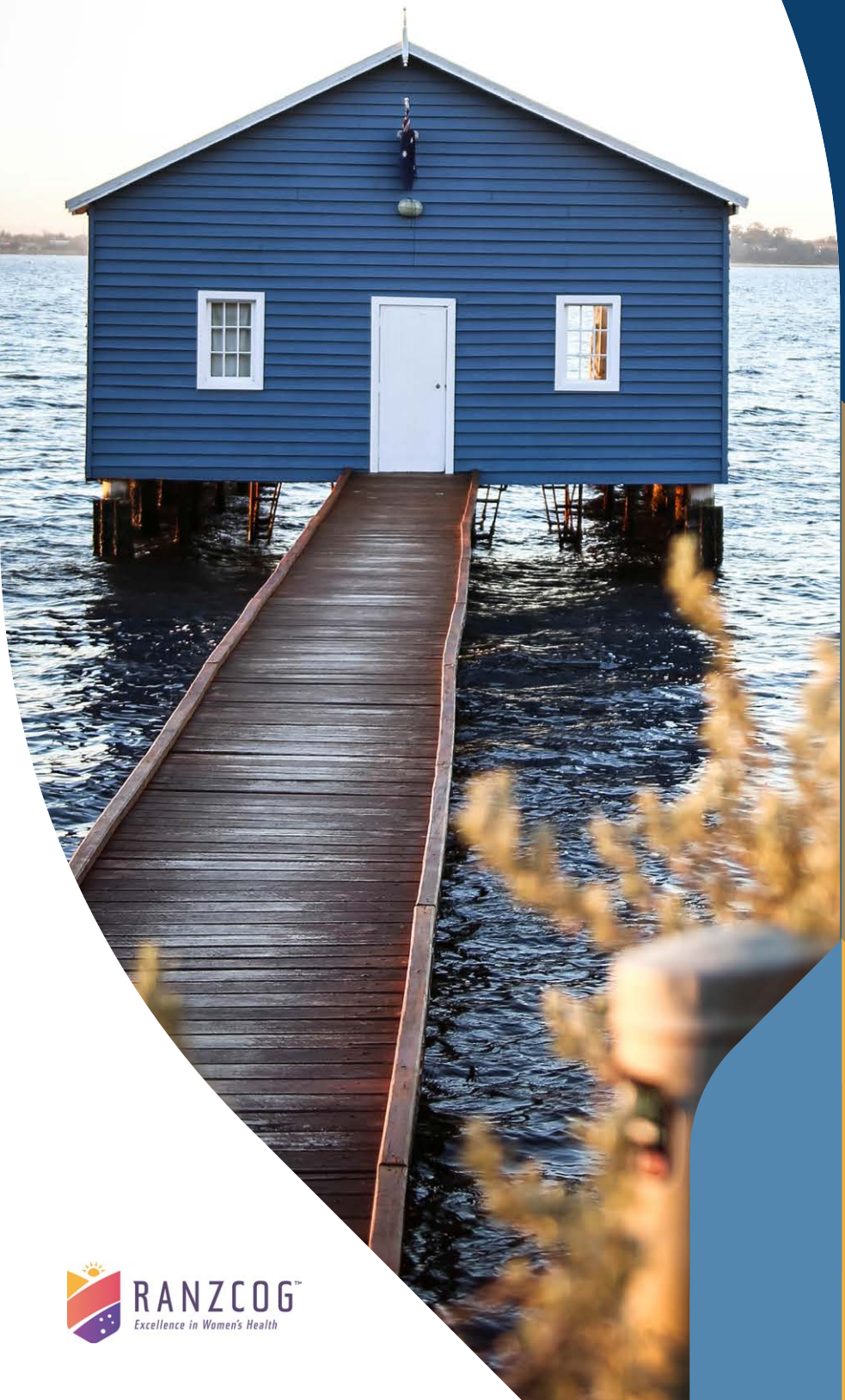
Royal Australasian College of Surgeons

The Western Australian Audit of Surgical Mortality (WAASM)

2022 Report

5-year review
Jan 2017 - Dec 2021



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The information contained in this 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 (Cwlth), Part VC (gazetted 24 April 2022).

Data analysed using the Statistical Package for Social Sciences (SPSS version 26) and Microsoft Office Excel (2010).

Cover photo by Amanda Klamrowski on Unsplash.

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The aim of any surgical audit is to assess clinical care, identify problems, encourage the required changes in practice and then confirm improvements. Identifying and changing a specific activity and then documenting a sustained improvement is a neat, tidy outcome that is easy to explain.

The reality is different. More often, the change required is systematic, slow to enact and complicated by wide annual variation. The audit cycle often has to be repeated and reinforced if improved care is to be sustained.

The Western Australian Audit of Surgical Mortality (WAASM) commenced in 2002. A special section in this report reflects the changes in the last 20 years. While some of the observed improvements will reflect improvement in practice, others reflect the direct impact of WAASM.

Over the 20 years there has been a substantial fall in operative-related mortality. Surgery in Western Australia (WA) has never been safer.

The use of routinely collected administrative data to drive clinical change has not been successful and this has led to the development of clinical quality registries (CQR). The development of CQR in Australia is many years behind other countries. However, that is rapidly changing. Key to the integrity of CQR is complete case ascertainment and near full completion of the data fields. This has been reflected in recent editorials in surgical journals[1,2] and government publications.[3,4] The Royal College of Surgeons of England has a clearly stated view regarding the professional obligations of both individual surgeons and indeed the College. The obligations in Australia are no less.

