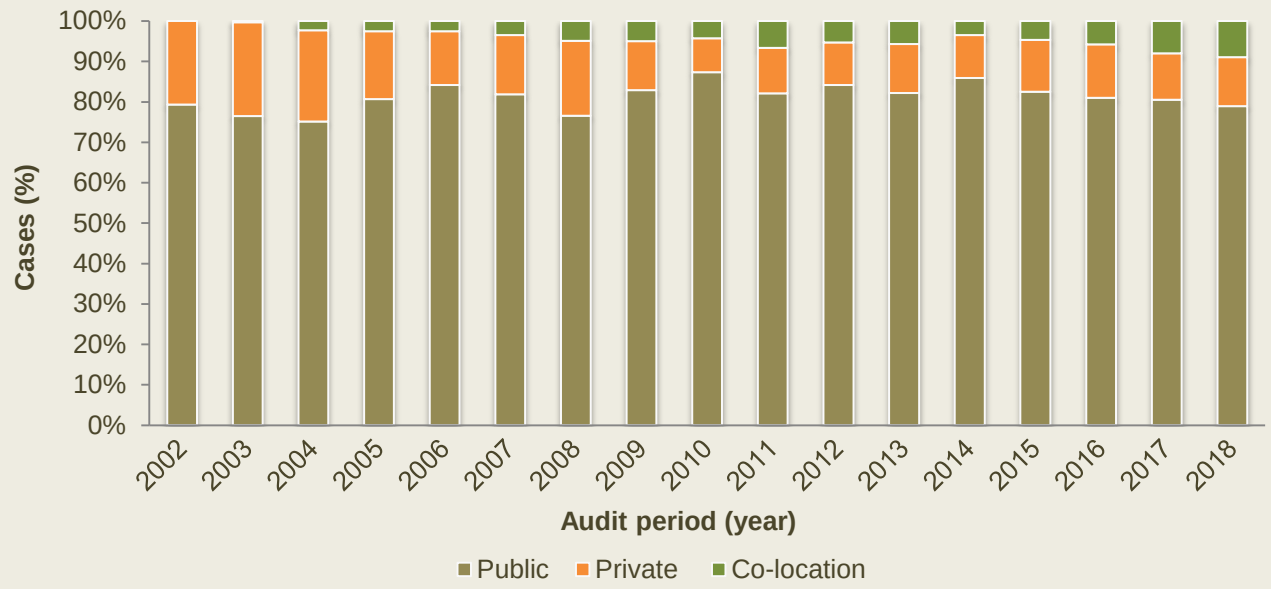
*FLA: First-line Assessment
#SLA: Second-line Assessment.
Refer to Appendix A, Table 6 for further information on data.

## 2.2 Hospital participation

All hospitals in WA where surgery is performed currently participate in the audit. There were 44 hospitals associated with the 10,597 deaths falling within the WAASM criteria. Figure 7 shows the number of patients admitted to public, private or co-location hospitals (where the information was provided on the SCF).

Public hospitals accounted for over three-quarters (81.4%; 6,614/8,129) of admissions, while private and co-location hospitals had 14.3% (1,161/8,129) and 4.4% (354/8,129) of admissions respectively.

**Figure 7: Deaths by hospital status by year**

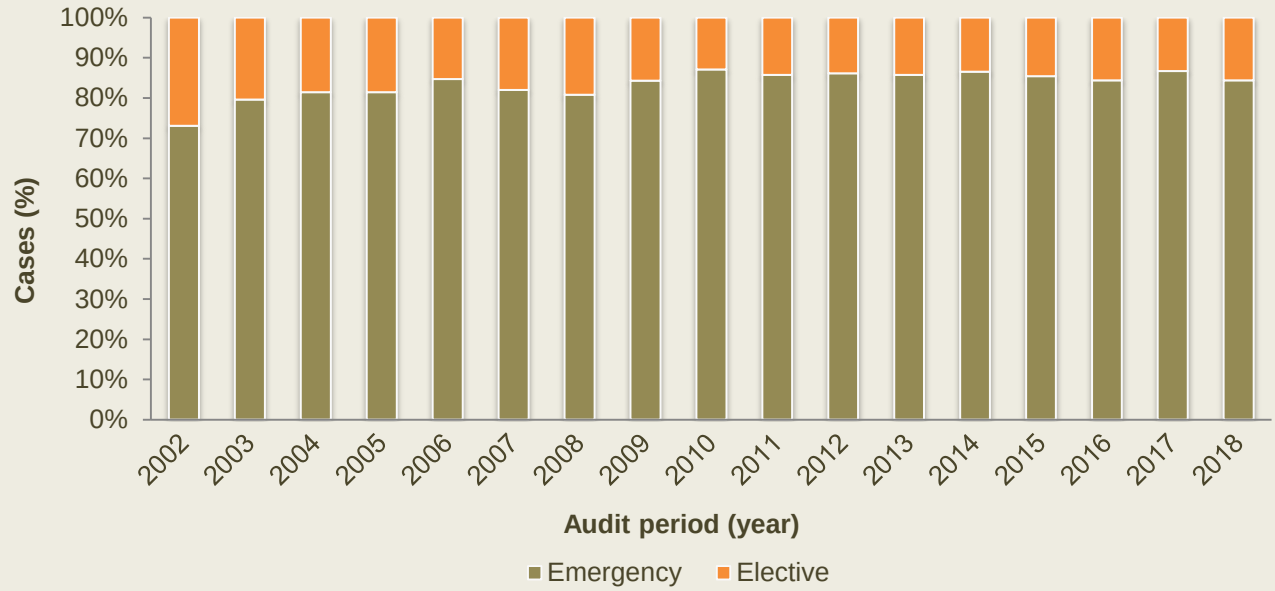



Refer to Appendix A, Table 7 for further information on data.

There was an increase in the proportion of deaths occurring in co-location hospitals. This is likely to reflect increasing admissions into co-location hospitals and, in particular, the greater number of emergencies. The proportion of deaths in public hospitals increased by 0.4% (79.3%; 325/410 in 2002 to 79.7%; 354/444 in 2018). Conversely, the proportion of deaths in private hospitals reduced by 9.4% (20.7%; 85/410 in 2002 to 11.3%; 50/444 in 2018). This fall will, in part, be a reflection of the greater number of emergency private patients presenting to public and co-location hospitals emergency departments.

The type of hospital admission, emergency or elective, is shown in Figure 8.

**Figure 8: Hospital admission by year**




Refer to Appendix A, Table 8 for further information on data.

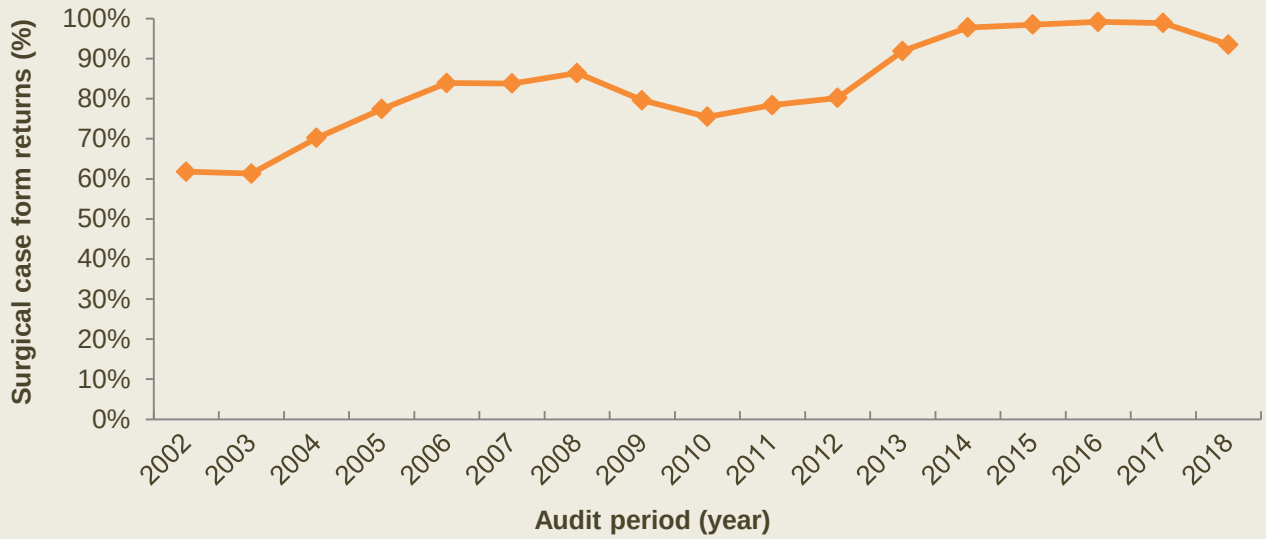
Emergency and elective admissions accounted for 83.6% (6,759/8,088) and 16.4% (1,329/8,088) respectively.

## 2.3 Surgeon participation

Since 1 January 2017, the WAASM mandated the use of Fellows Interface for completing and submitting SCFs and FLAs. The Fellows Interface is a web-based application developed by the RACS specifically for the audits of surgical mortality. It is intended to be a faster, more efficient and convenient way to complete SCFs and FLAs.

The overall SCF return rate was 82.9% (8,783/10,597). The SCF return rate has improved over the years (Figure 9). The return rates were 61.8% (415/672) and 98.9% (562/568) in 2002 and 2017 respectively. The lower return rate in 2018 (93.5%; 516/552) will increase as additional cases are finalised in 2019.

**Figure 9: Surgical case form returns by year**




Refer to Appendix A, Table 9 for further information on data.

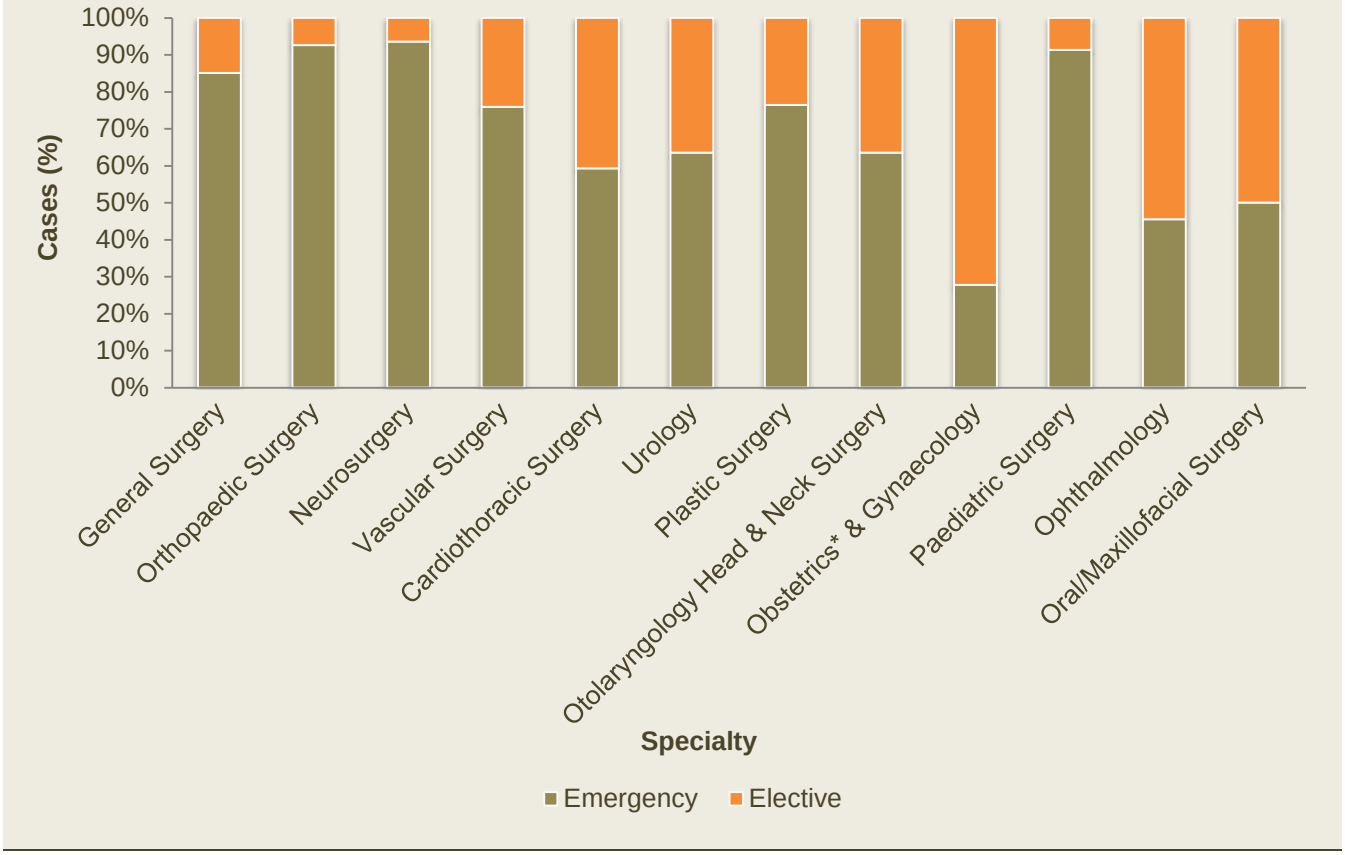
The deaths falling within the WAASM criteria from each surgical specialty and by hospital admission are shown in Table 3 and Figure 10 below. General Surgery reported the most deaths at 41.7% (4,421/10,597), followed by Orthopaedic Surgery at 18.2% (1,931/10,597). The majority of specialties had more emergency admissions compared to elective admissions.

**Table 3: Deaths falling within WAASM criteria by specialty**

| Surgical specialty | Number of deaths | Percentage (%) |
|---|---|---|
| General Surgery | 4,421 | 41.7 |
| Orthopaedic Surgery | 1,931 | 18.2 |
| Neurosurgery | 1,690 | 15.9 |
| Vascular Surgery | 1,008 | 9.5 |
| Cardiothoracic Surgery | 789 | 7.4 |
| Urology | 377 | 3.6 |
| Plastic Surgery | 171 | 1.6 |
| Otolaryngology Head & Neck Surgery | 122 | 1.2 |
| Obstetrics* & Gynaecology | 41 | 0.4 |
| Paediatric Surgery | 29 | 0.3 |
| Ophthalmology | 15 | 0.1 |
| Oral/Maxillofacial Surgery | 3 | 0.03 |

WAASM: Western Australian Audit of Surgical Mortality.
*Obstetric cases are not included in the audit process, only gynaecological cases are audited.
Refer to Appendix A, Table 10 for further information on data.

**Figure 10: Deaths by surgical specialty and hospital admission**



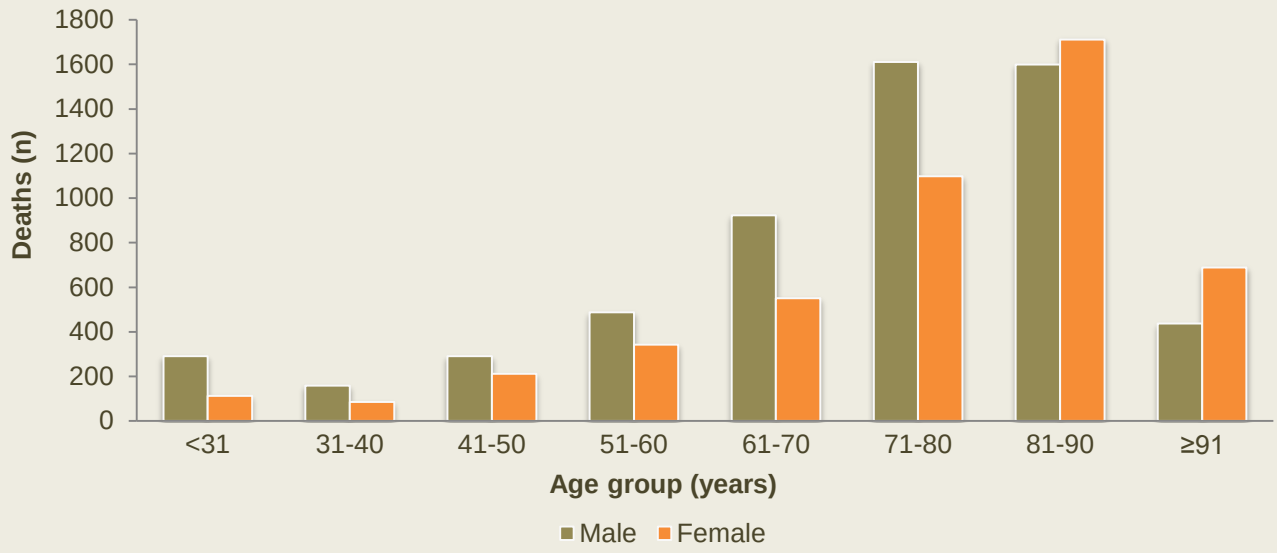

*Obstetric cases are not included in the audit process, only gynaecological cases are audited.
Refer to Appendix A, Table 11 for further information on data.

## 2.4 Age and gender distribution

The median age at death for all patients was 78 years (interquartile range, 66-85 years). Males accounted for 54.7% (5,797/10,597) and females 45.3% (4,800/10,597). The median age at death for males was 76 years (interquartile range, 64-84) and for females was 78 years (interquartile range, 69-87 years).

The breakdown of deaths by age group and gender is shown in Figure 11.

**Figure 11: Deaths by age group and gender**




Refer to Appendix A, Table 12 for further information on data.

## 3. CLINICAL RISK PROFILE AND MANAGEMENT

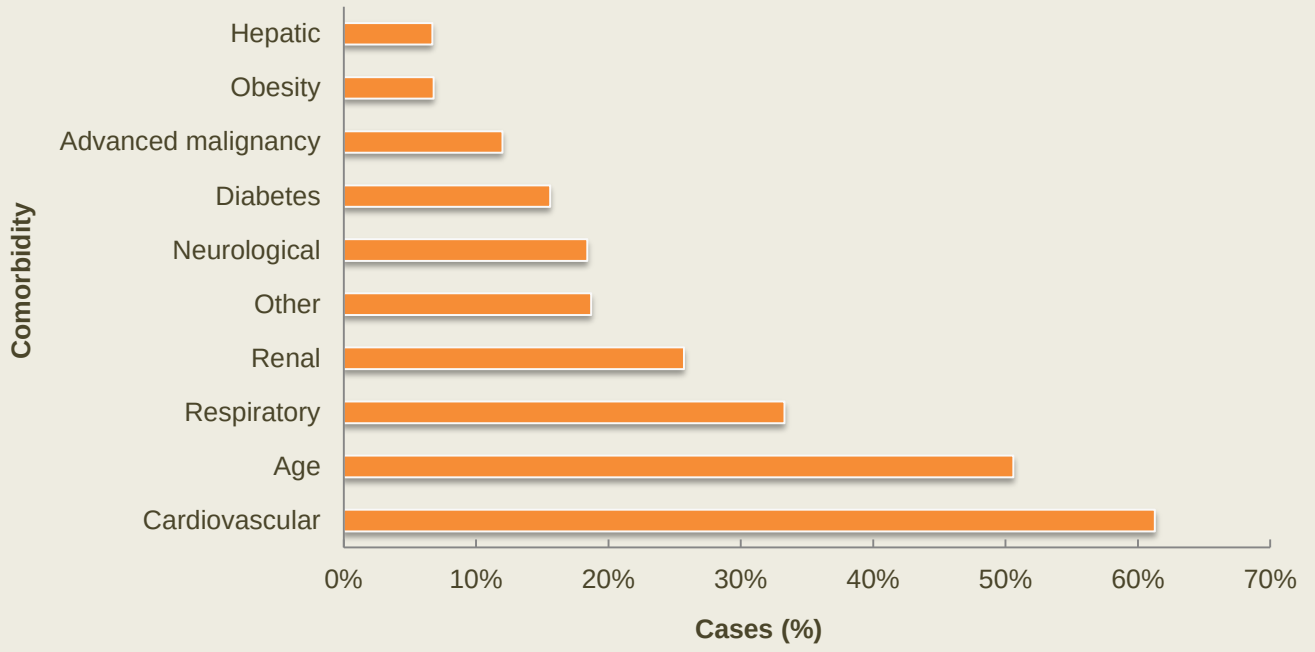
**Over the 17 year reporting period (2002-2018):**

- **One or more comorbidities were present in 90.7% of cases**
- **The most commonly assigned ASA grade was grade 4 (43.8%)**
- **Patients had a preoperative hospital transfer in 27.1% of cases**
- **Issues related to 'delay in transfer' were reported in 10.4% of transferred cases**
- **There was a preoperative diagnostic delay in 6.5% of cases; of these 35.8% were associated with the surgical unit**
- **Patients received DVT prophylaxis in 76.0% of cases**
- **Patients did not receive critical care support in 42.2% of cases**

### 3.1 Comorbidities

Treating surgeons are asked to identify any associated significant factors (comorbidities) that might increase the risk of death. Most patients (90.7%; 6,756/7,446) had at least one significant comorbidity. There may be more than one comorbidity listed per patient (Figure 12). The most frequently occurring comorbidities were cardiovascular disease (61.3%; 4,566/7,446), age (50.6%; 3,764/7,446) and respiratory disease (33.3%; 2,477/7,446).