However, the availability of more accurate and timely administrative data, coupled with artificial intelligence, is already changing the future. The traditional annual quality assurance 'data dump' is already being replaced with near real-time continuous quality improvement data that will increasingly extract and report daily data from administrative datasets. The United Kingdom Get It Right First Time program is a glimpse into the future and has already arrived in other Australian states.[4]

The WA Department of Health is actively engaged in the use of these new techniques. All WA clinicians, and those involved with WAASM, will have to engage with these new demands and at a rapidly accelerating rate. The next paragraphs outline examples as to how WAASM is changing so it can meet future demands.

WAASM would never have commenced without the protection provided by qualified privilege (QP), now under Commonwealth legislation. Over the last 20 years, QP has been fundamental to building the trust that surgeons have in WAASM. However, much has changed in that time and some limitations imposed by the Australian and New Zealand Audit of Surgical Mortality's original QP protection are now not required and even unhelpful. This was highlighted in the 2016 Victorian inquiry into events at Bacchus Marsh hospital. As a consequence of that report, the QP legislation related to the Victorian Audit of Surgical Mortality was modified to permit cases requiring multidisciplinary input being identified for hospital review. This sits with other Victorian safety and quality activities. Those changes have now been bedded down.

With that assurance, the QP covering WAASM and other states has recently been adjusted. This will permit WAASM to identify to the WA Department of Health any patient where assessors have identified a Health Roundtable 4 or 5 death.[5] Only patient identifiers will be provided. All WAASM information (activities and reports) will continue to be covered by exactly the same QP protection as previously. This is a small, but very necessary, step to ensure all deaths under a WA surgeon have been appropriately reviewed.

When completing their registration for the Australian Health Practitioner Regulation Agency (AHPRA) in September 2021, surgeons may, or may not, have noted the changes related to the reporting of their Continuing Profession Development (CPD) that is due to become effective from January 2023. Each surgeon will need to register with an accredited CPD 'home' and for most surgeons that will be the Royal Australasian College of Surgeons (RACS). The CPD home will be responsible for ensuring the CPD compliance of those registered, which may be reported to AHPRA.

It is a requirement of the RACS CPD program that surgeons return WAASM forms within 2 months. That has not previously been strictly enforced. There is a new focus on encouraging and supporting Fellows to comply with the standard to ensure timely completion of the audit requirements. This is an important obligation to comply with.

COVID-19 has been the dominant health theme for the last 2 years. Until early 2022, WA had minimal COVID-19 infections and WAASM is not aware of any patient who had died directly or indirectly from COVID-19. This has changed following the widespread development of COVID-19 in WA from early 2022. Any increase in deaths is likely to manifest itself directly or indirectly in 1 of 3 ways.

In the acute phase, there is clear evidence that patients with COVID-19 should not have surgery for at least 7 weeks after infection.[6] For those presenting as an emergency, that may not be possible.

Long COVID-19 will develop in at least 15% of infected patients.[7,8] At the time of writing this report, there is no published data reporting the outcome of surgery in patients suffering from long COVID-19. COVID-19 has an impact on the microvascular circulation and other health conditions that impact on this (e.g. smoking and diabetes) that can increase complications. So, there is the potential for long COVID-19 to adversely affect surgical outcomes.

During this time, there have been restrictions on elective surgery, and this has greatly increased waiting lists. Reducing the increased elective surgery backlog will be a major health priority for the next few years. Delaying emergency surgery has long been one safety valve used to prioritise elective lists, so they continue uninterrupted. There is a real risk that prioritising elective cases will delay theatre access for emergency operations. This will compromise emergency surgery outcomes and prolong hospital stay and hence costs.

Since the last report, there has been no meaningful progress permitting access to the Coroner's post mortem reports. The current situation is a major handicap for all those seeking to learn from post mortem reports. Change to the current legislation is now urgent and long overdue.

RJ Aitken
WAASM Clinical Director

Abbreviations

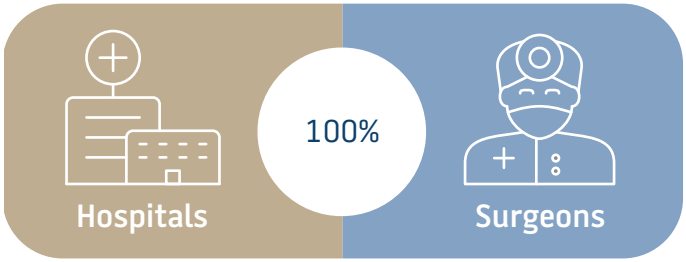
ANZASM	Australian and New Zealand Audit of Surgical Mortality
AHPRA	Australian Health Practitioner Regulation Agency
ASA	American Society of Anesthesiologists
CCU	Critical care units
CMI	Clinical management issues
CNR	Case note review
CPD	Continuing professional development
CQR	Clinical quality registries
DVT	Deep vein thrombosis
FLA	First-line assessment
HDU	High dependency unit
ICU	Intensive care unit
QP	Qualified privilege
RAAS	Research, Audit and Academic Surgery
RACS	Royal Australasian College of Surgeons
SCF	Surgical case form
SLA	Second-line assessment
TED	Thromboembolic deterrent
WA	Western Australia/n
WAASM	Western Australian Audit of Surgical Mortality

Executive summary

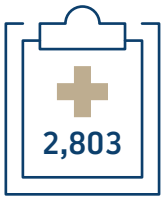
This summary covers cases reported to WAASM from **1 January 2017 to 31 December 2021**.