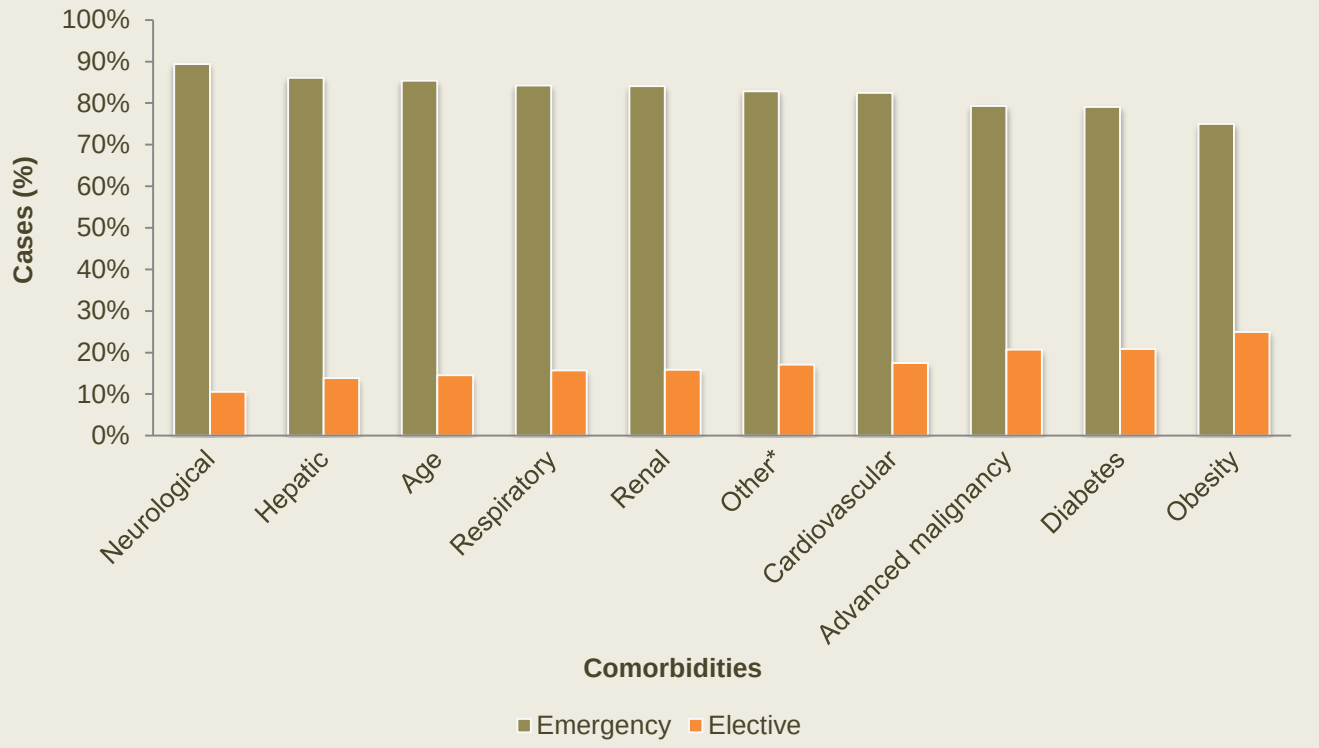
**Figure 12: Cases with specific comorbidities**




'Other' includes comorbidities other than those 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.
Refer to Appendix A, Table 13 for further information on data.

Figure 13 shows individual comorbidities by hospital admission.

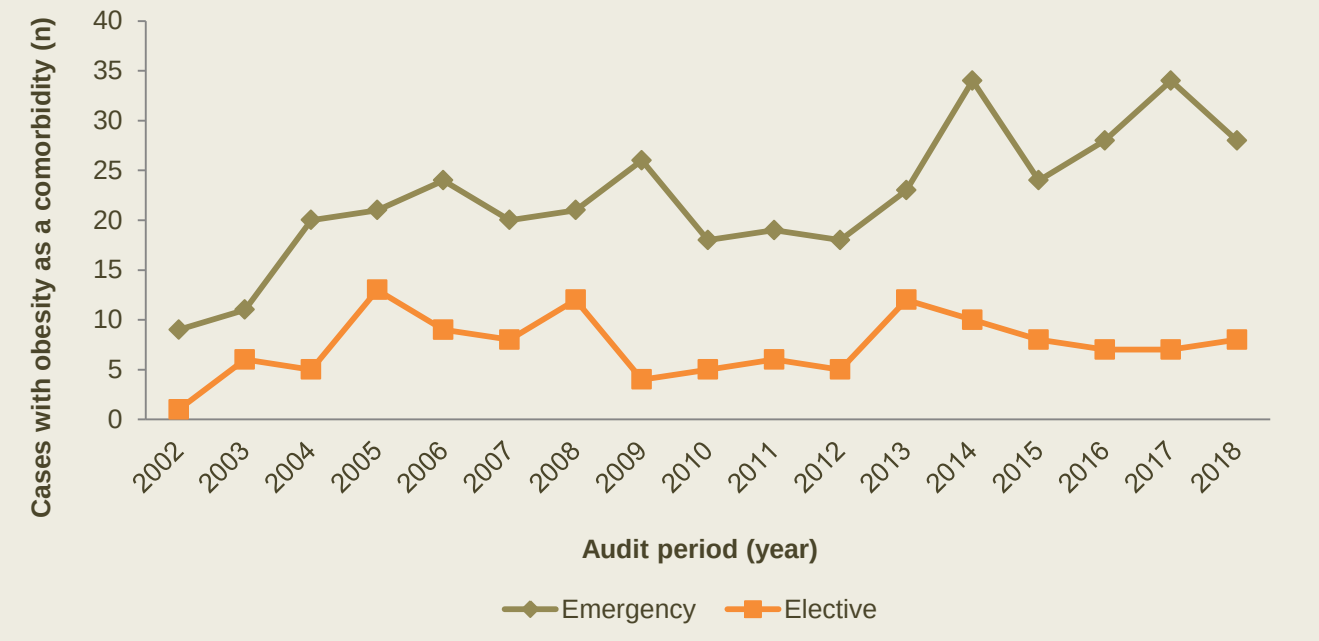
**Figure 13: Specific comorbidities by hospital admission**




*Other: Includes comorbidities other than those listed on the SCF and may include the presence of other chronic illnesses, haematological or drug-related conditions, vasculopathy, hypertension, dementia, malnutrition, alcoholism and cachexia.
Refer to Appendix A, Table 14 for further information on data.

Overall, emergency admissions accounted for the majority of cases with comorbidities. One-quarter (126/504) of cases where obesity was identified as a comorbidity were elective admissions.

**Figure 14: Obesity as a comorbidity by hospital admission by year**




Refer to Appendix A, Table 15 for further information on data.

It is very important to appreciate that the rise of obesity as a comorbidity is not related to bariatric surgery, but to obesity as a specific risk factor for non-bariatric surgery. Between 2002 and 2013, there was a fair variation in elective deaths with obesity as a comorbidity. Since 2014, there has been a more consistent proportion of elective deaths with obesity as a comorbidity. This may be secondary to case selection, with some elective surgery being deferred until patients have lost weight or, in some cases, because surgeons are declining to offer surgery to obese patients.

There is little opportunity to address obesity in the emergency setting and the progressive risk is likely to be a reflection of the increasing obesity in the general population. Clearly, obese patients presenting as an emergency should be proactively managed as high risk.

The American Society of Anesthesiologists (ASA) grade is an internationally recognised measure of a patient's preoperative physical status [14]. It is a simple but important indication of the overall health status of a patient. The ASA grade definitions can be found in Appendix A, Table 16.

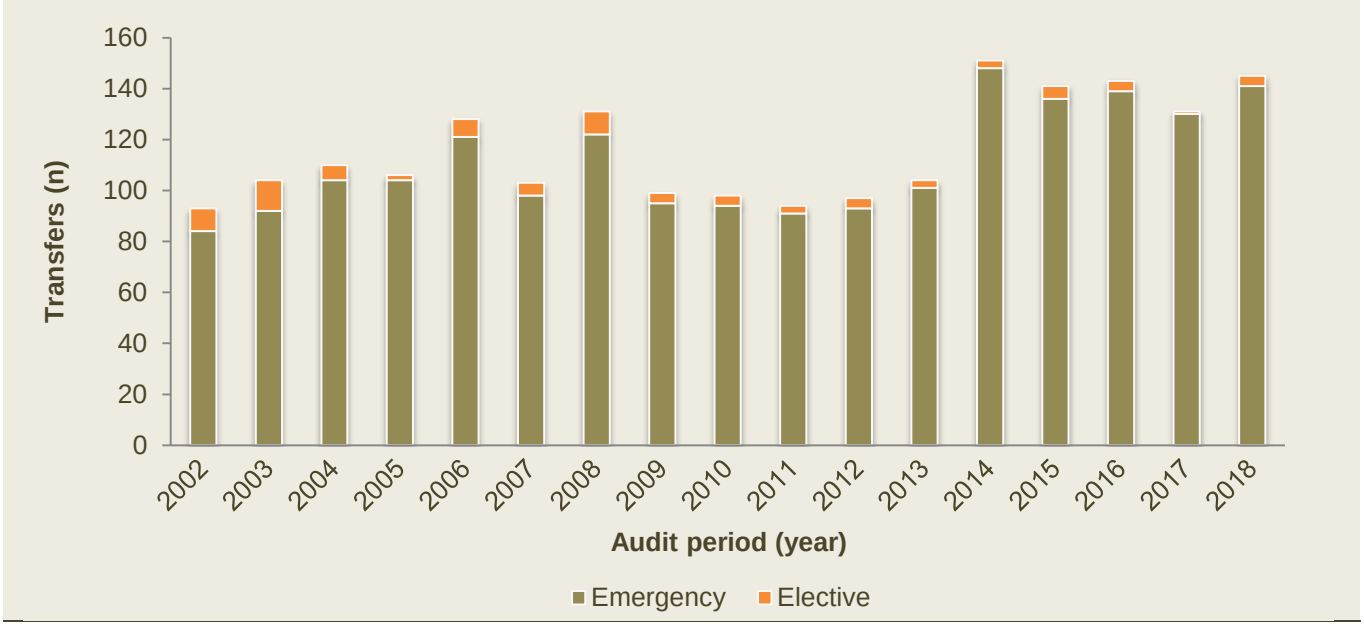
Over the reporting period, patients were assigned ASA grade 4 (severe degree of systemic disease) in 43.8% (2,753/6,281) of cases. The second most commonly assigned was ASA grade 3 (moderate degree of systemic disease) with 33.1% (2,076/6,281) of cases.

Critical Care and Perioperative Medicine is now a recognised anaesthetic sub-specialty. There is accumulating evidence showing improved outcomes if a patient is fully optimised [15]. This extends beyond optimisation of existing comorbidities. For example, in the elective setting, a six-week exercise program, smoking cessation and weight loss have all been shown to improve outcome. In the public sector, preoperative clinics are well established. However, anecdotal evidence from WAASM SLA case note reviews suggests that the lack of preoperative assessment in the private sector is a frequent issue.

## 3.2 Hospital transfers

Overall, there was a preoperative hospital transfer in 27.1% (1,994/7,354) of patients. There was an increase of 10.3% (23.3%; 93/400 in 2002 to 33.6%; 146/435 in 2018) in hospital transfers. Overall, a greater proportion of hospital transfers related to emergency admissions (95.7%; 1,893/1,979).

**Figure 15: Hospital transfers by hospital admission by year**




Refer to Appendix A, Table 17 for further information on data.

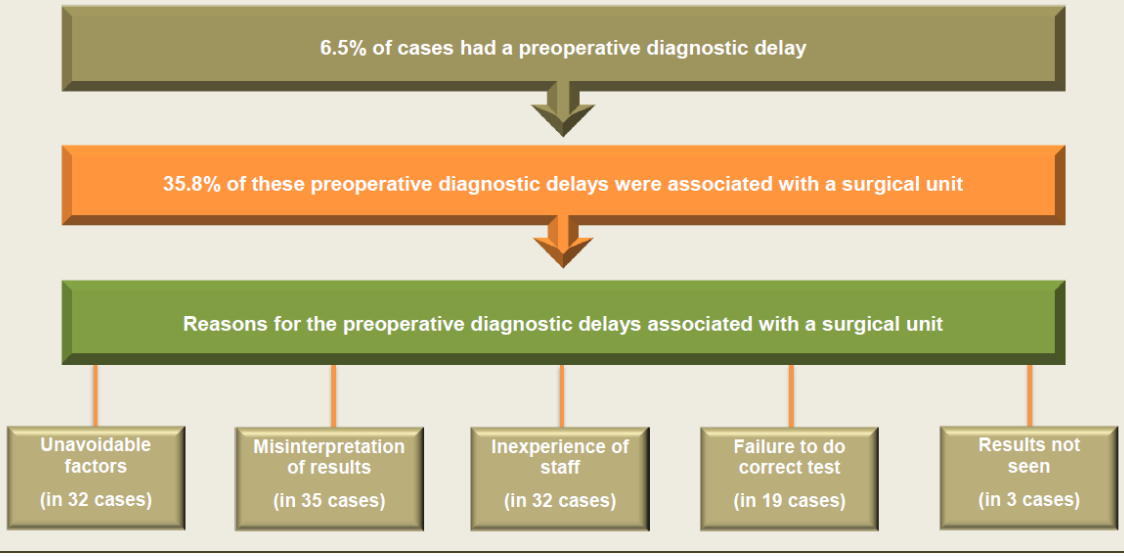
Deaths related to hospital transfers have been reported in previous WAASM reports and were specifically highlighted in the WAASM 2018 Report [3]. This was also the subject of the WAASM 2015 symposium.

In just over a quarter of cases, the treating surgeon reported an issue related to transfer, the commonest being ‘delay in transfer’ (10.4%; 192/1,844). Other transfer issues included; ‘inappropriate transfer’ (7.3%; 135/1,855), ‘insufficient clinical information’ (6.2%; 108/1,751) and ‘inappropriate level of care’ (2.5%; 44/1,753). Some cases had more than one transfer issue.

## 3.3 Preoperative diagnostic delays

Treating surgeons were asked if there was a preoperative delay in the confirmation of the main surgical diagnosis (Figure 16).

**Figure 16: Preoperative diagnostic delays**




Refer to Appendix A, Table 18 for further information on data.

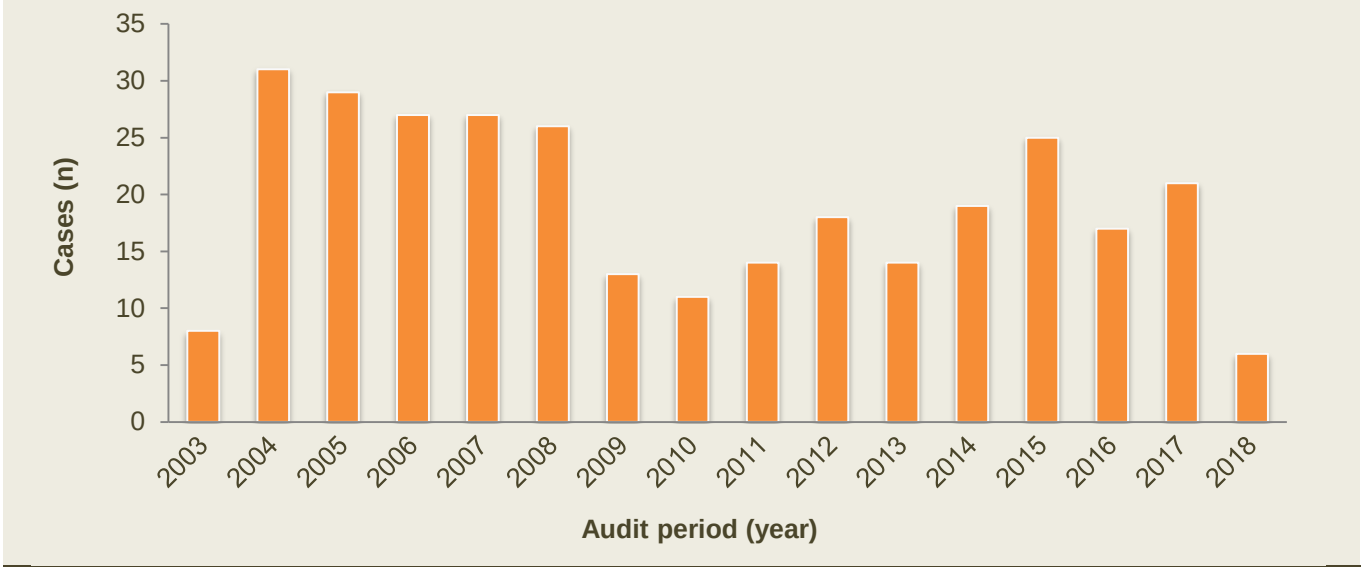
Overall, a preoperative delay in diagnosis was indicated by the treating surgeon in 6.5% (469/7,177) of cases. Of these delays, 11.9% (44/368) were associated with the general practitioner, 34.2% (136/398) with the medical unit and 35.8% (142/397) were associated with the surgical unit. The most common reason for preoperative diagnostic delays associated with a surgical unit was ‘misinterpretation of results’, listed in 35 cases.

## 3.4 Fluid balance

Data collection of fluid balance issues did not commence until the second half of 2003.

The treating surgeon indicated that there was ‘no issue’ with fluid balance in 90.5% (5,846/6,458) of cases. There was a fluid balance issue in 5.9% (381/6,458) of cases and in 3.6% (231/6,458) there was no comment.

**Figure 17: Cases with fluid balance issues**



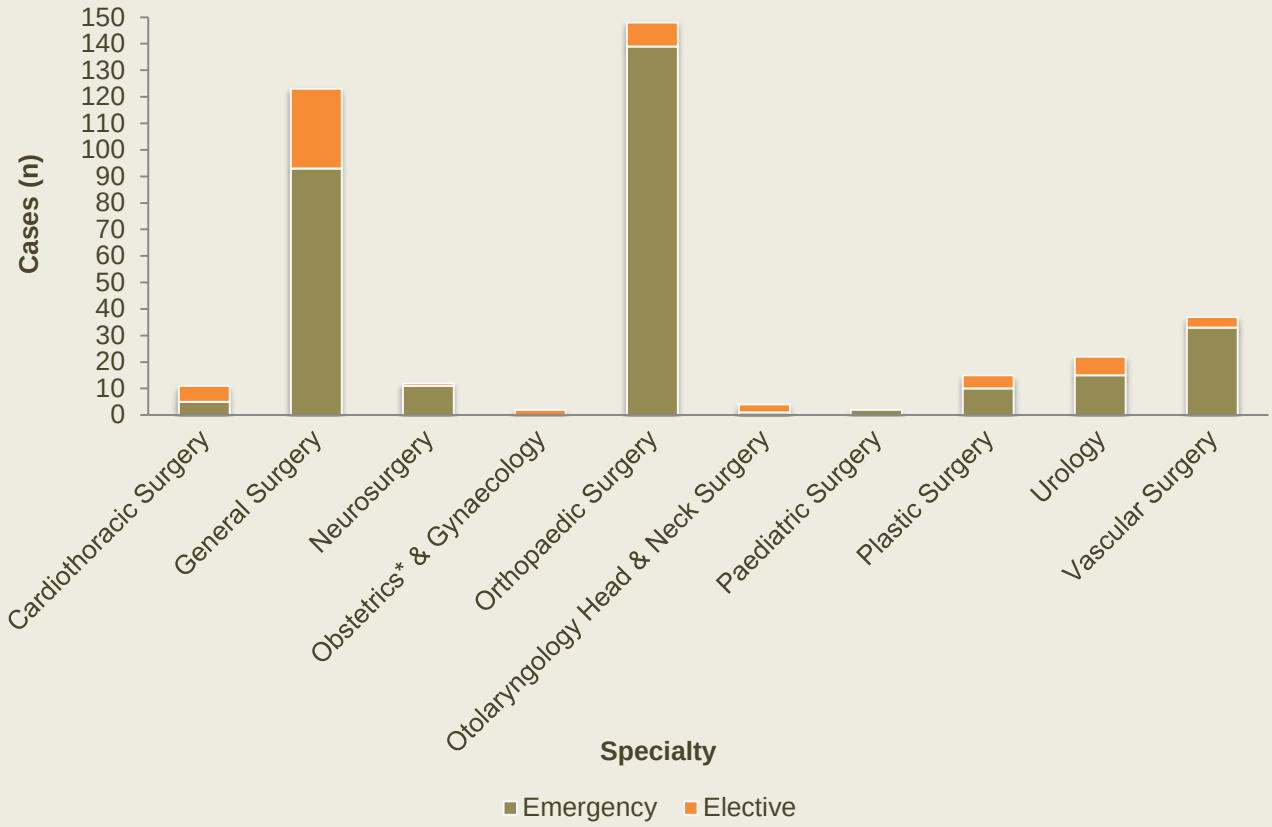

Refer to Appendix A, Table 19 for further information on data.

Operative cases had more fluid balance issues (6.6%; 306/4,620) than non-operative cases (4.0%; 72/1,799).

The overall data is likely to underestimate the issues related to fluid management. Fluid balance has long been highlighted by the WAASM as a specific issue resulting from poor care, culminating in a symposium on fluid management, held in 2008. In the following year (2009), there was a 36.6% (7.1%; 33/468 in 2008 to 4.5%; 17/374 in 2009) fall in the proportion of deaths related to fluid management issues. The more recent data suggests that the lessons learnt from the symposium are being forgotten.

There is, not surprisingly, great variation between specialties (Figure 18). Emergency admissions accounted for 93.9% (139/148) of Orthopaedic Surgery cases where fluid balance issues were identified. Most specialties had more fluid balance issues associated with emergency admissions, except for Obstetrics* and Gynaecology; Otolaryngology, Head and Neck Surgery; and Cardiothoracic Surgery.

**Figure 18: Fluid balance issues by specialty and hospital admission**

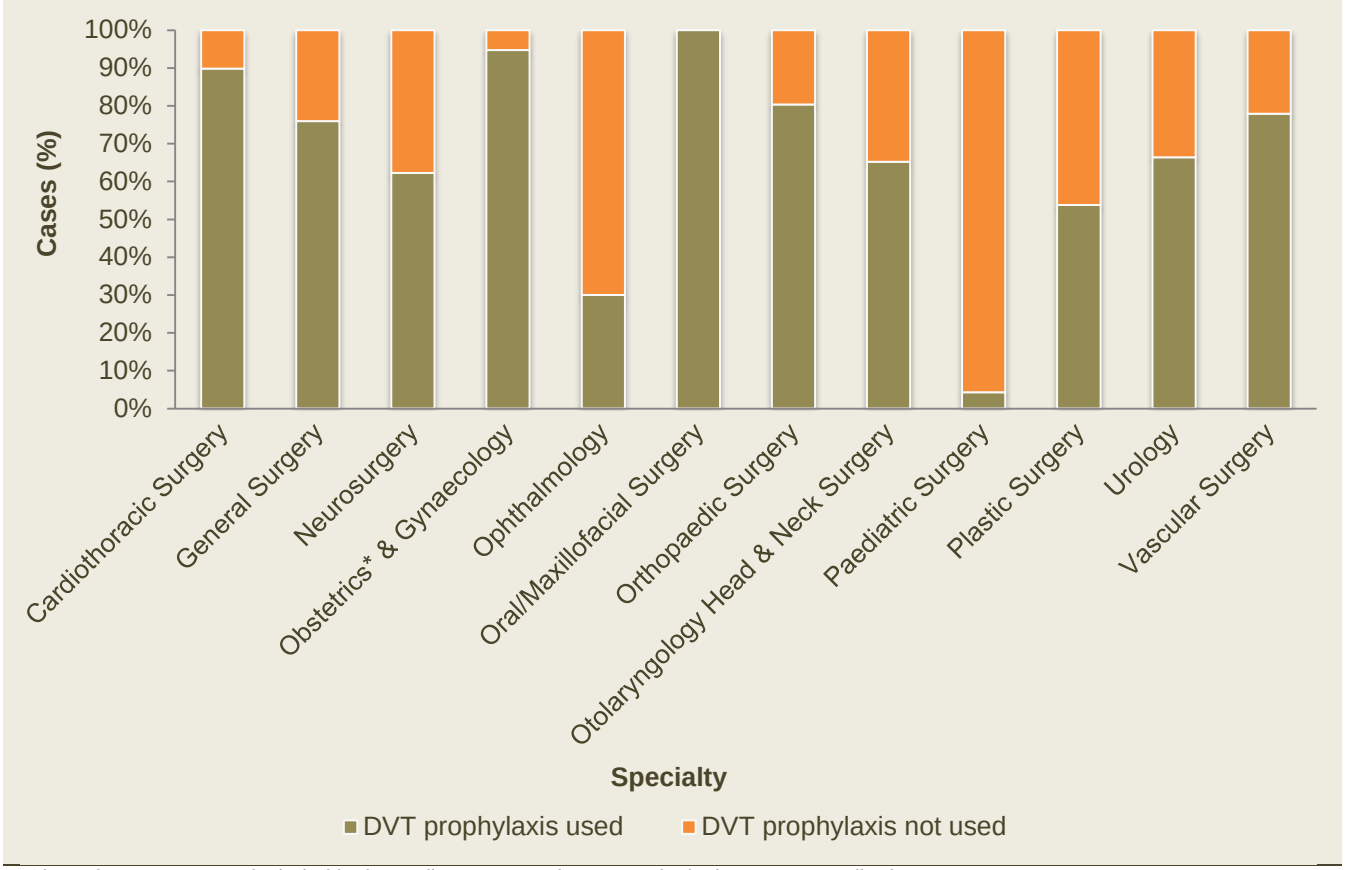



*Obstetric cases are not included in the audit process, only gynaecological cases are audited.
Refer to Appendix A, Table 20 for further information on data.

### 3.5 Deep vein thrombosis prophylaxis

In 76.0% (5,526/7,271) of cases, DVT prophylaxis was used. There was variation between specialties in relation to this (Figure 19).

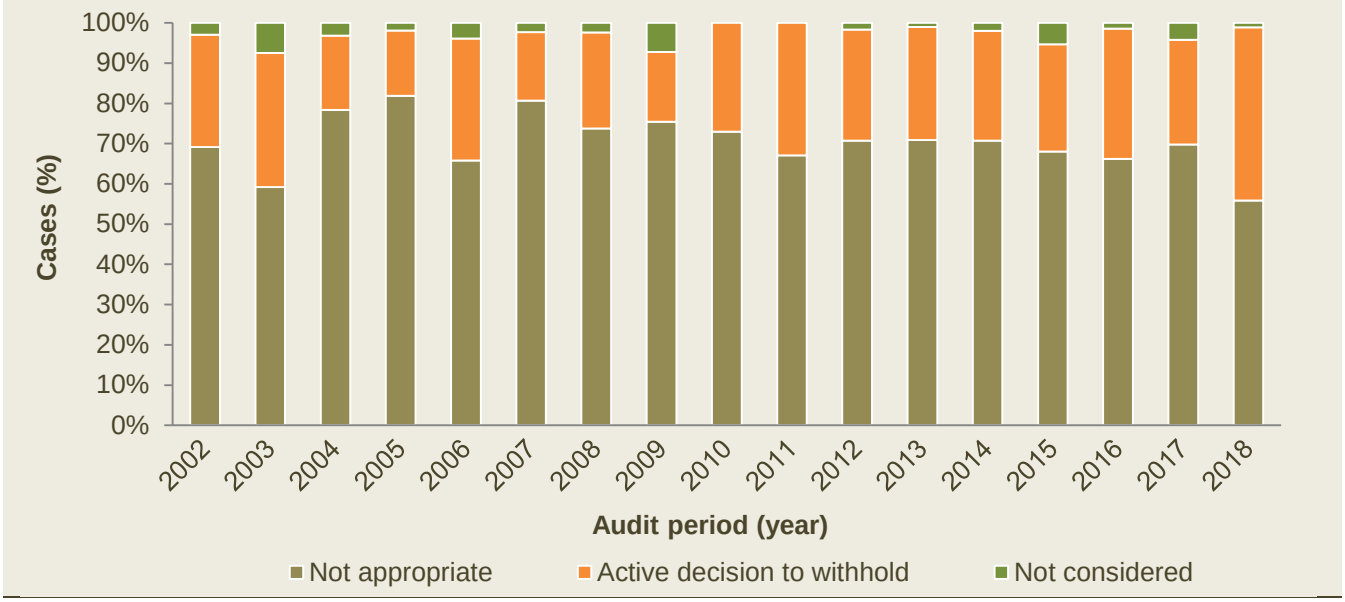
**Figure 19: DVT prophylaxis by specialty**




*Obstetric cases are not included in the audit process, only gynaecological cases are audited.
DVT: Deep vein thrombosis.
Refer to Appendix A, Table 21 for further information on data.

In the 24.0% (1,745/7,271) of cases where DVT prophylaxis was not used, it was considered not appropriate to use (70.4%; 1,075/1,527), there was an active decision to withhold it (26.7%; 407/1,527), or it was not considered (2.9%; 45/1,527).

**Figure 20: Reasons for not using DVT prophylaxis**



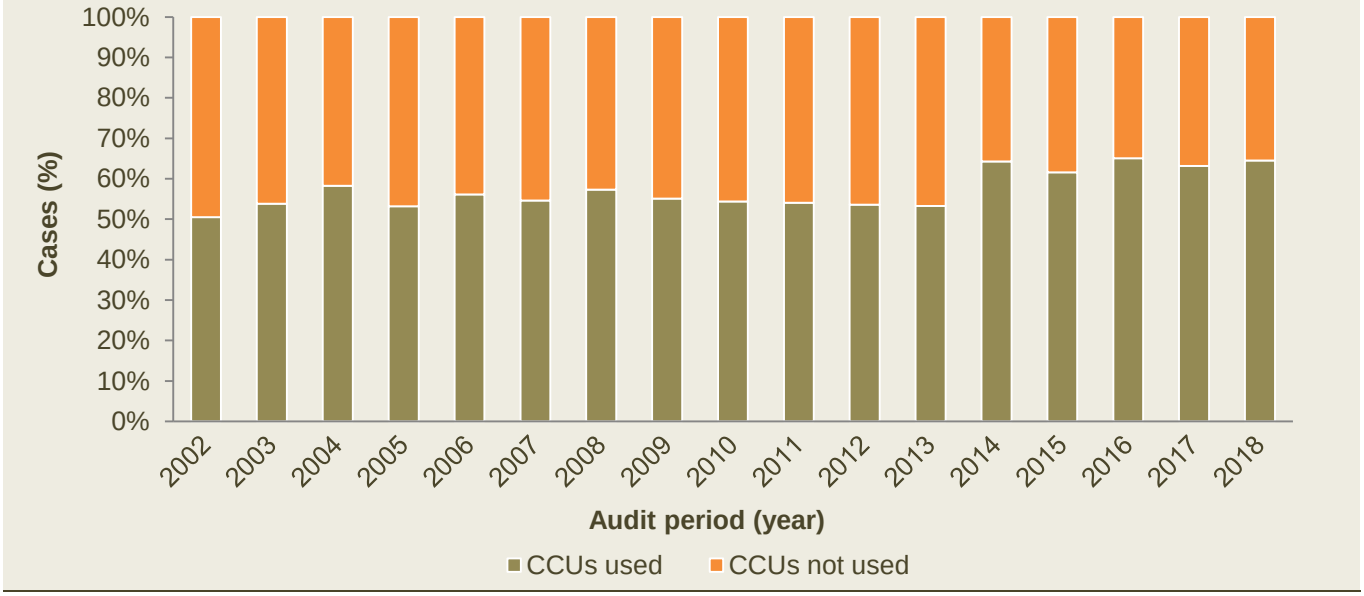

DVT: Deep vein thrombosis.
Refer to Appendix A, Table 22 for further information on data.

More than one type of DVT prophylaxis was used for many patients. The types of different DVT prophylaxis used over the reporting period were; Heparin (43.5%; 3,854/8,858), TED (Thromboembolic Deterrent) stockings (33.7%; 2,988/8,858), sequential compression device (14.1%; 1,249/8,858), aspirin (4.1%; 361/8,858) and warfarin (1.5%; 136/8,858). Other medications used for DVT prophylaxis included enoxaparin sodium, clopidogrel bisulfate and danaparoid sodium (3.0%; 270/8,858).

## 3.6 Critical care units

The treating surgeon is asked to indicate the use of a critical care unit (CCU). This includes care in either an intensive care unit (ICU) or a high dependency unit (HDU). In 57.8% (4,042/6,993) of cases, CCUs were utilised. Overall, the proportion of cases where a CCU was used has increased by 14.0%, from 50.5% (189/374) in 2002 to 64.5% (285/442) in 2018. Figure 21 gives the breakdown of CCUs use and non-use.

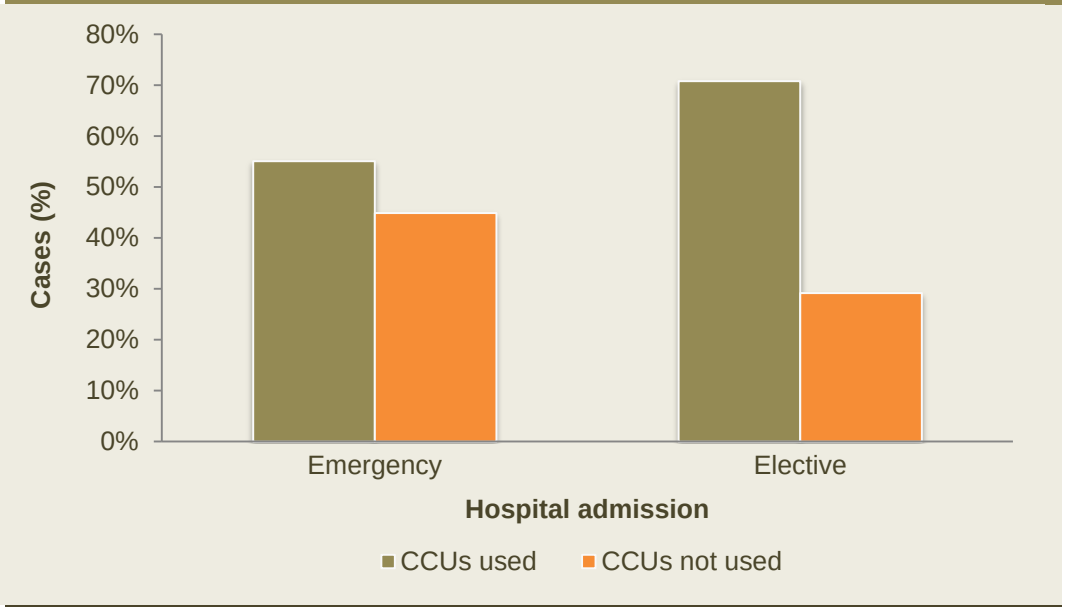
**Figure 21: Critical care units**




Refer to Appendix A, Table 23 for further information on data.

In both elective and emergency admissions, CCUs were used in 70.8% (878/1,240) and 55.1% (3,139/5,695) of cases respectively.

**Figure 22: Critical care units by hospital admission**




Refer to Appendix A, Table 24 for further information on data.

## 4. OPERATIVE AND NON-OPERATIVE DEATHS

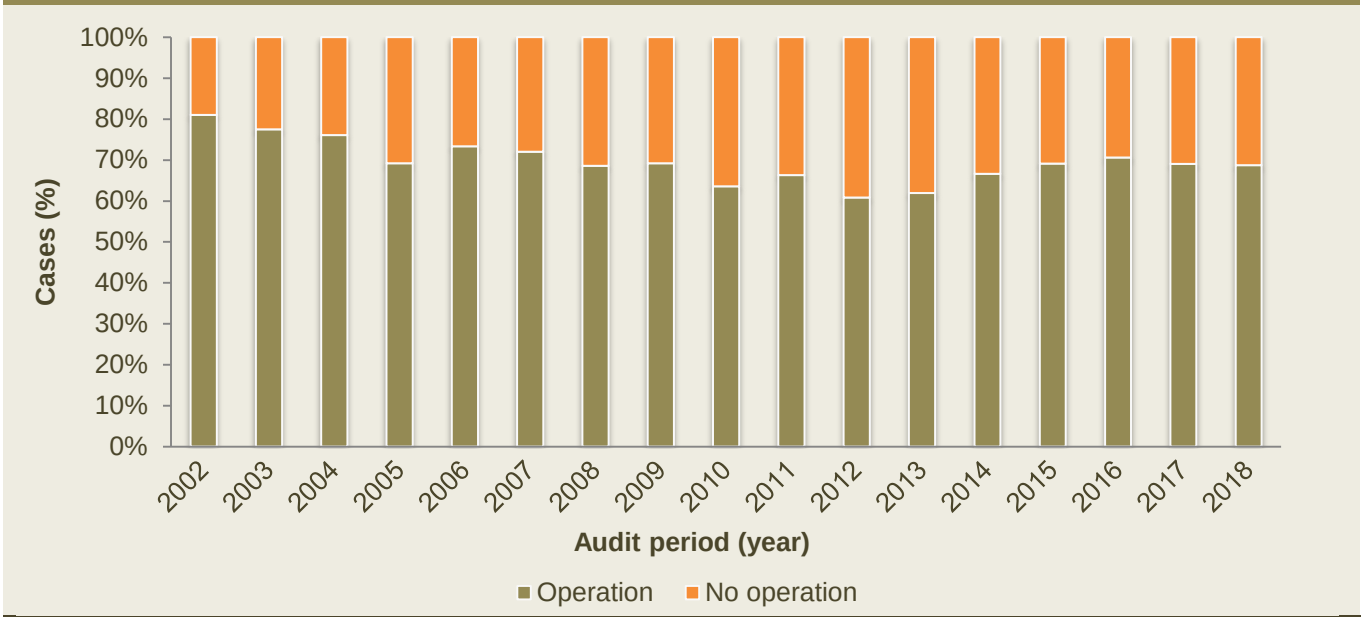
**Over the 17 year reporting period (2002-2018):**

- **One or more operations were performed in 69.5% of cases**
- **Of those 69.5% of patients who had an operation, consultant surgeons made the decision to proceed to theatre in 73.9% of cases**
- **Of all operative cases, 36.7% had postoperative complications**
- **There was a 12.3% increase in the proportion of cases not involving an operation**
- **A clinically significant infection was reported in 31.2% of patients (data from 2013-2018)**

### 4.1 Operative and non-operative cases

The majority of surgical deaths underwent one or more operations. The breakdown of operative and non-operative cases is shown in Figure 23. Whilst overall there was variation in the proportion of non-operative cases, it peaked in 2012 at 39.2% (178/454).

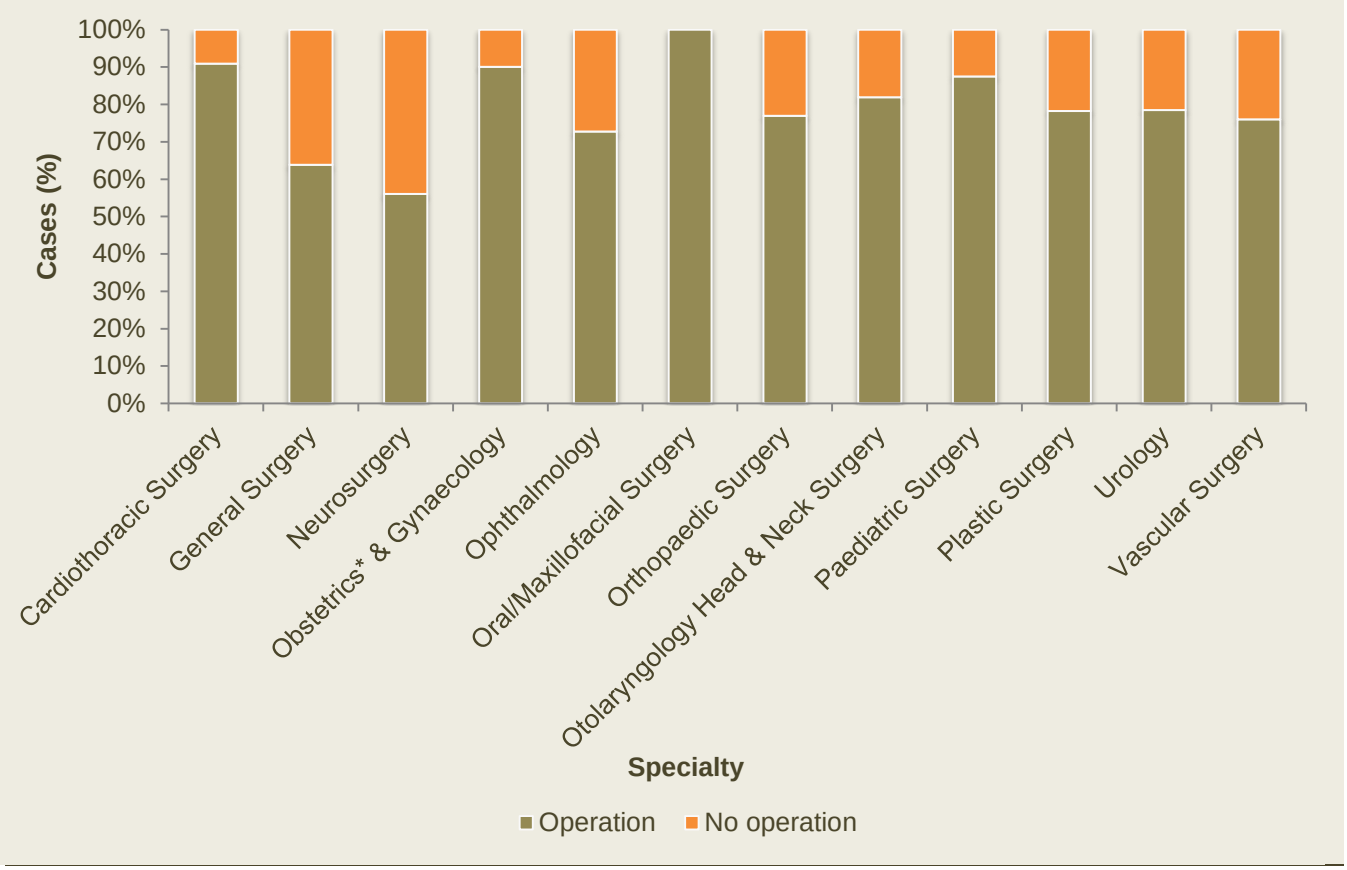
**Figure 23: Operative and non-operative cases**




Refer to Appendix A, Table 25 for further information on data.