Note that differences in denominators are due to incomplete information provided in surgical case forms (SCFs) and assessment forms, resulting in missing data.

Participation



Analysis and audit numbers



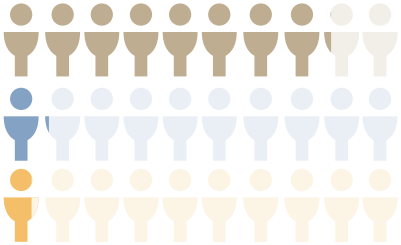
Reported cases meeting WAASM criteria

Completed cases
(2,213/2,803)

Excluded terminal care cases
(410/2,803)

Emergency 86.4%
(1,953/2,261)

Elective 13.6%
(308/2,261)

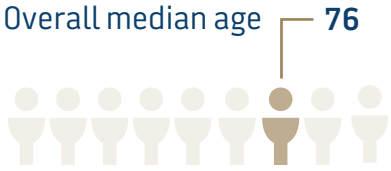


81.9% Public
(1,854/2,265)

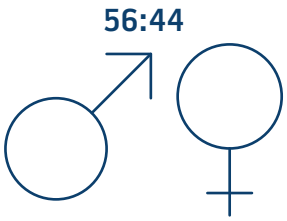
10.1% Private
(229/2,265)

8.0% Co-location
(182/2,265)

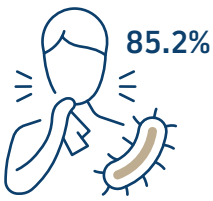
Risk profile



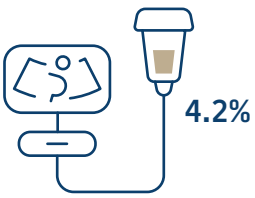
Ages
(range 1 day to 104 years)



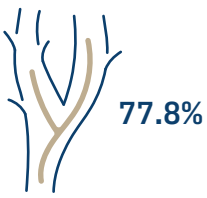
Male (1,576/2,803)
Female (1,227/2,803)



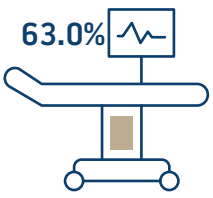
Comorbidities
(1,928/2,264)



Fluid balance issues
(95/2,257)



DVT prophylaxis use
(1,747/2,246)



CCU use
(1,423/2,259)

Patient transfers

30.2%
Patients transferred
(676/2,238)

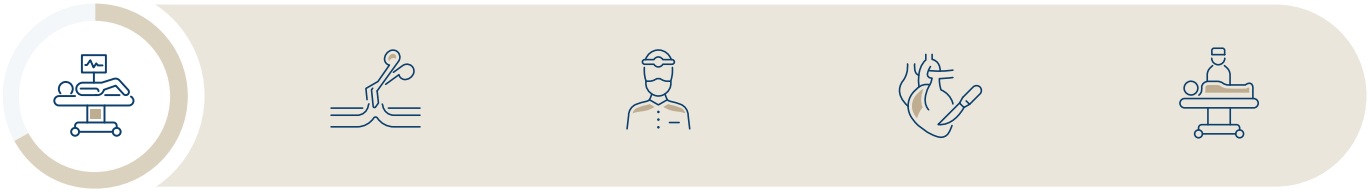
11.0%
Delay in transfer
(72/657)

4.4%
Inappropriate transfer
(29/658)

4.3%
Insufficient clinical information
(28/653)

3.5%
Inappropriate level of care
(23/652)

Operations



67.0%
Patients had surgery
(1,517/2,265)

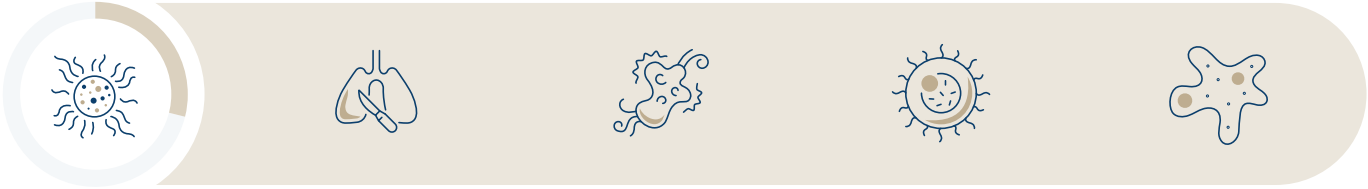
92.0%
Consultant surgeons who made the decision to operate
(1,945/2,114)

67.6%
Consultant surgeons who performed surgery
(1,429/2,114)

16.0%
Unplanned returns to theatre
(242/1,515)

4.8%
Operations abandoned on finding a terminal situation
(98/2,048)

Infection



29.0%
Patients with clinically significant infection
(656/2,259)

38.5%
Pneumonia
(252/655)

24.6%
Intra-abdominal sepsis
(161/655)

20.2%
Septicaemia
(132/655)

15.6%
'Other source' of infection
(102/655)

Peer-review outcomes

16.5%
Cases with one or more clinical management issues
(365/2,213)

571
Number of clinical management issues

12.8%
Adverse events
(73/571)

60.3%
Adverse events that caused death
(44/73)

40.9%
Definitely preventable adverse events that caused death
(18/44)

Review of 2021 recommendations

2021 Recommendations	Progress
Education	
Prepare a data analysis report based on the information received in the Peer-Review Feedback Evaluation Forms.	The data analysis report, based on the information contained in the Peer-Review Feedback Evaluation Forms received since February 2018, has been completed. All WA surgeons and the WA Department of Health received this report via email at the end of July 2022. To view the full data analysis report, please click here.
Clinical management	
Continue to monitor and report any trends observed in the proportion of surgical patients who die with trauma being implicated, for the next reporting period.	For the reporting period 2017–2021, trauma was reported in 26.9% of cases (608/2,258). This is a slight reduction when compared with the 27.9% of cases (625/2,242) for the 2016–2020 period. In the majority of these cases (71.5%; 435/608), the trauma was the result of a fall. This is similar to the findings in last year's WAASM Report (70.7%; 442/625). In regards to fall-related trauma, Figure A.1 in Appendix A shows that there was a drop in the number of cases between 2017–2018, followed by a slight increase in 2019, and the number has since remained relatively steady. For the reporting period 2017–2021, there was an overall decline in cases with fall-related trauma, similar to the 2016–2020 period.
Continue to monitor and report on any trends in the proportion of surgical patients where there was an issue with communication at any stage of their care, for the next reporting period.	For the reporting period 2017–2021, issues with communication were reported in 3.5% of cases (79/2,263), and a breakdown by year is shown in Figure A.2 in Appendix A. This is a slight increase on the 3.1% of cases (69/2,249) observed for the 2016–2020 period. Reported communication issues included treatment decisions being made without adequate discussion with the consultant surgeon; treatment instructions from the consultant surgeon not being followed; delays in referral to the surgical department; delays in advising the consultant surgeon of patient progress; and inadequate communication between specialties.
Research and reporting on audit data	
Continue to review the impact of COVID-19 on deaths under the care of a surgeon.	WAASM continues to ask surgeons to identify any patient deaths related to COVID-19. No data was received on this for the years 2020–2021. WAASM is still interested in reviewing this in the future.
Undertake a preliminary analysis of reported deaths in elective cases, in patients aged ≤50 years, or in regional hospitals (all considered low risk).	The preliminary analysis of low-risk deaths in these 3 categories is still in progress. This will be reported in the 2023 WAASM Report.

To view the full 2021 recommendations, please see the 2021 Report.

2022 recommendations

Education

- Investigate options for presenting a WAASM webinar, including identification of relevant topics and potential speakers.

Clinical management

- For the 2023 and 2024 WAASM reports, monitor and report any trends observed in unplanned returns to theatre, by different variables (e.g. surgical specialty).
- For the 2023 and 2024 WAASM reports, monitor and report any trends observed in unplanned readmissions within 30 days of surgery, by different variables (e.g. patient age).

Research and reporting on audit data

- Continue analysis of deaths occurring in elective cases in patients aged ≤50 years or in regional hospitals (where complex cases are predominantly transferred to metropolitan tertiary hospitals), which are considered unexpected.
- Continue to review the impact of COVID-19 on deaths under the care of a surgeon, given the increase of COVID-19 cases in WA in 2022.

1. Introduction

1.1 Background

The Western Australian Audit of Surgical Mortality (WAASM) is an independent, peer-reviewed audit of the processes of care associated with surgery-related deaths in Western Australia (WA). Established as a voluntary audit, WAASM is funded by the WA Department of Health and has protection under federal legislation. Participation in WAASM became a mandatory requirement of the Royal Australasian College of Surgeons (RACS) in 2010 and, since 2013, has been part of the RACS Continuing Professional Development (CPD) program.

WAASM is a patient safety and quality improvement intiative. The collection of data over time enables WAASM to detect and highlight emerging trends and system/process errors in surgical care to facilitate changes in practice, thereby improving patient safety and outcomes. This is achieved through an educational peer-review process, of which provision of information and feedback to surgeons is an integral component.

1.2 Objectives

The objectives of WAASM are:

1. to audit all surgery-related deaths with the following criteria:

- The patient was under the care of a surgeon, regardless of whether an operation was performed.
- The patient was under the care of a physician and subsequently underwent a surgical procedure.

(Cases outside of these criteria are excluded from the audit. Patients admitted under the care of a surgeon specifically for terminal care are excluded from the full audit process. These cases do not undergo peer review.)

2. to analyse CMI identified by assessors as follows:

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

2. Methods

2.1 Structure and governance

WAASM is governed by the Australian and New Zealand Audit of Surgical Mortality (ANZASM), which is managed by Research, Audit and Academic Surgery (RAAS) of RACS and is funded and supported by state and territory governments. The WAASM Management Committee monitors the structures and processes involved in the WAASM quality assurance activity (see Appendix B).

WAASM is protected by federal legislation. ANZASM receives legislative protection under the Commonwealth Qualified Privilege Scheme, under part VC of the Health Insurance Act 1973 (gazetted 24 April 2022).

2.2 Audit process

Public hospital deaths are reported to WAASM via the WA Department of Health's web-based patient administration system. WAASM is notified of deaths in private hospitals through medical records departments. A consultant surgeon involved in the care of a patient may also self-report a death using the Fellows Interface, a web-based application developed by RACS specifically for audits of surgical mortality.

All deaths where a consultant surgeon was involved in the care of a patient are included in the audit, whether or not the patient underwent a surgical procedure. Details and cause of death are recorded in the Surgical Case Form (SCF) by the consultant surgeon. This is based on the patient's diagnosis during the last admission, incorporating test results, operations and post mortem reports when available.