A further breakdown of operative and non-operative cases by specialty is shown in Figure 24. The Oral/Maxillofacial Surgery specialty had an operation rate of 100% (2/2) and Cardiothoracic Surgery had the next highest operation rate at 90.9% (568/625). Neurosurgery had the lowest operation rate (56.0%; 724/1,292).

**Figure 24: Operative and non-operative cases by specialty**




*Obstetric cases are not included in the audit process, only gynaecological cases are audited.
Refer to Appendix A, Table 26 for further information on data.

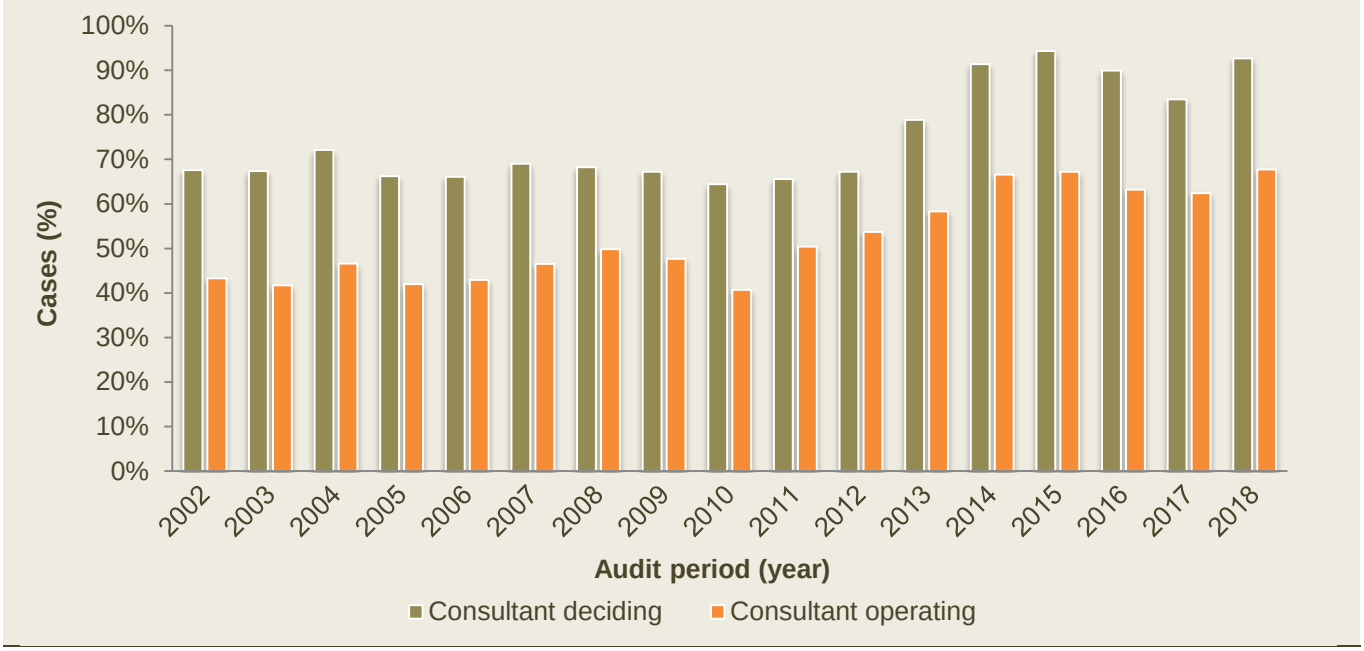
## 4.2 Operative cases

Overall, 69.5% (5,659/8,137) of patients had one or more operations. Of those patients who had one or more operations, the overall risk of death was considered 'moderate' in 26.2% (1,447/5,527) of cases and 'considerable' in 49.9% (2,757/5,527) of cases. A 'minimal' risk of death was identified in 2.6% (146/5,527) of surgical patients. There were 0.4% (20/5,527) of cases where the surgery was viewed as 'futile'.

In total, 8,935 operations were performed on 5,659 patients. In 78.1% (4,361/5,585) of patients who died after having one or more operations, they were admitted as an emergency.

In the SCF, consultant surgeons are asked to indicate their involvement in these operations. Overall, a consultant surgeon made the decision to proceed to surgery in 73.9% (6,601/8,935) of the reported operations, and operated in 51.5% (4,599/8,935) of these (Figure 25).

**Figure 25: Consultant surgeon involvement in operations**




Refer to Appendix A, Table 27 for further information on data.

Direct consultant input has increased over the years. There will be many reasons for this, but it may have been an important factor in the fall in the number of deaths.

Of the 73.9% of cases where a consultant surgeon made the decision to proceed to surgery, the distribution by hospital admission and year is shown in Figure 26.

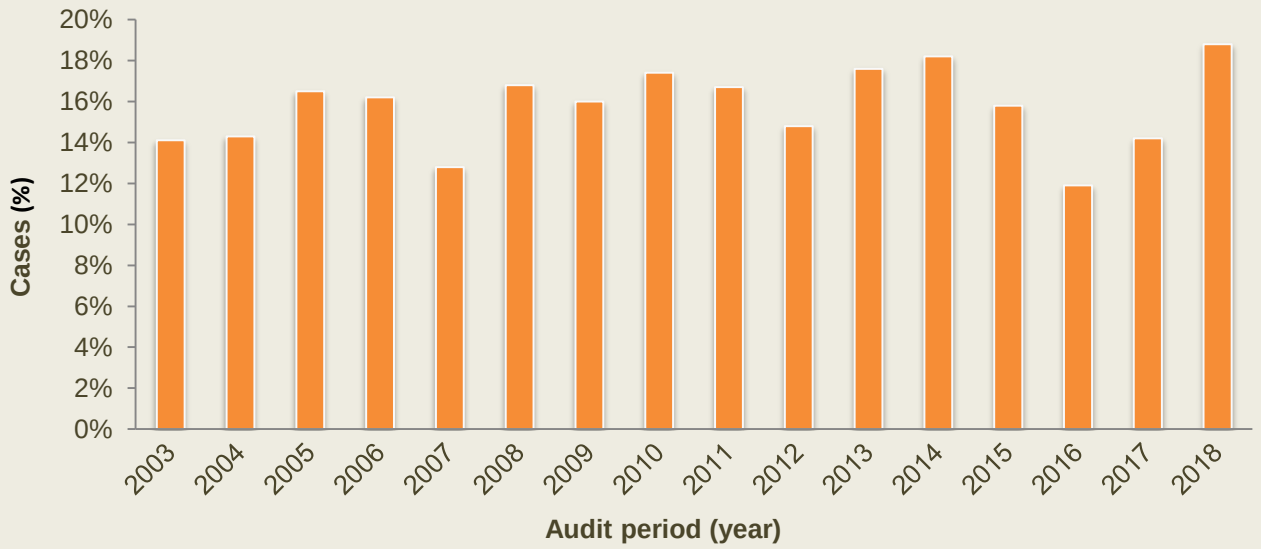
**Figure 26: Consultant surgeon decision to proceed to surgery by hospital admission**


Refer to Appendix A, Table 28 for further information on data.

An operation was abandoned on finding a terminal situation in 5.8% (345/5,942) of operations.

Data collection on unplanned returns to theatre commenced in the second half of 2003. Of those patients who underwent an operation, 15.8% (731/4,636) had an unplanned return to theatre. Over the reporting period, this rate has fluctuated between 11.9% (in 2016) and 18.8% (in 2018).

**Figure 27: Unplanned returns to operating theatre**




Refer to Appendix A, Table 29 for further information on data.

Studies have shown that postoperative complications have an adverse impact on outcome [16]. In patients who had an operation, there was a postoperative complication in 36.7% (1,910/5,211). Some patients have more than one postoperative complication.

**Figure 28: Postoperative complications by hospital admission by year**


Refer to Appendix A, Table 30 for further information on data.

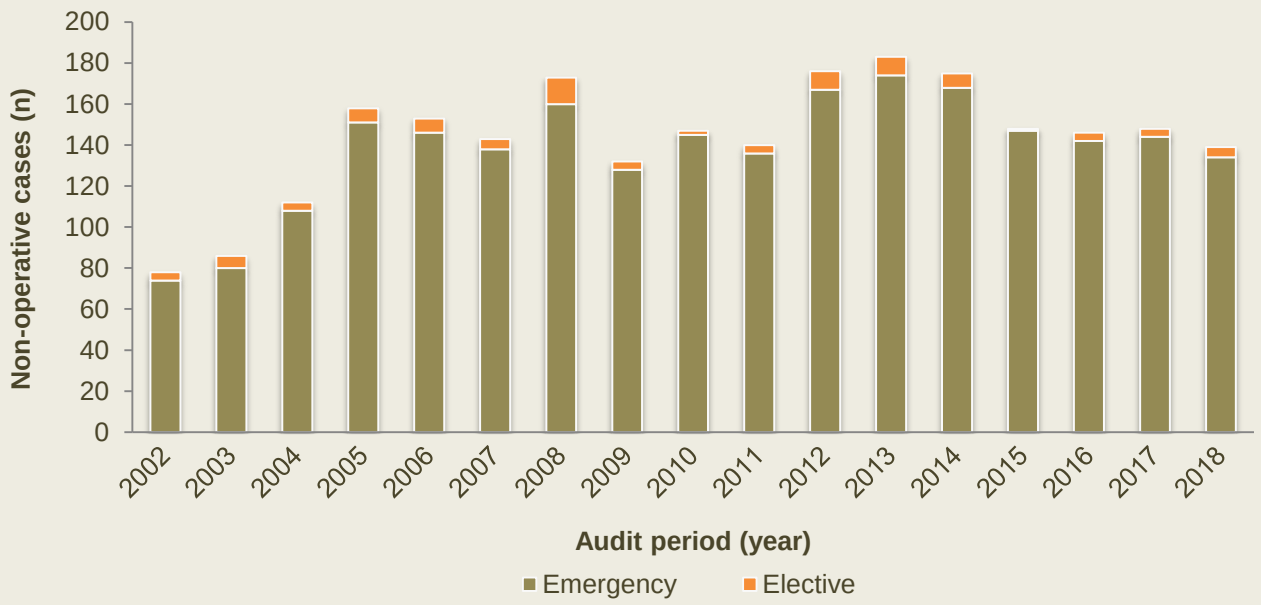
There was a total of 2,358 postoperative complications amongst 1,910 operative patients. The most frequently reported postoperative complications were sepsis (13.5%; 318/2,358), significant postoperative bleeding (12.4%; 293/2,358) and tissue ischaemia (11.6%; 274/2,358).

A higher proportion of elective patients (57.4%; 702/1,224) had a postoperative complication compared to emergency patients (27.4%; 1,195/4,361).

### 4.3 Non-operative cases

No operation was undertaken in 30.5% (2.478/8,137) of patients. The majority of the non-operative cases were emergency admissions (96.1%; 2,342/2,437).

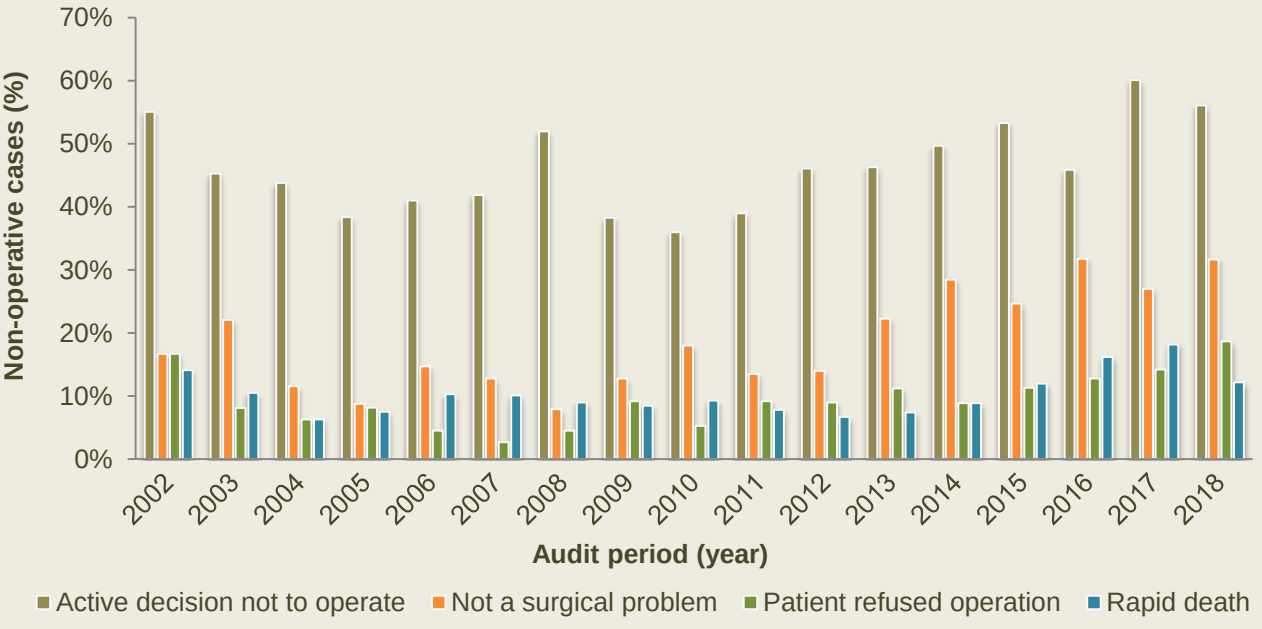
**Figure 29: Non-operative cases by hospital admission by year**




Refer to Appendix A, Table 31 for further information on data.

For some patients, the consultant surgeon considered an operation was not appropriate (Figure 30). There could be more than one reason given for not operating. In the last seven years, there has been an increase in the number of cases where the consultant surgeon has made an active decision not to operate.

**Figure 30: Reasons for not operating**




Refer to Appendix A, Table 32 for further information on data.

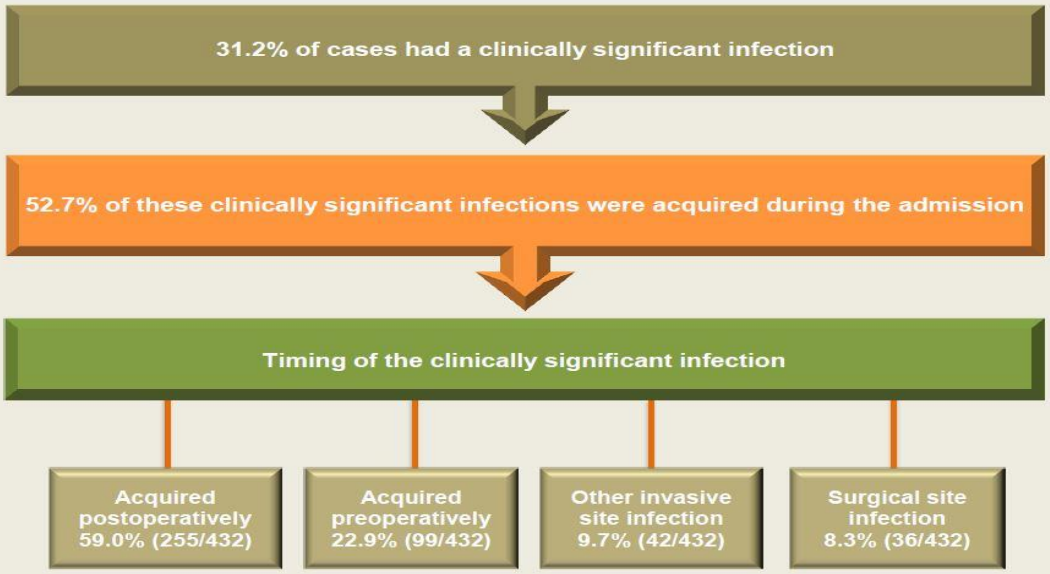
A decision not to operate is often more difficult than to operate, not least because emergency surgery is often time critical when the patient is unable to provide informed consent and the relatives of the patient are in emotional turmoil. On the other hand, 'futile' surgery often results in a poor outcome for the patient.

In a very high proportion of emergency cases, the consultant surgeon appropriately made the decision not to operate. However, both surgeons and assessors still comment that with hindsight, they would/should not have offered surgery.

### 4.4 Infections

Infections are significant in contributing to the cause of death in surgical patients. The set of questions relating to clinically significant infections commenced in 2013, hence the data reflects this. Figure 31 illustrates the stage at which these clinically significant infections were acquired.

**Figure 31: Clinically significant infections 2013-2018**



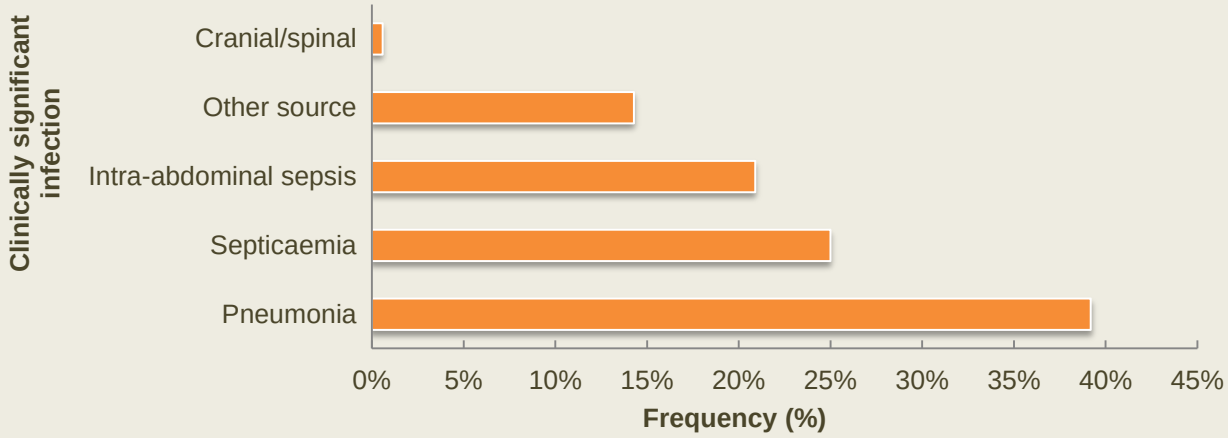

Refer to Appendix A, Table 33 for further information on data.

The proportion of patients who died with a clinically significant infection between 2013 and 2018 was 31.2% (872/2,791).

Treating surgeons reported that the infection was acquired prior to admission in 47.3% (403/852) of cases. In 52.7% (449/852) of cases, the infection was acquired during the admission and, of these infections, over half were acquired postoperatively (59.0%; 255/432).

The types of infections reported by treating surgeons, both prior to and during the admission, are shown in Figure 32.

**Figure 32: Type of clinically significant infections 2013-2018**




Refer to Appendix A, Table 34 for further information on data.

The most common type of clinically significant infection reported was pneumonia, accounting for 39.2% (341/869) of cases. Septicaemia accounted for 25.0% (217/869) of cases, intra-abdominal sepsis accounted for 20.9% (182/869), while other source and cranial/spinal infections accounted for 14.3% (124/869) and 0.6% (5/869) of cases respectively.

Antibiotic prophylaxis is a good infection control measure that should be considered [17]. Where information was provided, treating surgeons reported that the antibiotic regime was appropriate in 96.1% (821/854) of cases with infections. In 3.0% (26/854) of cases, the appropriateness of the antibiotic regime was unknown, and in 0.8% (7/854), it was considered inappropriate.

## 5. PEER REVIEW OUTCOMES

**Over the 17 year reporting period (2002-2018):**

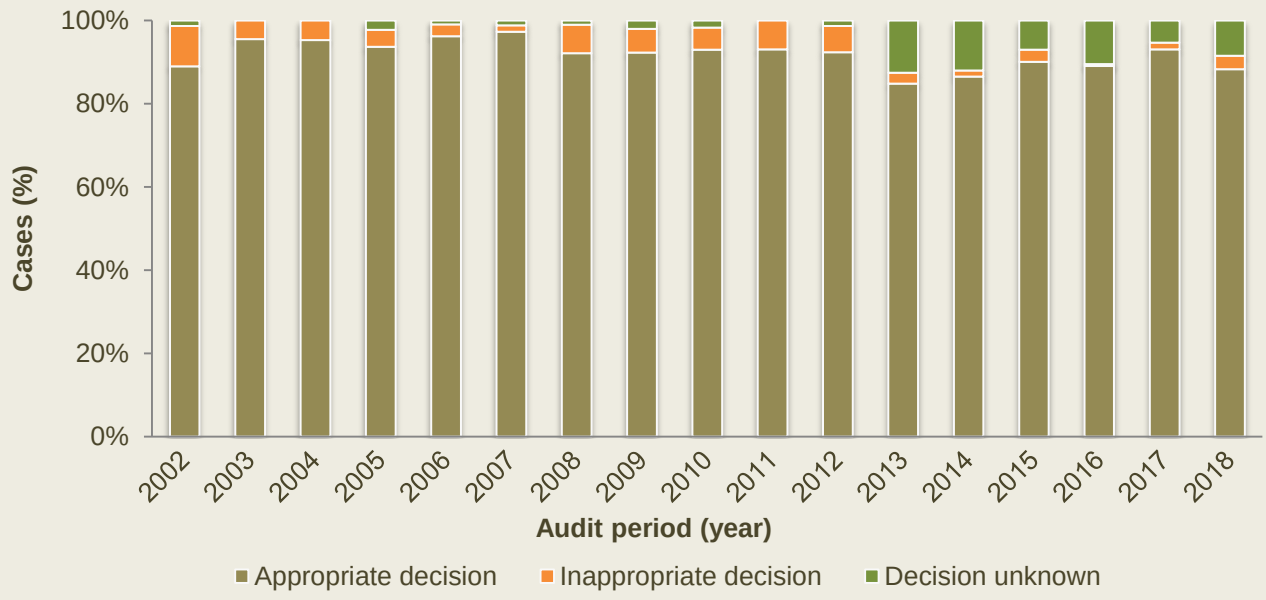
- **Assessors reported an appropriate decision on the use of DVT prophylaxis in 91.9% of cases**
- **Assessors identified 2,653 clinical management issues in 1,808 cases**
- **Of the 2,653 clinical management issues identified, 20.1% (533/2,653) of these were classified as adverse events**
- **Of the adverse events identified, 52.3% (276/528) caused the death of a patient**
- **Of the adverse events that caused the death of a patient, 28.6% (79/276) were considered definitely preventable**

The peer review process is a retrospective assessment of the clinical management of patients who died whilst under the care of a surgeon. All cases, with the exception of terminal care admissions, undergo an FLA. At this stage, the case will either be closed or be sent for an SLA, which includes a review of the patient's medical record. Where cases underwent both an FLA and an SLA, the analysis in this section uses data from the SLA.

### 5.1 Decision on deep vein thrombosis prophylaxis

As part of the assessment process, assessors are asked to indicate whether they think the decision on DVT prophylaxis was appropriate. Figure 33 shows assessor opinion on the appropriateness of DVT prophylaxis by year.

**Figure 33: Assessor opinion on appropriateness of DVT prophylaxis decision**

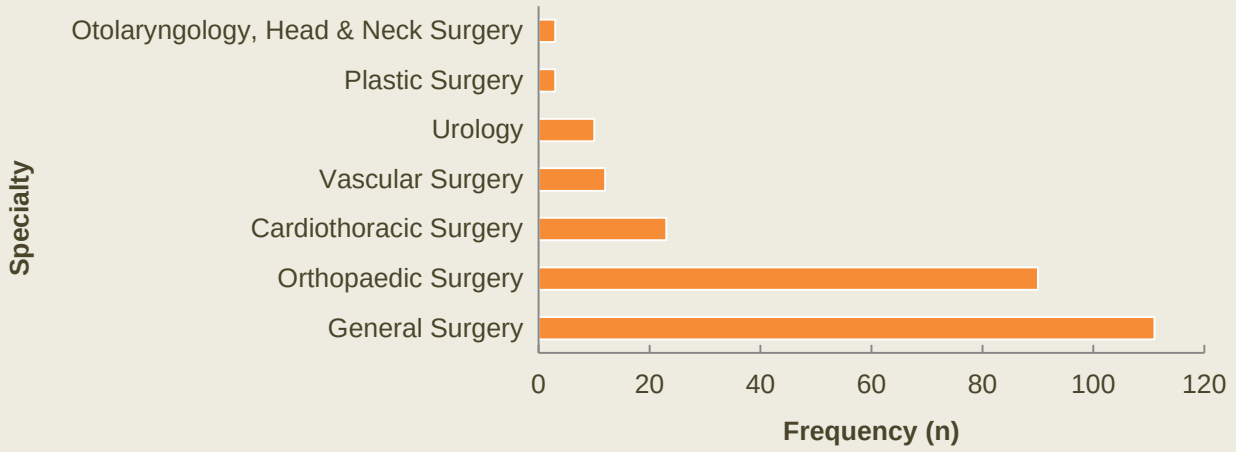



Refer to Appendix A, Table 35 for further information on data.

Overall, assessors indicated that the decision to use or withhold DVT prophylaxis was appropriate in 91.9% (5,729/6,234) of cases. Assessors could not comment on the appropriateness of the DVT prophylaxis decision in 4.1% (253/6,234) of cases. In 4.0% (252/6,234) of cases, assessors reported that there had been an inappropriate decision on the use of DVT prophylaxis.

Figure 34 shows the breakdown of cases by specialty where assessors reported an inappropriate decision on the use of DVT prophylaxis. General Surgery accounted for 44.0% (111/252) of cases where DVT prophylaxis was considered inappropriate by assessors.

**Figure 34: Inappropriate DVT prophylaxis decision by specialty**




Refer to Appendix A, Table 36 for further information on data.

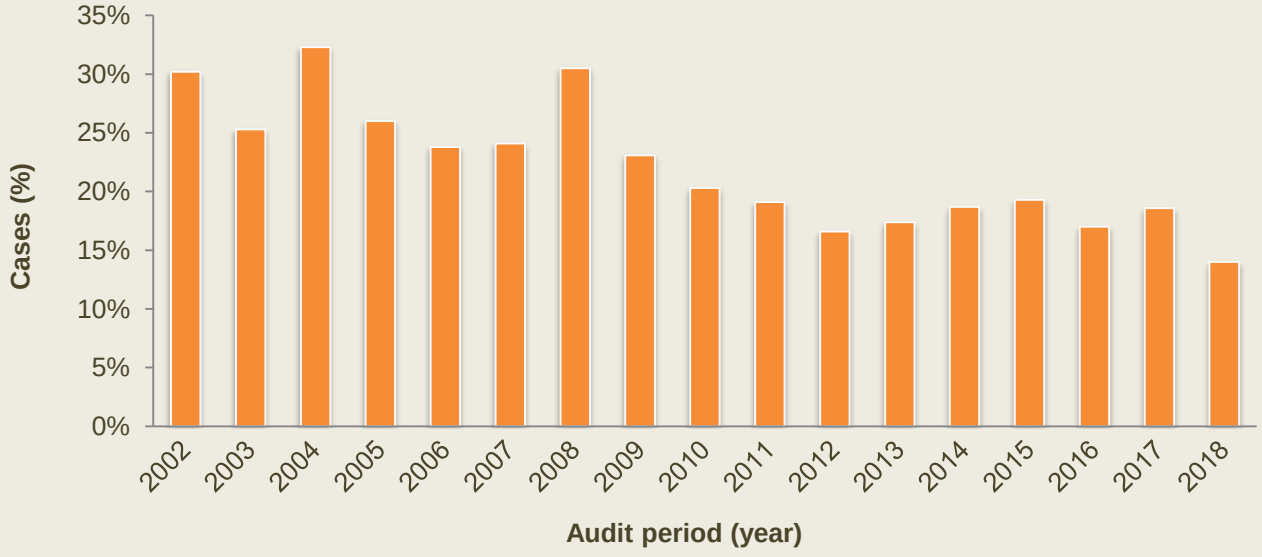
The importance of DVT prophylaxis has been clearly established [18]. Any death secondary to failure to administer DVT prophylaxis must be considered potentially preventable.

## 5.2 Clinical management issues

The assessor notes whether there was an 'area of consideration', 'area of concern' or an 'adverse event'; together these are grouped as clinical management issues (Figure 2 defines each of these).

The annual trend of cases with clinical management issues is shown in Figure 35.

**Figure 35: Cases with clinical management issues by year**

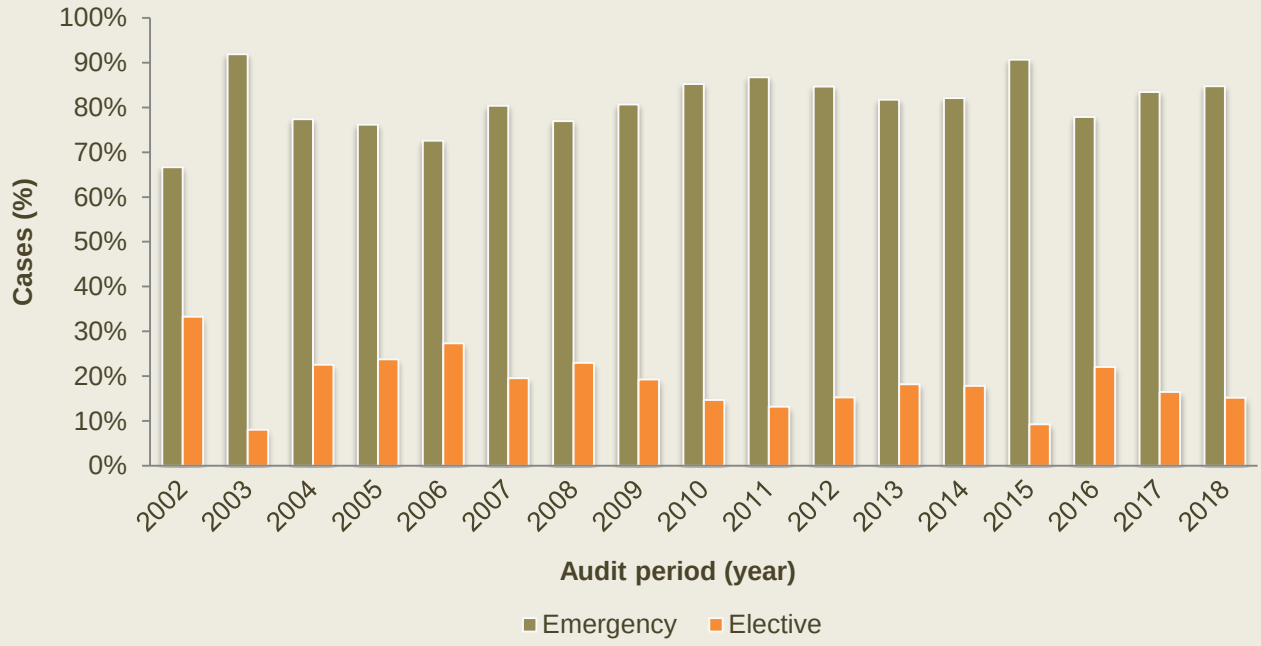



Refer to Appendix A, Table 37 for further information on data.

One or more clinical management issues occurred in 22.3% (1,808/8,106) of cases.

Overall, the majority of cases with clinical management issues were admitted as emergencies (80.4%; 1,092/1,359). Figure 36 shows this breakdown by year.

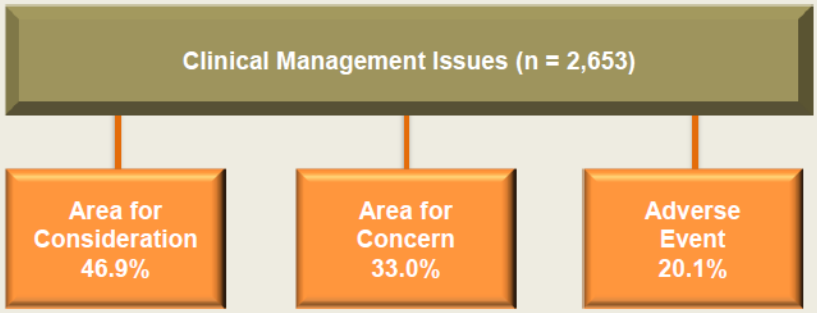
**Figure 36: Cases with clinical management issues by hospital admission**




Refer to Appendix A, Table 38 for further information on data.

Assessors may identify more than one clinical management issue for each patient. Figures 37 to 39 are based on the number of clinical management issues, **not** the number of patients.

**Figure 37: Categories of clinical management issues**

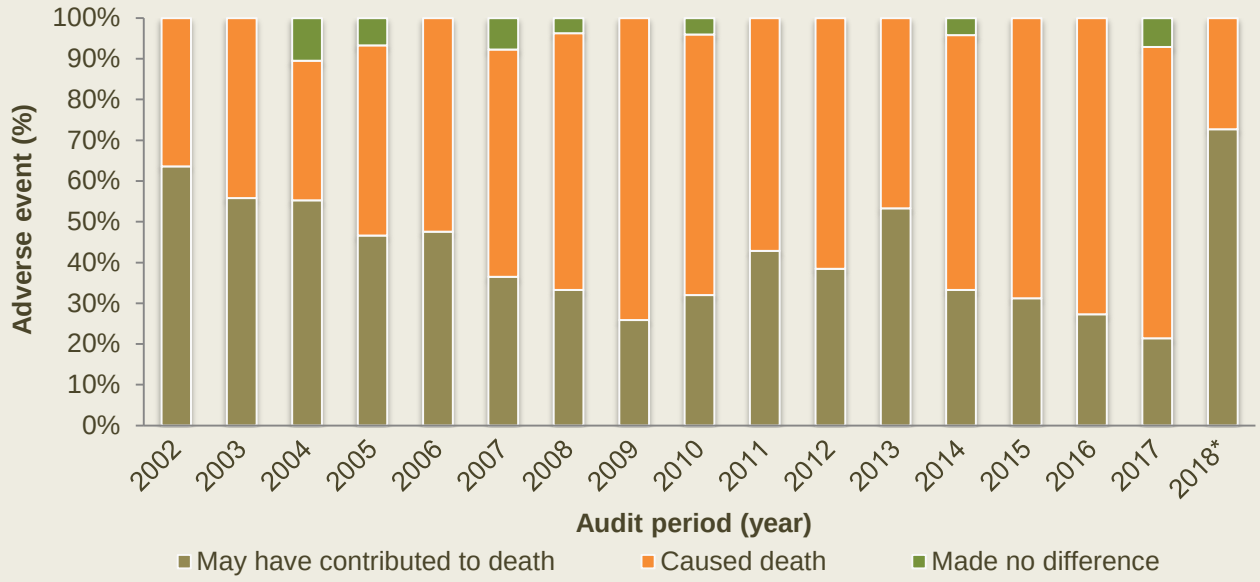



Refer to Appendix A, Table 39 for further information on data.

There were 2,653 clinical management issues identified in 1,808 completed cases (Figure 37).

When there is an adverse event, assessors are asked to indicate whether it contributed to or caused the death of a patient (Figure 38).

**Figure 38: Perceived impact of adverse events on clinical outcome**

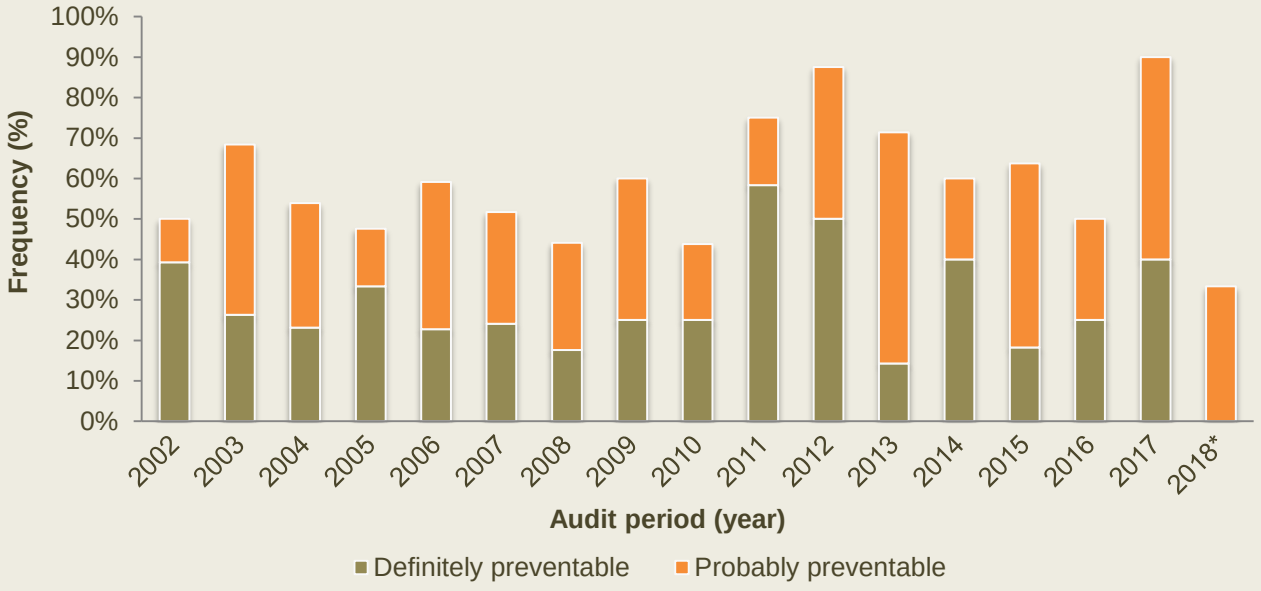



*Cases for 2018 are still being reviewed and this may change over time.
Refer to Appendix A, Table 40 for further information on data.

Overall, assessors perceived that 3.0% (16/528) of adverse events made no difference to the outcome, 44.7% (236/528) of adverse events may have contributed to death and 52.3% (276/528) caused the death of the patient.

Assessors also note whether any adverse events that caused the death of a patient were preventable (Figure 39).

**Figure 39: Perceived preventability of adverse events that caused death**



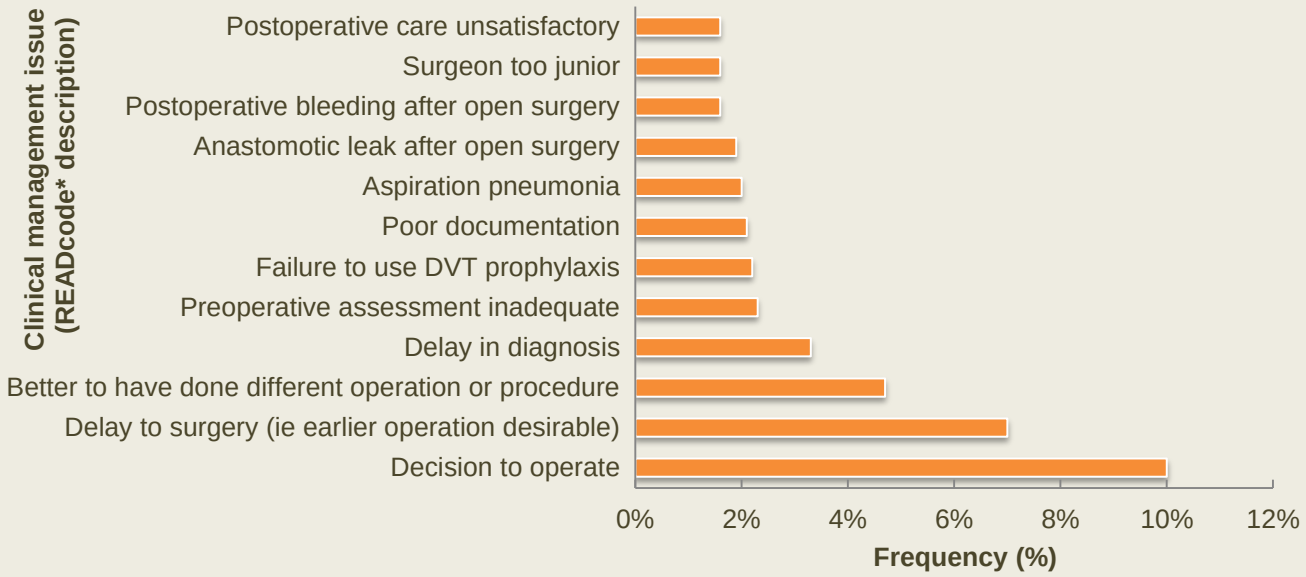

*Cases for 2018 are still being reviewed and this may change overtime.
Refer to Appendix A, Table 41 for further information on data.

Assessors indicated that 12.0% (33/276) of adverse events that caused the death of a patient were definitely not preventable and that 31.2% (86/276) were probably not preventable. Assessors considered that 28.3% (78/276) of adverse events that resulted in the death of a patient were probably preventable, and that 28.6% (79/276) were definitely preventable. In 2018, assessors indicated that there were three adverse events that caused the death of a patient. Assessors considered that two of these adverse events were probably not preventable and the other probably preventable.