The peer-review process, which follows submission of the SCF, is a retrospective assessment of the clinical management of the patient who died while under the care of the consultant surgeon. Assessors must determine whether management of the patient was appropriate.

WAASM's full audit process is outlined in Appendix C.

2.3 Providing feedback

The core purpose of WAASM is to improve patient outcomes. This is accomplished by the provision of detailed feedback to consultant surgeons and hospitals to inform, educate, facilitate change and improve practice. This is achieved at different levels (individual, hospital or grouped) and is provided in several ways:

- **Feedback on individual cases**

  Consultant surgeons are provided with assessor feedback on individual cases. The identities of assessors remain anonymous at all times. WAASM encourages consultant surgeons to complete the Peer-Review Feedback Evaluation Form providing comments in response to the feedback received.

- **Hospital report**

  Individual hospital reports are sent annually to all hospitals participating in WAASM. These reports contain de-identified aggregated data that can be used for monitoring trends within the individual hospital and for comparisons with other participating peer-grouped hospitals across the country.

- **National Case Note Review Booklet**

  A selection of cases reviewed by assessors is summarised, collated and disseminated to all consultant surgeons. All information in the case note reviews is de-identified so events cannot be linked to an individual patient, consultant surgeon or hospital.

  In addition, each month a national Case of the Month is emailed to consultant surgeons.

2.3 Providing feedback (continued)

- **Annual report**

  An annual report is published in October and made available on the WAASM website. It is also circulated to all WA consultant surgeons and hospitals, the WA Department of Health and published on the RACS website.

2.4 Data analysis

WAASM audits all surgery-related deaths occurring in WA hospitals. This 2022 report covers deaths reported to WAASM from 1 January 2017 to 31 December 2021 (census date 6 April 2022).

The full audit process can take 3 months or longer from initial notification of death, so some 2021 cases were still under review as of the census date, and outcomes were unavailable for this report. Case numbers in previous reports may differ from those in this report because some cases were completed after the relevant census dates.

Patients admitted specifically for terminal care are excluded from the full audit process. Cases are included in the full audit process if the patient was admitted with intention to treat but after assessment it was decided to manage the patient conservatively or to palliate.

Data is entered and stored in the binational audit system database. Since not all data were completed for some cases (resulting from incomplete SCFs and assessment forms), the total number of cases used in each analysis may vary.

3. Results

Key results for the period 2017 to 2021:

- 2,803 deaths met WAASM criteria
- 95.5% of SCFs returned
- 67.0% of patients had one or more operations
- 30.2% of patients had a preoperative transfer
- 85.2% of cases had one or more comorbidities present
- 29.0% of cases had a clinically significant infection.

3.1 Surgical deaths reported to WAASM

Between 1 January 2017 and 31 December 2021, there were 2,912 deaths reported to WAASM. Of these, 109 deaths were excluded for not meeting WAASM inclusion criteria. As a result, a total of 2,803 deaths met the inclusion criteria (Table 1).

Table 1: Deaths reported to WAASM, by year

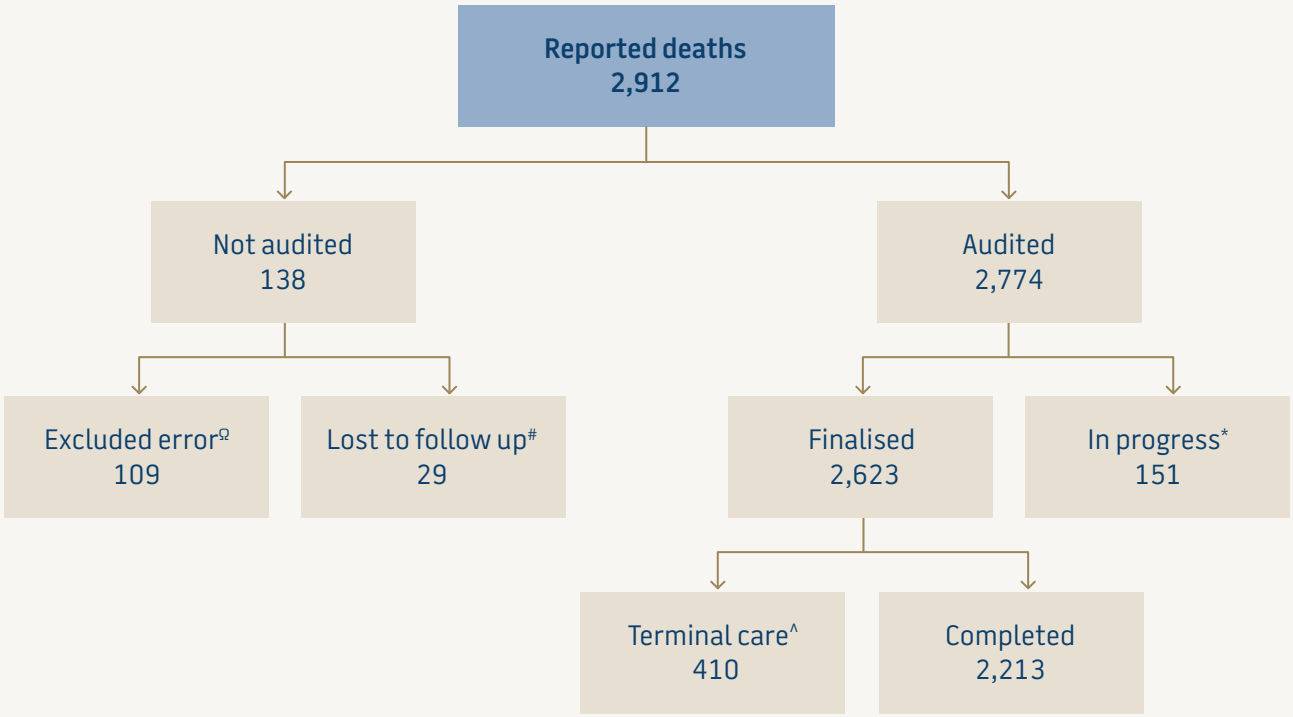
Year	Number of deaths reported	Deaths not meeting criteria*	Deaths meeting criteria#
2017	597	27	570
2018	584	29	555
2019	562	10	552
2020	556	22	534
2021	613	21	592
Total	2,912	109	2,803