## 5.3 Frequency of clinical management issues

The frequency of the 12 most common clinical management issues is shown in Figure 40.

**Figure 40: Frequency of clinical management issues**



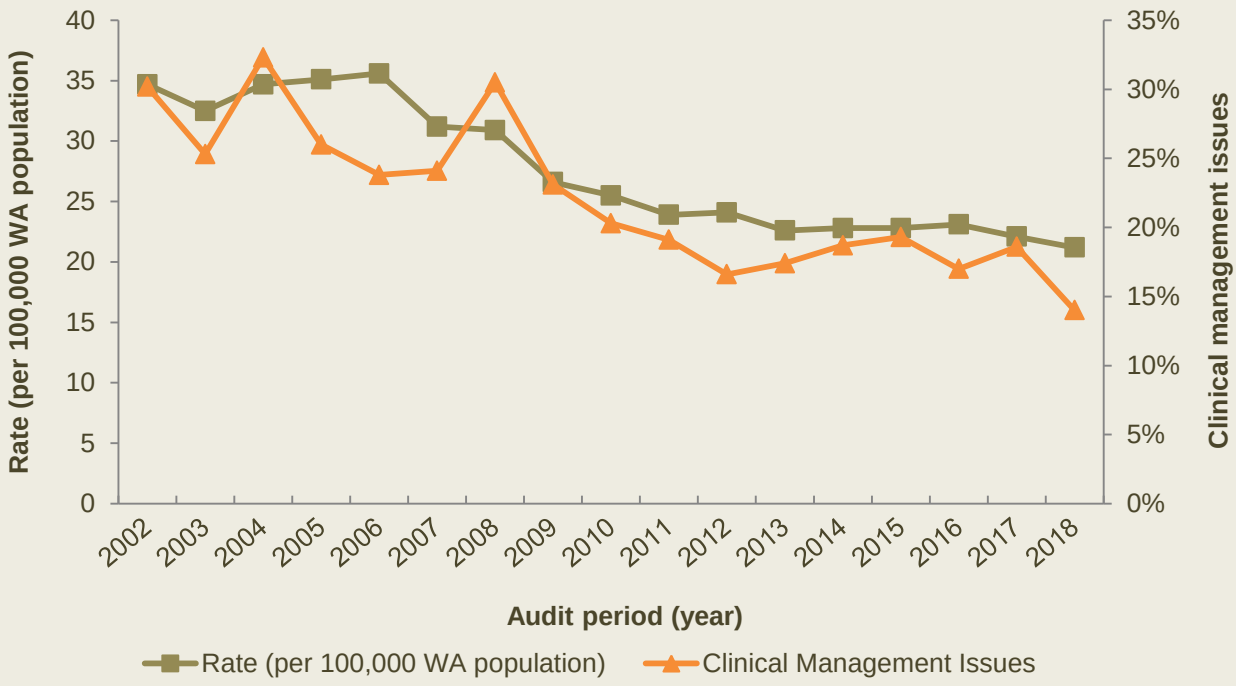

*READ Code: Surgical diagnoses categorised using coded thesaurus of clinical terms (READ Codes). READ Codes are a clinical decision tree that contains terms, synonyms, and abbreviations covering all aspects of patient care. It is a precursor to ICD9 coding.
Refer to Appendix A, Table 42 for further information on data.

'Decision to operate' and 'delay to surgery' were the two most frequent clinical management issues reported by assessors.

This section is key to the whole aim of the WAASM, which is to identify aspects of care that could be improved, to educate and so reduce suboptimal care.

The severity of any clinical management issue will vary, as will its impact. However, they are events that in the opinion of the assessor impacted on the patient in some way. The fewer of these, the better. The data shows that the proportion of surgical deaths reporting clinical management issues has progressively fallen (Figure 35). This will have contributed to the fall in the number of deaths (Figure 4). Figure 41 shows the association of the drop in clinical management issues with the decline in mortality.

**Figure 41: Association of clinical management issues with falling mortality**




Refer to Appendix A, Table 43 for further information on data.

The important question is whether the WAASM was responsible for this fall, or whether the audit merely records improved care due to other reasons. There is a high degree of concordance between the opinions of surgeons and assessors [4], as well as between assessors. So this observation is almost certainly a true reflection of a change in practice and not related to any change in the assessment process. This suggests that the WAASM has been a major contributor to the fall in deaths.

# 6. CLOSER LOOK: DECISION TO OPERATE

## 6.1 Decision to operate by treating surgeon and assessor

Surgeons often comment that, with hindsight, the patient should not have been offered surgery. The SCF and the assessment form specifically consider where the patient's management could have been improved and one option is 'decision to operate at all'.

Figure 42 gives the breakdown by year of both the treating surgeon and assessor responses on the decision to operate on a patient, acknowledging that on reconsideration an operation should probably not have been performed.

**Figure 42: Decision to operate by treating surgeon/assessor by year**


Refer to Appendix A, Table 44 for further information on data.

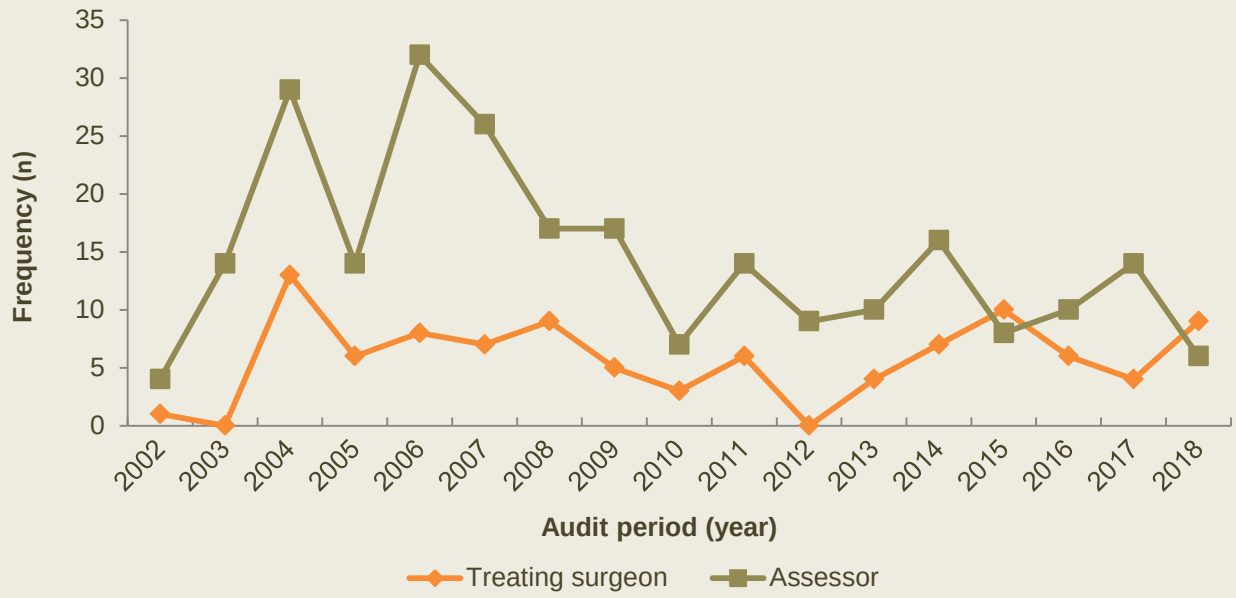
Overall, the treating surgeon felt an operation should probably not have occurred in 6.7% (316/4,706) of cases. In 6.5% (209/3,221) of cases, the assessors agreed that the decision to operate was probably not the right one. There appears to be a strong concordance between treating surgeons and assessors regarding the 'decision to operate'.

## 6.2 'Decision to operate' as a clinical management issue

In the SCF and assessment form, both the treating surgeon and assessor are asked to state if there were any issues in the management of the patient. In a number of instances, either/both the treating surgeon and assessor stated 'decision to operate' was a clinical management issue.

Figure 43 shows the counts by year where the treating surgeon and assessor stated ‘decision to operate’ was a clinical management issue.

**Figure 43: ‘Decision to operate’ as a clinical management issue identified by treating surgeon/assessor**




Refer to Appendix A, Table 45 for further information on data.

Overall, ‘decision to operate’ as a clinical management issue identified by assessors was greater than that from the treating surgeons.

The decision to operate, or not, is becoming of greater importance as the population ages. The issue of ‘futile’ surgery was included in the WAASM’s 2004 Report [19] and was the subject of its symposium in 2016. Traditionally, this has not been managed well at any level. Patients do not express nor document their wishes, relatives have unrealistic expectations as to what can be achieved, and doctors do not clearly explain the limitations of treatment.

This is changing, and great attention is being directed to the patient’s end-of-life wishes and documentation of ‘Goals of Care’. It is also clear that many patients value quality of life above quantity of life. Care of elderly, comorbid patients is often very expensive and frequently results in only a small extension of life, which is often of poor quality.

There is increasing evidence that a major determinant of outcome is preoperative frailty [20]. The majority of patients where an operation was not deemed appropriate were admitted as emergencies.

## 7. PERFORMANCE REVIEW

This section reviews progress relating to each of the recommendations in the 2018 WAASM Report.

### Audit management

***Through the Royal Australasian College of Surgeons (RACS) WA Regional Office, continue to increase the profile of the WAASM through regular correspondence in the Regional Office quarterly newsletter distributed to all WA surgeons.***

The WAASM contributed to each 2018 quarterly newsletter produced by the RACS WA Regional Office. This has provided a valuable opportunity to distribute information on audit activities to all WA surgeons.

***Continue to promote the mandatory use of the Fellows Interface (online platform) for completion and submission of surgical case forms (SCFs) and first-line assessments (FLAs).***

The WAASM continues to widely promote the mandatory use of the Fellows Interface and this has now become a well-accepted component of the audit. New participants are provided with extensive information packages in relation to the use of the online platform and the WAASM staff offer support and assistance to individual surgeons at all stages of the audit process.

***Facilitate the Australian and New Zealand Audit of Surgical Mortality (ANZASM) processes to develop and test ongoing enhancements to the Fellows Interface, Delegates Interface and the Bi-national Audit System. These improvements include: a redesigned new look to both the Fellows Interface and Delegates Interface; ongoing security updates to the Fellows Interface, Delegates Interface and Bi-national Audit System; and mandatory completion of all questions on the SCFs.***

Throughout 2018, the WAASM continued to undertake thorough and extensive user acceptance testing in order to facilitate ongoing improvements to both the Fellows Interface and the Bi-national Audit System. This has also incorporated enhancements to the Delegates Interface to better accommodate completion of SCFs by registrars and surgical trainees.

***Maintain the high return rate of SCFs (98.0%; 580/592) set in 2016.***

Of the 568 deaths in 2017 falling within the WAASM criteria, SCFs were returned for 562 cases – a return rate of 98.9%. This reflects an increase from the 2016 return rate of 98.0%.

### Research and reporting on audit data

***Undertake longitudinal analysis of key data, such as transfers, and compare WA with other states.***

In examining data over a period of 17 years, the WAASM 2019 Report provides longitudinal analyses of a range of key issues, including transfers. Comparison with national data has been restricted by the unavailability of some state-specific data.

***Study in detail cases returned as terminal care cases and review their management.***

Throughout 2018, in instances where a relatively high number of terminal care cases were received from an individual treating surgeon, these were brought to the attention of the WAASM Clinical Director. Upon scrutiny of the medical records, where case details suggested that patient treatment went beyond terminal care, the SCF was returned to the treating surgeon for detailed completion.

***Collaborate with the Patient Safety Surveillance Unit, WA Department of Health, to produce and distribute a combined hospital report incorporating the hospital performance summary report, identifying trends in clinical management issues and comparing each hospital with like-state and like-national hospitals.***

Following extensive discussions with both the Patient Safety Surveillance Unit and other ANZASM regions, a combined hospital report has now been developed which encompasses both the identification of trends in clinical

management issues and comparisons at both state and national levels. This new report format is scheduled for production and distribution from 2019.

***Continue to progress the joint initiative between the WAASM and the University of Western Australia (UWA), which aims to utilise the ANZASM data to examine the impact of process and regulatory changes on the quality of audit data.***

With the ANZASM's transition from paper to electronic SCFs in 2012, this retrospective study examined SCF data collected between 2013 and 2015 to determine if the move was associated with a change in the amount of written text provided in open-ended questions. Objective fields (admission and surgical diagnoses) and subjective fields (course to death and operation narrative) were compared for both paper and electronic records.

After controlling for specialty, risk of death, ASA score and comorbidities, the results indicated that there was no difference between these mediums for the shorter objective fields. However, there was significantly more text in the electronic SCFs for the subjective fields, particularly where an adverse event was identified. This suggests that surgeon responses were more expansive and reflective in the subjective components of the SCF when using the electronic platform.

## Clinical management

***Monitor and report trends observed in the proportion of surgical patients who die from clinically significant infections for an additional year. Between 2013 and 2017, clinically significant infections were reported in 31.7% (736/2,320) of cases. Pre-admission infections comprised 46.1% (330/716) and infections acquired during the admission were reported for 53.9% (386/716) of cases with infections.***

Between 2013 and 2018, clinically significant infections were reported in 31.2% (872/2,791) of cases, a small decrease since data collection commenced in 2013. Pre-admission infections comprised 47.3% (403/852) of these, reflecting an increase of 1.6%. Infections acquired during the admission were reported for 52.7% (449/852) of cases, representing a 1.6% decrease since 2013.

Over the last three reporting periods, the overall reduction in clinically significant infections has been consistent, as has the fall in infections acquired during admission. Please see Appendix B for a breakdown of the data.

***Monitor trends in communication issues observed at any stage of treatment in cases of surgical mortality for the next three years.***

A preliminary examination of reported communication issues between 2014 and 2018 shows some variation between years with no clear trend. Please see Appendix B for a breakdown of the data. Trends in communication issues will continue to be monitored over the next two reporting periods.

## Education

***Disseminate audit findings through reports and publications.***

The *WAASM 2018 Case Note Review* booklet, with an accompanying WAASM newsletter, was distributed electronically to all WA surgeons on 18 July 2018. An electronic link to the ANZASM National Case Note Review booklet was also circulated. The booklet incorporated a range of themes, which included preoperative assessment prior to joint replacement surgery, delays, and non-surgical interventions.

The *WAASM 2018 Report* was released on 8 October 2018. This was accompanied by a RACS media release highlighting the 3.1% overall relative decrease in the rate of deaths per 100,000 population over the 5 year reporting period, as well as noting the rising trend in inter-hospital transfers. A link to the report was emailed to all WA surgeons on this date. An article relating to the report was published in *The West Australian* on 9 October 2018.

The *2018 Hospital Reports* for public and private hospitals were distributed to Health Service Providers and Hospital Executives in April and May 2018 respectively. These reports provided a comparative analysis of WAASM cases with like state and national hospitals from the Australian Institute of Health and Welfare peer group classification. They are released annually to hospitals that have three or more operating surgeons and where there have been five or more deaths where the audit process has been completed.

The *2018 Hospital Performance Summary Reports* for public and private hospitals were distributed to hospitals in November 2018. These reports reflected individual hospital performance relating to potentially preventable clinical management issues.

The *WAASM Case of the Month* was introduced in September 2018. This is distributed by email to all WA surgeons in the first week of each month, with the intention of covering a range of surgical specialties over time. The cases are a source of valuable and constructive discussion.

The WAASM contributed two articles to the RACS *Surgical News* during 2018. The first, entitled 'WAASM 2017 Report Highlights', appeared in the March edition. The second, entitled 'The Wind of Change', was included in the August edition of the publication.

***Collate, analyse and produce a report on the Peer Review Feedback Evaluation Forms received from WA surgeons, where cases have gone on for a second-line assessment (SLA) or an FLA with identified clinical management issues.***

In February 2018, the WAASM commenced using a *'Peer Review Feedback Evaluation Form'*. This form is attached to feedback letters for all cases that progress to an SLA and those cases closed at the FLA stage where a clinical management issue is identified by the assessor. The form provides treating surgeons with the opportunity to give their opinion on the peer reviews undertaken on their cases. Updates regarding the data collected are regularly provided at the WAASM Quarterly and Management Committee meetings.

Between 1 February and 31 December 2018, 122 evaluation forms were sent out to WA surgeons. Of these, 41 were completed and returned to the WAASM (a return rate of 33.6%). The data showed that 78.0% (32/41) of respondents agreed or strongly agreed that the peer review was fair; 73.2% (30/41) agreed or strongly agreed that the peer review was informative; and 73.2% (30/41) agreed or strongly agreed that the peer review was a good source of information to improve care.

## 8. ACKNOWLEDGEMENTS

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- second-line assessors
- hospital medical records departments
- WA Department of Health for funding the project
- Patient Safety Surveillance Unit, Clinical Excellence Division, at the WA Department of Health for their continual commitment to, and support of, the WAASM
- RACS for their infrastructure and oversight of this project
- ANZASM Steering Committee
- Dr Katherine Broughton

- **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 |
| Dr Jennifer Bruce | Consultant Anaesthetist, anaesthetic representative |
| Mr Gregory Janes | Consultant Orthopaedic Surgeon, orthopaedic representative |

- **WAASM staff:**

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| Dr Franca Itotoh | WAASM Project Manager |
| Ms Natalie Zorbas | WAASM Senior Project Officer |
| Ms Sonya Furneyvall | WAASM Project Officer |

- **RACS, Division of RAAS staff, particularly:**

| | |
|---|---|
| Professor Guy Maddern | Chair, ANZASM Steering Committee |
| A/Prof Wendy Babidge | General Manager, RAAS |
| Dr Helena Kopunic | Surgical Audit Manager |

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## APPENDIX A: DATA DEFINITIONS

(n = number; d = denominator; % = percentage)

| *Table 1: Deaths falling within WAASM criteria* | |
|---|---|
| **Definition** | Counts of deaths reported to the WAASM. *Not audited* cases comprised 'excluded error', 'lost to follow-up' and 'closed non-participant'. *Audited* cases comprised 'finalised' [all cases which have completed the entire audit process and terminal care cases] and 'in progress' [all 'surgical case pending', first-line assessment pending', and 'second-line assessment pending'] cases. |
| **Data included** | All data collected between 2002 and 2018. |
| **Data excluded** | No exclusions. |

| *Table 2: Deaths reported to WAASM* | |
|---|---|
| **Definition** | Counts of deaths reported to the WAASM. |
| **Data included** | All data collected between 2002 and 2018. Total number of deaths reported to WAASM, including 'excluded error' and 'closed non-participant' cases. |
| **Data excluded** | No exclusions. |

| *Table 3: Surgical deaths per 100,000 WA population* | | | |
|---|---|---|---|
| **Definition** | Counts of deaths falling within WAASM criteria per year as a function of surgical mortality rates per 100,000 WA population. | | |
| **Data included** | All deaths falling within WAASM criteria. Population data compiled from the Australian Bureau of Statistics. Population data is only available for up until September 2018. | | |
| **Data excluded** | All 'excluded error' cases. | | |
| **Rate (per 100,000 WA population) (n)** | | | |
| **2002** 34.7 | **2003** 32.5 | **2004** 34.7 | **2005** 35.1 |
| **2006** 35.6 | **2007** 31.2 | **2008** 30.9 | **2009** 26.6 |
| **2010** 25.5 | **2011** 23.9 | **2012** 24.1 | **2013** 22.6 |
| **2014** 22.8 | **2015** 22.8 | **2016** 23.1 | **2017** 22.0 |
| **2018** 21.2 | | | |

| *Table 4: Most common causes of death* | |
|---|---|
| **Definition** | Percentages of the five most common causes of death. |
| **Data included** | All deaths falling within WAASM criteria. Some cases had more than one cause of death reported (n=11,757). |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. |
| **Cause of death in READ Code description (n/%)** | |
| **Pneumonia due to unspecified organism** 419/3.6 | **Respiratory failure** 535/4.6 |
| **Acute myocardial infarction** 562/4.8 | **Septicaemia** 875/7.4 |
| **Multiple organ failure** 1,037/8.8 | |

| *Table 5: Audit case status* | | | |
|---|---|---|---|
| **Definition** | Deaths falling within WAASM criteria and audit case status. *Audit process complete* comprised all cases which have completed the entire audit process. *Pending cases* comprised 'surgical case pending', 'first-line assessment pending', and 'second-line assessment pending'. *Excluded cases* comprised 'closed non-participant', 'excluded terminal care' and 'lost to follow-up'. | | |
| **Data included** | All deaths falling within WAASM criteria (n=10,597). | | |
| **Data excluded** | All 'excluded error' cases. | | |
| **Audit process complete (n/%); Pending cases (n/%); Excluded cases (n/%)** | | | |
| **2002** 410/61.0; 0/0; 262/39.0 | **2003** 383/59.9; 0/0; 256/40.1 | **2004** 470/67.9; 0/0; 222/32.1 | **2005** 524/73.5; 0/0; 189/26.5 |
| **2006** 597/80.7; 0/0; 143/19.3/ | **2007** 536/80.4; 0/0; 131/19.6 | **2008** 573/84.0; 0/0; 109/16.0 | **2009** 463/76.96; 0/0; 139/23.1 |
| **2010** 419/70.1; 0/0; 173/29.2 | **2011** 429/75.3; 0/0; 141/24.7 | **2012** 457/77.2; 0/0; 135/22.8 | **2013** 494/87.3; 0/0; 72/12.7 |
| **2014** 536/92.7; 0/0; 42/7.3 | **2015** 486/83.6; 0/0; 95/16.4 | **2016** 505/85.4; 0/0; 86/14.6 | **2017** 467/82.2; 12/2.1; 89/15.7 |
| **2018** 357/64.7; 123/22.3; 72/13.0 | | | |

| *Table 6: Second-line assessments* | |
|---|---|
| **Definition** | Counts and percentages of cases referred to second-line assessments. |
| **Data included** | All deaths falling within WAASM criteria where the first-line assessor recommended an SLA. |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded-terminal care' and 'lost to follow-up' cases. |

| *Table 7: Deaths by hospital status by year* | | | |
|---|---|---|---|
| **Definition** | Percentages of all cases by hospital status. Co-location comprised hospitals with both public and private health services in the same location. | | |
| **Data included** | All deaths falling within WAASM criteria where hospital status was reported (n=8,129). | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. Data missing = 75. | | |
| **Public (n/%); Private (n/%); Co-location (n/%)** | | | |
| **2002** 325/79.3; 85/20.7; 0/0 | **2003** 293/76.5; 89/23.2; 1/0.3 | **2004** 353/75.1; 106/22.6; 11/2.3 | **2005** 423/80.7; 88/16.8; 13/2.5 |
| **2006** 501/84.2; 79/13.3; 15/2.5 | **2007** 439/81.9; 78/14.6; 19/3.5 | **2008** 438/76.6; 106/18.5; 28/4.9 | **2009** 384/82.9; 56/12.1; 23/5.0 |
| **2010** 364/87.3; 35/8.4; 18/4.3 | **2011** 347/82.0; 48/11.3; 28/6.6 | **2012** 368/84.2; 46/10.5; 23/5.3 | **2013** 375/82.2; 55/12.1; 26/5.7 |
| **2014** 460/85.8; 57/10.6; 19/3.5 | **2015** 401/82.5; 62/12.8; 23/4.7 | **2016** 404/81.0; 66/13.2; 29/5.8 | **2017** 385/80.5; 55/11.5; 38/8.0 |
| **2018** 354/79.7; 50/12.3; 40/9.0 | | | |

| *Table 8: Hospital admission by year* | | | |
|---|---|---|---|
| **Definition** | Percentages of cases by hospital admission by year. | | |
| **Data included** | All deaths falling within WAASM criteria where admission type was reported (n=8,088). | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. Data missing = 116. | | |
| **Emergency (n/%); Elective (n/%)** | | | |
| **2002** 299/73.1; 110/26.9 | **2003** 305/79.6; 78/20.4 | **2004** 382/81.4; 87/18.6 | **2005** 425/81.4; 97/18.6 |
| **2006** 499/84.7; 90/15.3 | **2007** 428/82.0; 94/18.0 | **2008** 451/80.8; 107/19.2 | **2009** 376/84.3; 70/15.7 |
| **2010** 357/87.1; 53/12.9 | **2011** 361/85.7; 60/14.3 | **2012** 390/80.1; 63/13.9 | **2013** 414/85.7; 69/14.3 |
| **2014** 454/86.5; 71/13.5 | **2015** 411/85.4; 70/14.6 | **2016** 421/84.4; 78/15.6 | **2017** 412/86.7; 63/13.3 |
| **2018** 374/84.4; 69/15.6 | | | |

| *Table 9: Surgical case form returns by year* | | | |
|---|---|---|---|
| **Definition** | Percentages of SCFs returned by year. | | |
| **Data included** | All deaths falling within the WAASM criteria (n=10,597). | | |
| **Data excluded** | All 'excluded error' cases. | | |
| **Surgical case form returns (n/%)** | | | |
| **2002** 415/61.8 | **2003** 392/61.3 | **2004** 486/70.2 | **2005** 552/77.4 |
| **2006** 621/83.9 | **2007** 559/83.8 | **2008** 589/86.4 | **2009** 479/79.6 |
| **2010** 447/75.5 | **2011** 447/78.4 | **2012** 475/80.2 | **2013** 520/91.9 |
| **2014** 565/97.8 | **2015** 572/98.5 | **2016** 586/99.2 | **2017** 562/98.9 |
| **2018** 516/93.5 | | | |

| *Table 10: Deaths falling within WAASM criteria by specialty* | |
|---|---|
| **Definition** | Counts and percentages of surgical mortality data in relation to surgeon specialty. |
| **Data included** | All deaths falling within WAASM criteria. |
| **Data excluded** | All 'excluded error' cases. |

| *Table 11: Deaths by surgical specialty and hospital admission* | |
|---|---|
| **Definition** | Percentages of surgical mortality data in relation to surgeon specialty and hospital admission. |
| **Data included** | All deaths falling within the WAASM criteria. |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. Data missing = 117. |

| Emergency (n/%); Elective (n/%) | |
|---|---|
| **General Surgery** 2,763/85.1; 485/14.9 | **Orthopaedic Surgery** 1,448/92.6; 115/7.4 |
| **Neurosurgery** 1,172/93.6; 80/6.4 | **Vascular Surgery** 613/75.9; 195/24.1 |
| **Cardiothoracic Surgery** 372/59.3; 255/40.7 | **Urology** 190/63.5; 109/36.5 |
| **Plastic Surgery** 107/76.4; 33/23.6 | **Otolaryngology Head & Neck Surgery** 61/63.5; 35/36.5 |
| **Obstetrics & Gynaecology** 5/27.8; 13/72.2 | **Paediatric Surgery** 21/91.3; 2/8.7 |
| **Ophthalmology** 5/45.5; 6/54.5 | **Oral & Maxillofacial Surgery** 1/50.0; 1/50.0 |

| *Table 12: Deaths by age group and gender* | | | |
|---|---|---|---|
| **Definition** | Counts of deaths by age groups and gender. | | |
| **Data included** | All deaths falling within the WAASM criteria (n=10,597). | | |
| **Data excluded** | All 'excluded error' cases. | | |
| Male (n); Female (n) | | | |
| **<31** 291; 113 | **31-40** 159; 85 | **41-50** 290; 212 | **51-60** 488; 342 |
| **61-70** 923; 551 | **71-80** 1,610; 1,097 | **81-90** 1,599; 1,711 | **>91** 437; 689 |

| *Table 13: Cases with specific comorbidities* | | | |
|---|---|---|---|
| **Definition** | Percentages of cases with comorbidities. | | |
| **Data included** | All deaths falling within the WAASM criteria where comorbidities were reported (n=7,446). | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where no comorbidities were reported. Data missing = 758. | | |
| Cases (%) | | | |
| **Hepatic** 6.7 | **Obesity** 6.8 | **Advanced malignancy** 12.0 | **Diabetes** 15.6 |
| **Neurological** 18.4 | **Other** 18.7 | **Renal** 25.7 | **Respiratory** 33.3 |
| **Age** 50.6 | **Cardiovascular** 61.3 | | |

| *Table 14: Specific comorbidities by hospital admission* | | |
|---|---|---|
| **Definition** | Percentages of comorbidities by hospital admission. | |
| **Data included** | All deaths falling within the WAASM criteria where the different comorbidities were listed (n=18,365). | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where no comorbidities were reported. Data missing = 166. | |
| Emergency (n/%); Elective (n/%) | | |
| **Neurological** 1,215/89.4; 144/10.6 | **Hepatic** 428/86.1; 69/13.9 | **Age** 3,180/85.4; 544/14.6 |
| **Respiratory** 2,064/84.3; 385/15.7 | **Renal** 1,593/84.1; 302/15.9 | **Other** 1,142/82.9; 235/17.1 |
| **Cardiovascular** 3,730/82.5; 792/17.5 | **Advanced malignancy** 703/79.3; 184/20.7 | **Diabetes** 911/79.1; 240/20.9 |
| **Obesity** 378/75.0; 126/25.0 | | |

| Table 15: Obesity as a comorbidity by hospital admission by year | | | |
|---|---|---|---|
| **Definition** | Counts of obesity as a comorbidity by hospital admission by year. | | |
| **Data included** | All deaths falling within the WAASM criteria where obesity was reported as a comorbidity (n = 506) | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', surgical case pending', 'excluded terminal care' and lost to follow-up' cases. All cases where obesity as comorbidity was not reported. Missing data = 2. | | |
| **Emergency (n); Elective (n)** | | | |
| **2002** 9; 1 | **2003** 11; 6 | **2004** 20; 5 | **2005** 21; 13 |
| **2006** 24; 9 | **2007** 20; 8 | **2008** 21; 12 | **2009** 26; 4 |
| **2010** 18; 5 | **2011** 19; 6 | **2012** 18; 5 | **2013** 23; 12 |
| **2014** 34; 10 | **2015** 24; 8 | **2016** 28; 7 | **2017** 34; 7 |
| **2018** 28; 8 | | | |

| Table 16: ASA grade and 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 |

| Table 17: Hospital transfers by hospital admission by year | | | |
|---|---|---|---|
| **Definition** | Counts of hospital transfers by hospital admission by year. | | |
| **Data included** | All deaths falling within the WAASM criteria where emergency (n=1,894) and elective (n=85) transfers were reported. | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where transfer was not reported. Data missing = 15. | | |
| **Emergency (n); Elective (n)** | | | |
| **2002** 84; 9 | **2003** 92; 125 | **2004** 104; 6 | **2005** 104; 2 |
| **2006** 121; 7 | **2007** 98; 5 | **2008** 122; 9 | **2009** 95; 4 |
| **2010** 94; 4 | **2011** 91; 3 | **2012** 93; 4 | **2013** 101; 3 |
| **2014** 148; 3 | **2015** 136; 5 | **2016** 139; 4 | **2017** 130; 1 |
| **2018** 142; 4 | | | |

| Table 18: Preoperative diagnostic delays | |
|---|---|
| **Definition** | Percentages and counts of cases with preoperative diagnostic delays. |
| **Data included** | All deaths falling within the WAASM criteria where preoperative diagnostic delays were reported (n=7,177). |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where no preoperative diagnostic delays were reported. |

| Table 19: Cases with fluid balance issues | | | | |
|---|---|---|---|---|
| **Definition** | Counts of cases with fluid balance issues by year. | | | |
| **Data included** | All deaths falling within WAASM criteria where fluid balance issues were reported (n=381). | | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where fluid balance issues were not reported. | | | |
| **Issues (n)** | | | | |
| **2003** 9 | **2004** 35 | **2005** 34 | **2006** 34 | **2007** 36 |
| **2008** 33 | **2009** 17 | **2010** 17 | **2011** 16 | **2012** 20 |
| **2013** 16 | **2014** 27 | **2015** 31 | **2016** 21 | **2017** 26 |
| **2018** 9 | | | | |

| *Table 20: Fluid balance issues by specialty and hospital admission* | |
|---|---|
| **Definition** | Counts of cases with fluid balance issues by specialty and hospital admission. |
| **Data included** | All deaths falling within WAASM criteria where fluid balance issues were reported (n=376). |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where fluid balance issues were not reported. Data missing = 5. |

| | **Emergency (n); Elective (n)** |
|---|---|
| **Cardiothoracic Surgery** 5; 6 | **General Surgery** 93; 30 |
| **Neurosurgery** 11; 1 | **Obstetrics & Gynaecology** 0; 2 |
| **Orthopaedic Surgery** 139; 9 | **Otolaryngology Head & Neck** 1; 3 |
| **Paediatric Surgery** 2; 0 | **Plastic Surgery** 10; 5 |
| **Urology** 15; 7 | **Vascular Surgery** 33; 4 |

| *Table 21: DVT prophylaxis by specialty* | |
|---|---|
| **Definition** | Percentages of DVT prophylaxis use/non-use by specialty. |
| **Data included** | All deaths falling within WAASM criteria where use (n=5,526) and non-use (n=1,745) of DVT prophylaxis was reported. |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. Data missing = 933. |

| | **DVT prophylaxis used (n/%); DVT prophylaxis not used (n/%)** |
|---|---|
| **Cardiothoracic Surgery** 557/89.8; 63/10.2 | **General Surgery** 2,396; 759/24.1 |
| **Neurosurgery** 368/62.2; 224/37.8 | **Obstetrics & Gynaecology** 18/94.7; 1/5.3 |
| **Ophthalmology** 3/30.0; 7/70.0 | **Oral/Maxillofacial Surgery** 1/100; 0/0 |
| **Orthopaedic Surgery** 1,244/80.3; 305/19.7 | **Otolaryngology Head & Neck** 58/65.2; 31/34.8 |
| **Paediatric Surgery** 1/4.3; 22/95.7 | **Plastic Surgery** 71/53.8; 61/46.2 |
| **Urology** 192/66.4; 97/33.6 | **Vascular Surgery** 617/77.9; 175/22.1 |

| *Table 22: Reasons for not using DVT prophylaxis* | | | |
|---|---|---|---|
| **Definition** | Percentages of non-use of DVT prophylaxis. | | |
| **Data included** | All deaths falling within WAASM criteria where non-use (n=1,527) of DVT prophylaxis was reported. | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where use of DVT prophylaxis was reported. Data missing = 218. | | |
| **Not appropriate (n/%); Active decision to withhold (n/%); Not considered (n/%)** | | | |
| **2002** 94/69.1; 38/27.9; 4/2.9 | **2003** 71/59.2; 40/33.3; 9/7.5 | **2004** 98/78.4; 23/18.4; 4/3.2 | **2005** 86/81.9; 17/16.2; 2/1.9 |
| **2006** 50/65.8; 23/30.3; 3/3.9 | **2007** 71/80.7; 15/17.0; 2/2.3 | **2008** 62/73.8; 20/23.8; 2/2.4 | **2009** 52/75.4; 12/17.4; 5/7.2 |
| **2010** 46/73.0; 17/27.0; 0/0 | **2011** 47/67.1; 23/32.9; 0/0 | **2012** 41/70.7; 16/27.6; 1/1.7 | **2013** 68/70.8; 27/28.1; 1/1.0 |
| **2014** 70/70.7; 27/27.3; 2/2.0 | **2015** 51/68.0; 20/26.7; 4/5.3 | **2016** 49/66.2; 24/32.4; 1/1.4 | **2017** 67/69.8; 25/26.0; 4/4.2 |
| **2018** 52/55.9; 40/43.0; 1/1.1 | | | |

| *Table 23: Critical care units* | |
|---|---|
| **Definition** | Percentages of critical care units (intensive care and high dependency units) use/non-use by year. |
| **Data included** | All deaths falling within WAASM criteria where use (n=4,042) and non-use (n=2,951) of critical care units was reported. |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where use/non-use of critical care units was not reported. Data missing = 1,211. |

| CCUs used (n/%); CCUs not used (n/%) | | | |
|---|---|---|---|
| **2002** 189/50.5; 185/49.5 | **2003** 191/53.8; 164/46.2 | **2004** 238/58.3; 170/41.7 | **2005** 223/53.2; 196/46.8 |
| **2006** 248/56.1; 194/43.9 | **2007** 218/54.6; 181/45.4 | **2008** 244/57.3; 182/42.7 | **2009** 195/55.1; 159/44.9 |
| **2010** 178/54.4; 149/45.6 | **2011** 172/54.1; 146/45.9 | **2012** 172/53.6; 149/46.4 | **2013** 221/53.3; 194/46.7 |
| **2014** 341/64.3; 189/35.7 | **2015** 299/61.6; 186/38.4 | **2016** 327/65.1; 175/34.9 | **2017** 301/63.2; 175/36.8 |
| **2018** 285/64.5; 157/35.5 | | | |

| *Table 24: Critical care units by hospital admission* | |
|---|---|
| **Definition** | Percentages of critical care units (intensive care and high dependency units) use/non-use by hospital admission. |
| **Data included** | All deaths falling within WAASM criteria where use (n=4,017) and non-use (n=2,918) of critical care units was reported. |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where use/non-use of critical care units was not reported. Data missing = 1,269. |

| CCUs used (n/%); CCUs not used (n/%) | |
|---|---|
| **Emergency** 3,139/55.1; 2,556/44.9 | **Elective** 878/70.8; 362/29.2 |

| *Table 25: Operative and non-operative cases* | |
|---|---|
| **Definition** | Percentages of operative and non-operative cases. |
| **Data included** | All deaths falling within WAASM criteria where operative and non-operative status was reported (n=8,137). |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. Data missing = 67. |

| Operation (n/%); No operation (n/%) | | | |
|---|---|---|---|
| **2002** 332/81.0; 78/19.0 | **2003** 297/77.5; 86/22.5 | **2004** 356/76.1; 112/23.9 | **2005** 357/69.2; 159/30.8 |
| **2006** 429/73.3; 156/26.7 | **2007** 380/72.0; 148/28.0 | **2008** 387/68.6; 177/31.4 | **2009** 317/69.2; 141/30.8 |
| **2010** 262/63.6; 150/36.4 | **2011** 278/66.3; 141/33.7 | **2012** 276/60.8; 178/39.2 | **2013** 305/61.9; 188/38.1 |
| **2014** 357/66.6; 179/33.4 | **2015** 336/69.1; 150/30.9 | **2016** 355/70.6; 148/29.4 | **2017** 330/69.0; 148/31.0 |
| **2018** 305/68.7; 139/31.3 | | | |

| *Table 26: Operative and non-operative cases by specialty* | |
|---|---|
| **Definition** | Percentages of operative and non-operative cases by surgical specialty. |
| **Data included** | All deaths falling within WAASM criteria where operative and non-operative status was reported. |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. Data missing = 67. |

| Operation (n/%); No operation (n/%) | |
|---|---|
| **Cardiothoracic Surgery** 567/90.9; 57/9.1 | **General Surgery** 2,065/63.8; 1,171/36.3 |
| **Neurosurgery** 724/56.0; 569/44.0 | **Obstetrics & Gynaecology** 18/90.0; 2/10.0 |
| **Ophthalmology** 8/72.7; 3/27.3 | **Oral/Maxillofacial Surgery** 2/100; 0/0 |
| **Orthopaedic Surgery** 1,209/76.9; 364/23.1 | **Otolaryngology Head & Neck** 77/81.9; 17/18.1 |
| **Paediatric Surgery** 21/87.5; 3/12.5 | **Plastic Surgery** 111/78.2; 31/21.8 |
| **Urology** 238/78.5; 65/21.5 | **Vascular Surgery** 619/76.0; 196/24.0 |

| Table 27: Consultant surgeon involvement in operations | | | |
|---|---|---|---|
| **Definition** | Percentages of consultant surgeons making the decision to operate and operating by year. | | |
| **Data included** | All deaths falling within WAASM criteria where the number of operations performed was reported (n= 8,935). | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where an operation was not reported. No missing data. | | |
| **Consultant deciding (n/%); Consultant operating (n/%)** | | | |
| **2002** 397/67.6; 254/43.3 | **2003** 347/67.4; 215/41.7 | **2004** 396/72.1; 256/46.6 | **2005** 397/66.2; 252/42.0 |
| **2006** 462/66.1; 300/42.9 | **2007** 414/69.0; 279/46.5 | **2008** 444/68.2; 324/49.8 | **2009** 356/67.2; 253/47.7 |
| **2010** 317/64.4; 200/40.7 | **2011** 341/65.6; 362/50.4 | **2012** 299/67.2; 239/53.7 | **2013** 344/78.9; 254/58.3 |
| **2014** 468/91.4; 341/66.6 | **2015** 417/94.3; 297/67.2 | **2016** 418/89.9; 294/63.2 | **2017** 391/83.5; 292/62.4 |
| **2018** 393/92.7; 287/67.7 | | | |

| Table 28: Consultant surgeon decision to proceed to surgery by hospital admission | | | |
|---|---|---|---|
| **Definition** | Percentages of consultant surgeons making the decision to proceed to surgery by hospital admission distribution and year. | | |
| **Data included** | All deaths falling within WAASM criteria where the decision to proceed to surgery was made by the consultant surgeon (n= 6,543). | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where an operation was not reported. Data missing = 58. | | |
| **Emergency (n/%); Elective (n/%)** | | | |
| **2002** 252/63.6; 144/36.4 | **2003** 260/74.9; 87/25.1 | **2004** 298/75.3; 98/24.7 | **2005** 282/71.0; 115/29.0 |
| **2006** 344/75.3; 113/24.7 | **2007** 283/69.7; 123/30.3 | **2008** 308/70.5; 129/29.5 | **2009** 263/74.3; 91/25.7 |
| **2010** 251/80.2; 62/19.8 | **2011** 248/74.3; 86/25.7 | **2012** 224/74.9; 75/25.1 | **2013** 259/76.4; 80/23.6 |
| **2014** 366/79.4; 95/20.6 | **2015** 325/78.5; 89/21.5 | **2016** 317/76.6; 97/23.4 | **2017** 317/81.7; 71/18.3 |
| **2018** 295/75.4; 96/24.6 | | | |