WAASM: Western Australian Audit of Surgical Mortality.
*Deaths not meeting criteria: reported deaths not meeting WAASM inclusion criteria, hence excluded from the audit process.
#Deaths meeting criteria: all deaths meeting WAASM criteria, including terminal care cases.
Refer to Appendix D.1 for further information on data.

3.1 Surgical deaths reported to WAASM (continued)

Figure 1 shows the number of reported deaths that were audited and not audited in the period 2017 to 2021.

Figure 1: Deaths audited by WAASM



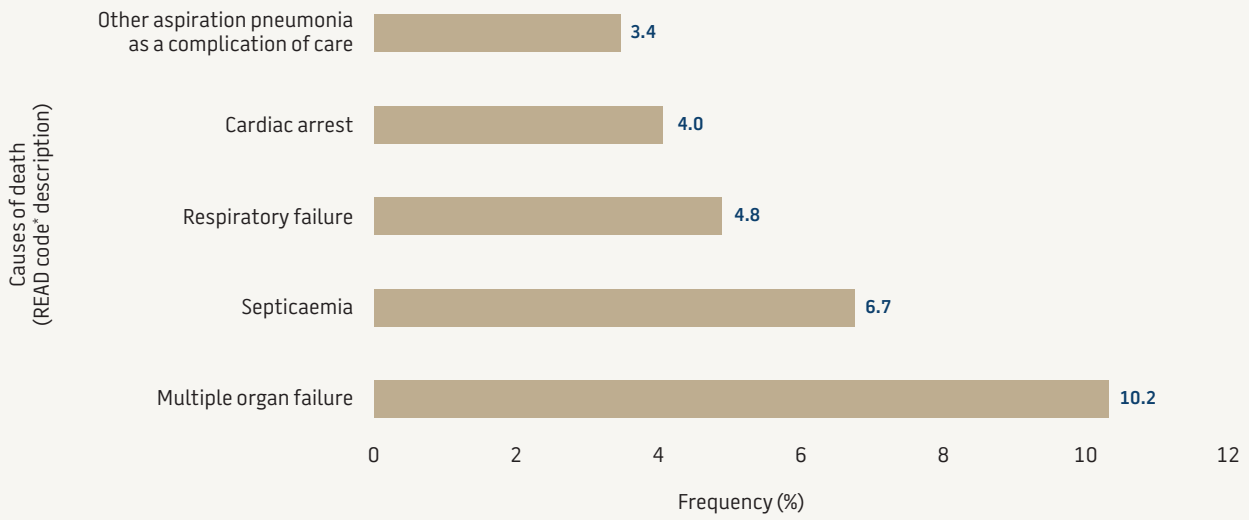
[Ω]Excluded error: reported deaths not meeting WAASM inclusion criteria.
[#]Lost to follow up: cases remaining incomplete for a period of 2 years or more.
[*]In progress: cases that have not completed the full audit process.
[^]Terminal care: patients admitted specifically for terminal care are excluded from the full audit process.
Refer to Appendix D.2 for further information for data.

The consultant surgeon records the cause of death of the patient on the SCF. This is based on the patient diagnosis during the last admission, considering test results, operations performed and available post mortem reports.

Some cases have more than one cause of death listed. The most frequently reported causes of death were multiple organ failure (10.2%; 354/3,466) and septicaemia (6.7%; 231/3,466).

3.1 Surgical deaths reported to WAASM (continued)

Figure 2: Most common causes of death



*READ codes are surgical diagnoses categorised using a coded thesaurus of clinical terms (READ codes). READ codes form a clinical decision tree containing terms, synonyms and abbreviations covering all aspects of patient care.

Note: Some 2021 cases still undergoing review so case data unavailable for this report.

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

As of 6 April 2022, 79.0% of cases (2,213/2,803) had completed the audit process and 5.4% (151/2,803) were in progress, with 2021 cases constituting a large proportion of that number (4.6%; 129/2,803).

Patients admitted specifically for terminal care are excluded from the full audit process and consultant surgeons do not have to complete the SCF. Prior to 2015, the proportion of patients admitted for terminal care was less than 5.0%. Between 2015 and 2020, the proportion of reported terminal care cases slowly increased (14.8%, 2015; 13.7%, 2016; 14.9%, 2017; 13.2%, 2018; 18.1%, 2019; 18.0%, 2020).

Due to this observed rise, WAASM undertook a detailed review of these cases in 2021. It found many had not been admitted for terminal care but had their nonoperative care capped, often after substantial treatment, which frequently included invasive active monitoring and, in some cases, admission to the intensive care unit (ICU). A number of 2021 cases that appeared to have been incorrectly classified as terminal care cases were returned to consultant surgeons to complete the SCF. The proportion of terminal care cases in 2021 reduced significantly (9.5%). These cases did not have an operation, but had they been correctly classified, the proportion of patients who did not have an operation would have been greater.

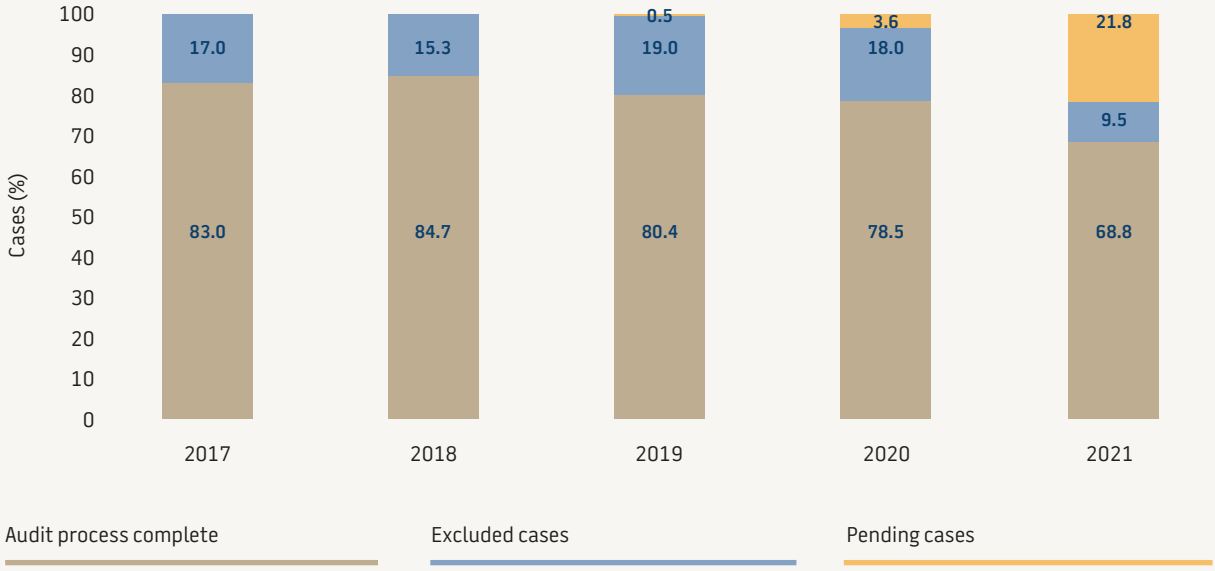
3.1 Surgical deaths reported to WAASM (continued)

Most of the 'excess' terminal care cases were from General Surgery. In the vast majority, an early decision was made to limit the patient care to nonoperative treatment only. However, capping care, especially if it involves active treatment, is not the same as admitting the patient for terminal care, as per the definition used by WAASM and ANZASM. The specialty with the second highest number of 'excess' terminal care cases was Neurosurgery. In many cases, the patients were admitted following trauma and a decision was made almost immediately, often in the emergency department, that the injury was non-survivable. These patients were sometimes admitted to the ICU pending organ donation or to permit time for family to attend. These types of cases were accepted as terminal care.

Previously, cases not received by WAASM within 2 years were defined as 'lost to follow up'. This practice was changed as at 31 December 2020, and all outstanding cases and assessments now continue to be followed up until they are received. For the years 2017, 2018 and 2019, 'lost to follow up' cases accounted for 2.1% (12/570), 2.2% (12/555) and 0.9% (5/552) of cases, respectively. The total proportion of cases deemed 'lost to follow up' over this 3-year period was 1.7% (29/1,677).

Overall, a total of 15.7% of cases (439/2,803) were excluded from the audit due to being terminal care admissions or those 'lost to follow up' (Figure 3).