| Table 29: Unplanned returns to operating theatre | | | |
|---|---|---|---|
| **Definition** | Percentages of unplanned returns to operating theatre. | | |
| **Data included** | All deaths falling within WAASM criteria where unplanned returns to theatre was reported (n= 4,636). | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All non-operative cases and all operative cases where an unplanned return to theatre was not reported. Data missing = 1,021. | | |
| **Yes (n/d/%)** | | | |
| **2003** 9/64/14.1 | **2004** 49/342/14.3 | **2005** 53/321/16.5 | **2006** 57/352/16.2 |
| **2007** 40/313/12.8 | **2008** 57/339/16.8 | **2009** 43/268/16.0 | **2010** 39/224/17.4 |
| **2011** 39/233/16.7 | **2012** 35/237/14.8 | **2013** 47/267/17.6 | **2014** 64/352/18.2 |
| **2015** 53/336/15.8 | **2016** 42/354/11.9 | **2017** 47/330/14.2 | **2018** 57/304/18.8 |

| Table 30: Postoperative complications by hospital admission by year | | | |
|---|---|---|---|
| **Definition** | Percentages of postoperative complications by hospital admission and year. It is possible for patients to have more than one postoperative complication. | | |
| **Data included** | All deaths falling within WAASM criteria where postoperative complications by hospital admission was reported (n= 1,897). | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All non-operative cases and all operative cases where postoperative complication was not reported. Data missing = 13. | | |
| **Emergency (n/d/%); Elective (n/d/%)** | | | |
| **2002** 76/225/33.8; 63/106/59.4 | **2003** 77/225/34.2; 30/72/41.7 | **2004** 78/274/28.5; 43/81/53.1 | **2005** 69/268/25.7; 52/88/59.1 |
| **2006** 93/343/27.1; 39/81/48.1 | **2007** 70/283/24.7; 57/88/64.8 | **2008** 79/283/27.9; 57/93/61.3 | **2009** 58/243/23.9; 45/66/68.2 |
| **2010** 70/205/34.1; 33/51/64.7 | **2011** 62/217/28.6; 22/55/40.0 | **2012** 48/220/21.8; 37/54/68.5 | **2013** 62/239/25.9; 36/60/60.0 |
| **2014** 86/286/30.1; 39/64/60.9 | **2015** 76/264/28.8; 41/69/59.4 | **2016** 61/278/21.9; 40/73/54.8 | **2017** 62/268/23.1; 31/59/52.5 |
| **2018** 68/240/28.3; 37/64/57.8 | | | |

| *Table 31: Non-operative cases by hospital admission by year* | | | |
|---|---|---|---|
| **Definition** | Counts of non-operative cases by hospital admission. | | |
| **Data included** | All deaths falling within WAASM criteria where no operation was reported. Emergency (n= 2,342) and elective (n=95). | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where an operation was reported. Data missing = 41. | | |
| **Emergency (n/%); Elective (n/%)** | | | |
| **2002** 74/94.9; 4/5.1 | **2003** 80/93.0; 6/7.0 | **2004** 108/96.4; 4/3.6 | **2005** 151/95.6; 7/4.4 |
| **2006** 146/95.1; 7/4.9 | **2007** 138/96.5; 5/3.5 | **2008** 160/92.5; 13/7.5 | **2009** 128/97.0; 4/3.0 |
| **2010** 145/98.6; 2/1.4 | **2011** 136/97.1; 4/2.9 | **2012** 167/94.9; 9/5.1 | **2013** 174/95.1; 9/4.9 |
| **2014** 168/96.0; 7/4.0 | **2015** 147/99.3; 1/0.7 | **2016** 142/97.3; 4/2.7 | **2017** 144/97.3; 4/2.7 |
| **2018** 134/96.4; 5/3.6 | | | |

| *Table 32: Reasons for not operating* | | |
|---|---|---|
| **Definition** | Percentages of cases with reasons for not operating. | |
| **Data included** | All deaths falling within WAASM criteria where reasons for no operation was reported. | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where an operation was reported. | |
| **Total number of non-operative cases (d); Active decision not to operate (n/%); Not a surgical problem (n/%);** | | |
| **Patient refused operation (n/%); Rapid death (n/%)** | | |
| **2002** 78; 43/55.1; 13/16.7; 13/16.7; 11/14.1 | **2003** 86; 39/45.3; 19/22.1; 7/8.1; 9/10.5 | **2004** 112; 49/43.8; 13/11.6; 7/6.3 ; 7/6.3 |
| **2005** 159; 61/38.4; 14/8.8; 13/8.2; 12/7.5 | **2006** 156; 64/41.0; 23/14.7; 7/4.5; 16/10.3 | **2007** 148; 62/41.9; 19/12.8; 4/2.7; 15/10.1 |
| **2008** 177; 92/52.0; 14/7.9; 8/4.5; 16/9.0 | **2009** 141; 54/38.3; 18/12.8; 13/9.2; 12/8.5 | **2010** 150; 54/36.0; 27/18.0; 8/5.3; 14/9.3 |
| **2011** 141; 55/39.0; 19/13.5; 13/9.2; 11/7.8 | **2012** 178; 82/46.1; 25/14.0; 16/9.0; 12/6.7 | **2013** 188; 87/46.3; 42/22.3; 21/11.2; 14/7.4 |
| **2014** 179; 89/49.7; 51/28.5;16/8.9; 16/8.9 | **2015** 150; 80/53.3; 37/24.7; 17/11.3; 18/12.0 | **2016** 147; 60/45.9; 47/31.8; 19/12.8; 24/16.2 |
| **2017** 148; 89/60.1; 40/27.0; 21/14.2; 27/18.2 | **2018** 139; 78/56.1; 44/31.7; 26/18.7; 17/12.2 | |

| *Table 33: Clinically significant infections 2013-2018* | |
|---|---|
| **Definition** | Percentages and counts of cases with clinically significant infections from 2013 to 2018. |
| **Data included** | All deaths falling within WAASM criteria where clinically significant infections was reported (n= 872). |
| **Data excluded** | All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where a clinically significant infection was not reported. Data missing = 20. |

| *Table 34: Type of clinically significant infections 2013-2018* | | |
|---|---|---|
| **Definition** | Percentages of type of clinically significant infection. | |
| **Data included** | All deaths falling within WAASM criteria where type of clinically significant infections was reported (n= 869). | |
| **Data excluded** | All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where a clinically significant infection was not reported. Data missing = 3. | |
| **Frequency (n/%)** | | |
| **Cranial/spinal** 5/0.6 | **Other source** 124/14.3 | **Intra-abdominal sepsis** 182/20.9 |
| **Septicaemia** 217/25.0 | **Pneumonia** 341/39.2 | |

| *Table 35: Assessor opinion on appropriateness of DVT prophylaxis decision* | |
|---|---|
| **Definition** | Percentages of appropriateness of DVT prophylaxis decision as reported by assessors. |
| **Data included** | All deaths falling within WAASM criteria using the highest level of assessment in completed cases where appropriateness of DVT prophylaxis decision was reported (n= 6,234). |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending',' excluded terminal care' and 'lost to follow-up' cases. All neurosurgery cases. Data missing = 557. |

| **Appropriate decision (n/%); Inappropriate decision (n/%); Decision unknown (n/%)** | | | |
|---|---|---|---|
| **2002** 338/88.9; 37/9.7; 5/1.3 | **2003** 350/95.6; 16/4.4; 0/0 | **2004** 383/95.3; 19/4.7; 0/0 | **2005** 386/93.7; 17/4.1; 9/2.2 |
| **2006** 410/96.2; 12/2.8; 4/0.9 | **2007** 360/97.3; 6/1.6; 4/1.1 | **2008** 368/92.2; 27/6.8; 4/1.0 | **2009** 274/92.3; 17/5.7; 6/2.0 |
| **2010** 282/93.1; 16/5.3; 5/1.7 | **2011** 282/93.1; 21/6.9; 0/0 | **2012** 294/92.5; 20/6.3; 4/1.3 | **2013** 327/84.9; 10/2.6; 48/12.5 |
| **2014** 367/86.6; 6/1.4; 51/12.0 | **2015** 347/90.1; 11/2.9; 27/7.0 | **2016** 367/89.1; 2/0.5; 43/10.4 | **2017** 353/93.1; 6/1.6; 20/5.3 |
| **2018** 241/88.3; 9/3.3; 23/8.4 | | | |

| *Table 36: Inappropriate DVT prophylaxis decision by specialty* | | |
|---|---|---|
| **Definition** | Counts of inappropriate use of DVT prophylaxis decision as reported by assessors by specialty. | |
| **Data included** | All deaths falling within WAASM criteria using the highest level of assessment in completed cases where inappropriate use of DVT prophylaxis decision was reported (n= 252). | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending',' excluded terminal care' and 'lost to follow-up' cases. All neurosurgery cases. No missing data. | |

| **Frequency (n/%)** | | |
|---|---|---|
| **Otolaryngology Head & Neck Surgery** 3/1.2 | **Plastic Surgery** 3/1.2 | **Urology** 10/4.0 |
| **Vascular Surgery** 12/4.8 | **Cardiothoracic Surgery** 23/9.1 | **Orthopaedic Surgery** 90/35.7 |
| **General Surgery** 111/44.0 | | |

| *Table 37: Cases with clinical management issues by year* | | | |
|---|---|---|---|
| **Definition** | Percentages of cases with clinical management issues as reported by assessors. | | |
| **Data included** | All deaths falling within WAASM criteria using the highest level of assessment in completed cases where clinical management issues was reported (n= 1,808). | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending',' excluded terminal care' and 'lost to follow-up' cases. All cases where clinical management issue was not reported. | | |

| **Cases (n/d/%)** | | | |
|---|---|---|---|
| **2002** 124/410/30.2 | **2003** 97/383/25.3 | **2004** 152/470/32.3 | **2005** 136/524/26.9 |
| **2006** 142/597/23.8 | **2007** 129/536/24.1 | **2008** 175/573/30.5 | **2009** 107/463/23.1 |
| **2010** 85/419/20.3 | **2011** 82/429/19.1 | **2012** 76/457/16.6 | **2013** 86/494/17.4 |
| **2014** 100/536/18.7 | **2015** 94/486/19.3 | **2016** 86/505/17.0 | **2017** 87/467/18.6 |
| **2018** 50/357/14.0 | | | |

| *Table 38: Cases with clinical management issues by hospital admission* | | | |
|---|---|---|---|
| **Definition** | Percentages of cases by hospital admission with clinical management issues as reported by assessors. | | |
| **Data included** | All deaths falling within WAASM criteria using the highest level of assessment in completed cases where clinical management issues was reported (n= 1,359). | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending',' excluded terminal care' and 'lost to follow-up' cases. All cases where clinical management issue was not reported. Data missing = 449. | | |

| **Emergency (n/%); Elective (n/%)** | | | |
|---|---|---|---|
| **2002** 56/66.7; 28/33.3 | **2003** 57/91.9; 5/8.1 | **2004** 82/77.4; 24/22.6 | **2005** 77/76.2; 24/23.8 |
| **2006** 69/72.6; 26/27.4 | **2007** 74/80.4; 18/19.6 | **2008** 104/77.0; 31/23.0 | **2009** 71/80.7; 17/19.3 |
| **2010** 58/85.3; 10/14.7 | **2011** 59/86.8; 9/13.2 | **2012** 50/84.7; 9/15.3 | **2013** 54/81.8; 12/18.2 |
| **2014** 55/82.1; 12/17.9 | **2015** 68/90.7; 7/9.3 | **2016** 53/77.9; 15/22.1 | **2017** 66/83.5; 13/16.5 |
| **2018** 39/84.8 ; 7/15.2 | | | |

| *Table 39: Categories of clinical management issues* | |
|---|---|
| **Definition** | Counts and percentages of categories of clinical management issues as reported by assessors. Based on the number of incidents of clinical management issues and not the number of patients. |
| **Data included** | All deaths falling within WAASM criteria using the highest level of assessment in completed cases where categories of clinical management issues was reported (n= 2,653). |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending',' excluded terminal care' and 'lost to follow-up' cases. All cases where clinical management issue was not reported. Data missing = 20. |

| *Table 40: Perceived impact of adverse events on clinical outcome* | | | |
|---|---|---|---|
| **Definition** | Percentages of perceived impact of adverse events as reported by assessors. Based on the number of incidents of clinical management issues and not the number of patients. | | |
| **Data included** | All deaths falling within WAASM criteria using the highest level of assessment in completed cases where the perceived impact of adverse events was reported (n= 528). | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending',' excluded terminal care' and 'lost to follow-up' cases. All cases where clinical management issue was not reported. All cases where 'areas for consideration' and 'areas for concern' was reported. Data missing = 5. | | |
| **Made no difference (n/%); May have contributed to death (n/%); Caused death (n/%)** | | | |
| **2002** 0/0; 49/63.6; 28/36.4 | **2003** 0/0; 24/55.8; 19/44.2 | **2004** 4/10.5; 21/55.3; 13/34.2 | **2005** 3/6.7; 21/46.7; 21/46.7 |
| **2006** 0/0; 20/47.6; 22/52.4 | **2007** 4/7.7; 19/36.5; 29/55.8 | **2008** 2/3.7; 18/33.3; 34/63.0 | **2009** 0/0; 7/25.9; 20/74.1 |
| **2010** 1/4.0; 8/32.0; 16/64.0 | **2011** 0/0; 9/42.9; 12/57.1 | **2012** 0/0; 5/38.5; 8/61.5 | **2013** 0/0; 8/53.3; 7/46.7 |
| **2014** 1/4.2; 8/33.3; 15/62.7 | **2015** 0/0; 5/31.3; 11/68.8 | **2016** 0/0; 3/27.3; 8/72.7 | **2017** 1/7.1; 3/21.4; 10/71.4 |
| **2018** 0/0; 8/72.7; 3/27.3 | | | |

| *Table 41: Perceived preventability of adverse events that caused death* | | | |
|---|---|---|---|
| **Definition** | Percentages of perceived preventability of adverse events causing death as reported by assessors. Based on the number of incidents of clinical management issues and not the number of patients. | | |
| **Data included** | All deaths falling within WAASM criteria using the highest level of assessment in completed cases where preventability of adverse events causing death was reported (n= 276). | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending',' excluded terminal care' and 'lost to follow-up' cases. All cases where clinical management issue was not reported. All cases where 'areas for consideration' and 'areas for concern' was reported. All cases where adverse events not causing death was reported. No missing data. | | |
| **Adverse events that caused death (d); Definitely preventable (n/%); Probably preventable (n/%)** | | | |
| **2002** 28; 11/39.3; 3/10.7 | **2003** 19; 5/26.3; 8/42.1 | **2004** 13; 3/23.1; 4/30.8 | **2005** 21; 7/33.3; 3/14.3 |
| **2006** 22; 5/22.7; 8/36.4 | **2007** 29; 7/24.1; 8/27.6 | **2008** 34; 6/17.6; 9/26.5 | **2009** 20; 5/25.0; 7/35.0 |
| **2010** 16; 4/25.0; 3/18.8 | **2011** 12; 7/58.3; 2/16.7 | **2012** 8; 4/50.0; 3/37.5 | **2013** 7; 1/14.3; 4/57.1 |
| **2014** 15; 6/40.0; 3/20.0 | **2015** 11; 2/18.2; 5/45.5 | **2016** 8; 2/25.0; 2/25.0 | **2017** 10; 4/40.0; 5/50.0 |
| **2018** 3; 0/0; 1/33.3 | | | |

| *Table 42: Frequency of clinical management issues* | |
|---|---|
| **Definition** | Percentages and descriptions (in READ Codes) of the 12 most common clinical management issues as reported by assessors. |
| **Data included** | All deaths falling within WAASM criteria where clinical management issues was reported (n=2,673). |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending',' excluded terminal care' and 'lost to follow-up' cases. All cases where clinical management issue was not reported. |

| **Clinical management issue in READ Code description (n/%)** | |
|---|---|
| **Postoperative care unsatisfactory** 42/1.6 | **Surgeon too junior** 42/1.6 |
| **Postoperative bleeding after open operation** 43/1.6 | **Anastomotic leak after open surgery** 50/1.9 |
| **Aspiration pneumonia** 53/2.0 | **Poor documentation** 55/2.1 |
| **Failure to use DVT prophylaxis** 59/2.2 | **Preoperative assessment inadequate** 62/2.3 |
| **Delay in diagnosis** 87/3.3 | **Better to have done different operation or procedure** 126/4.7 |
| **Delay to surgery (ie earlier operation desirable)** 188/7.0 | **Decision to operate** 266/10.0 |

| *Table 43: Association of clinical management issues with falling mortality* | | | |
|---|---|---|---|
| **Definition** | Aggregate figure showing the number of deaths falling within WAASM criteria per year as a function of surgical mortality rates per 100,000 WA population and percentages of cases with clinical management issues as reported by assessors. | | |
| **Data included** | All deaths falling within WAASM criteria in calculating the fall in mortality and the highest level of assessment in completed cases where clinical management issues was reported by assessors in calculating the clinical management issues. | | |
| **Data excluded** | All 'excluded error' cases in calculating the fall in mortality. All 'closed non-participant', 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending',' excluded terminal care' and 'lost to follow-up' cases, all cases where clinical management issue was not reported in calculating the clinical management issues. | | |
| **Rate (per 100,000 WA population) (n); Clinical Management Issues (%)** | | | |
| **2002** 34.7; 30.2 | **2003** 32.5; 25.3 | **2004** 34.7; 32.3 | **2005** 35.1; 26.9 |
| **2006** 35.6; 23.8 | **2007** 31.2; 24.1 | **2008** 30.9; 30.5 | **2009** 26.6; 23.1 |
| **2010** 25.5; 20.3 | **2011** 23.9; 19.1 | **2012** 24.1; 16.6 | **2013** 22.6; 17.4 |
| **2014** 22.8; 18.7 | **2015** 22.8; 19.3 | **2016** 23.1; 17.0 | **2017** 22.0; 18.6 |
| **2018** 21.2; 14.0 | | | |

| *Table 44: Decision to operate by treating surgeon/assessor by year* | | | |
|---|---|---|---|
| **Definition** | Percentages of cases with the decision to operate ticked by treating surgeon/assessor as a consideration for improvement. | | |
| **Data included** | All operative deaths falling within WAASM criteria with completed cases for both treating surgeon and the highest level of assessment used for assessor. | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending',' excluded terminal care' and 'lost to follow-up' cases. All cases where no operation was reported. All neurosurgery cases. | | |
| **Treating surgeon (n/d/%); Assessor (n/d/%)** | | | |
| **2002** 20/310/6.5; 5/181/2.8 | **2003** 15/276/5.4; 7/181/3.9 | **2004** 30/306/9.8; 18/202/8.9 | **2005** 14/296/4.7; 10/221/4.5 |
| **2006** 26/353/7.4; 16/233/6.9 | **2007** 19/315/6.0; 14/224/6.3 | **2008** 22/324/6.8; 14/218/6.4 | **2009** 19/265/7.2; 11/195/5.6 |
| **2010** 14/227/6.2; 9/153/5.9 | **2011** 15/227/6.6; 11/158/7.0 | **2012** 10/224/4.5; 7/148/4.7 | **2013** 18/248/7.3; 15/176/8.5 |
| **2014** 25/278/9.0; 15/174/8.6 | **2015** 20/286/7.0; 14/198/7.1 | **2016** 16/308/5.2; 14/194/7.2 | **2017** 17/274/6.2; 18/200/9.0 |
| **2018** 16/189/8.5; 11/165/6.7 | | | |

| *Table 45: 'Decision to operate' as a clinical management issue identified by treating surgeon/assessor* | | | |
|---|---|---|---|
| **Definition** | Counts of decision to operate as a clinical management issue as reported by treating surgeon/assessor. | | |
| **Data included** | All operative deaths falling within WAASM criteria with completed cases for both treating surgeon and the highest level of assessments used for assessor. | | |
| **Data excluded** | All 'closed non-participant', 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending',' excluded terminal care' and 'lost to follow-up' cases. All cases where no clinical management issues was reported. All neurosurgery cases. | | |
| **Treating surgeon (n); Assessor (n)** | | | |
| **2002** 1; 4 | **2003** 0; 14 | **2004** 13; 29 | **2005** 6; 14 |
| **2006** 8; 32 | **2007** 7; 26 | **2008** 9; 17 | **2009** 5; 17 |
| **2010** 3; 7 | **2011** 6; 14 | **2012** 0; 9 | **2013** 4; 10 |
| **2014** 7; 16 | **2015** 10; 8 | **2016** 6; 10 | **2017** 4; 14 |
| **2018** 9; 6 | | | |

## APPENDIX B: PERFORMANCE REVIEW DATA