Figure 3: Case status, by year

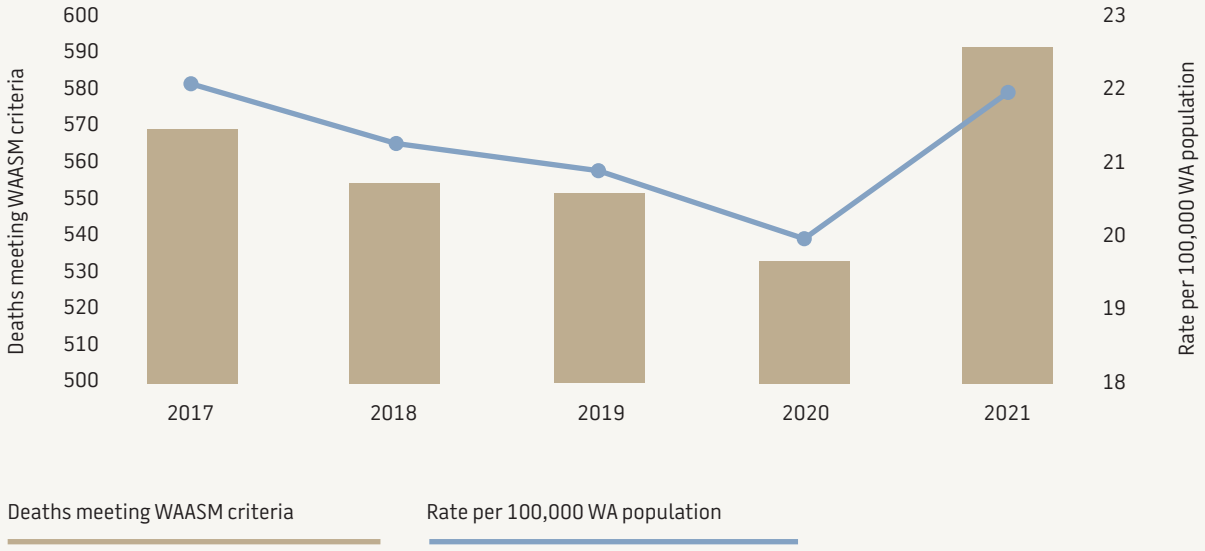


Note: Some 2021 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.1 Surgical deaths reported to WAASM (continued)

The rate of deaths under the care of a consultant surgeon per 100,000 WA population decreased between 2017 and 2020, with an increase in 2021 (Figure 4).[9] However, as Figure 33 shows, over a 20 year period, there has been a plateau in the number of deaths since 2013.

Figure 4: WAASM deaths and mortality rate per 100,000 WA population, by year



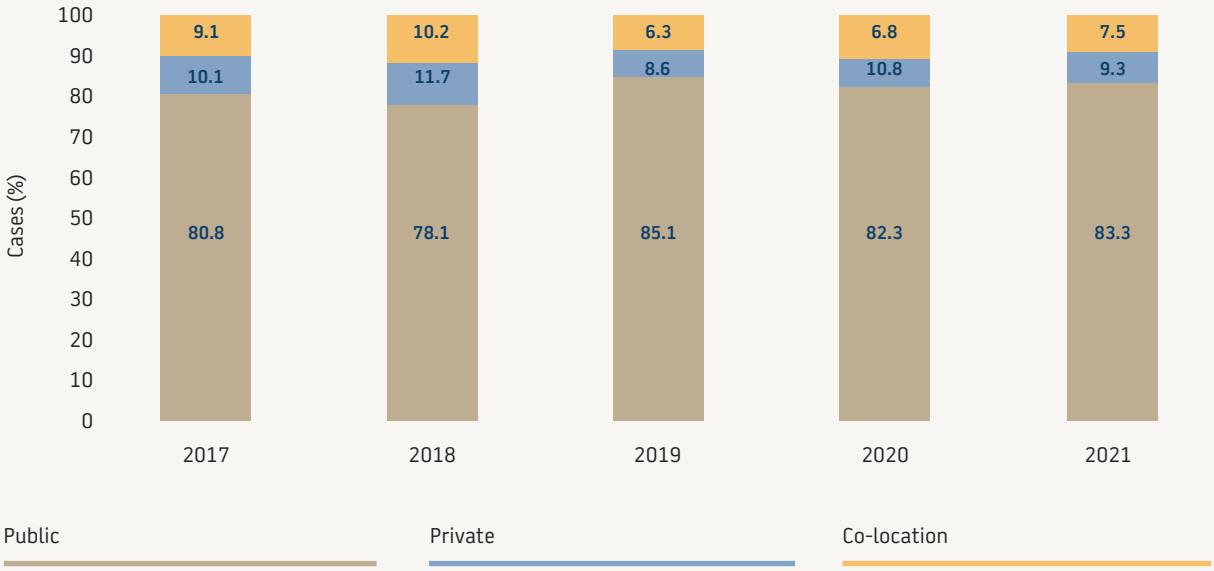
Note: Some 2021 cases still undergoing review, so case data unavailable for this report.
WAASM: Western Australian Audit of Surgical Mortality, WA: Western Australia.
Refer to Appendix D.2 for further information on data.

3.2 Hospital participation

All hospitals in WA where surgery is performed currently participate in the audit. Between 2017 and 2021, there were 26 hospitals (of 52) associated with the 2,803 deaths meeting WAASM criteria.

Between 2017 and 2021, public hospitals accounted for 81.9% of admissions (1,854/2,265), with private and co-location hospitals accounting for 10.1% (229/2,265) and 8.0% (182/2,265) of admissions, respectively (Figure 5). (Co-location hospitals are those that provide both privately and publicly funded surgical services. Data for co-location hospitals includes public and private patients.)

Figure 5: Deaths by hospital status, by year



Note: Some 2021 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.3 Surgeon participation

The return rate for SCFs, including terminal care cases, was 95.5% (2,676/2,803).

Table 2 shows WAASM deaths for each surgical specialty in the period 2017 to 2021. General Surgery reported the most deaths at 43.1% (1,207/2,803), followed by Neurosurgery and Orthopaedic Surgery at 16.9% (474/2,803) and 16.9% (473/2,803) respectively.

Table 2: WAASM deaths by surgical specialty

Surgical specialty	Number of deaths	Percentage (%)
General Surgery	1,207	43.1
Neurosurgery	474	16.9
Orthopaedic Surgery	473	16.9
Cardiothoracic Surgery	209	7.5
Vascular Surgery	202	7.2
Urology	113	4.0
Plastic Surgery	51	1.8
Otolaryngology Head & Neck Surgery	42	1.5
Paediatric Surgery	16	0.6
Obstetrics* & Gynaecology	11	0.4
Ophthalmology	4	0.1
Oral & Maxillofacial Surgery	1	0.04

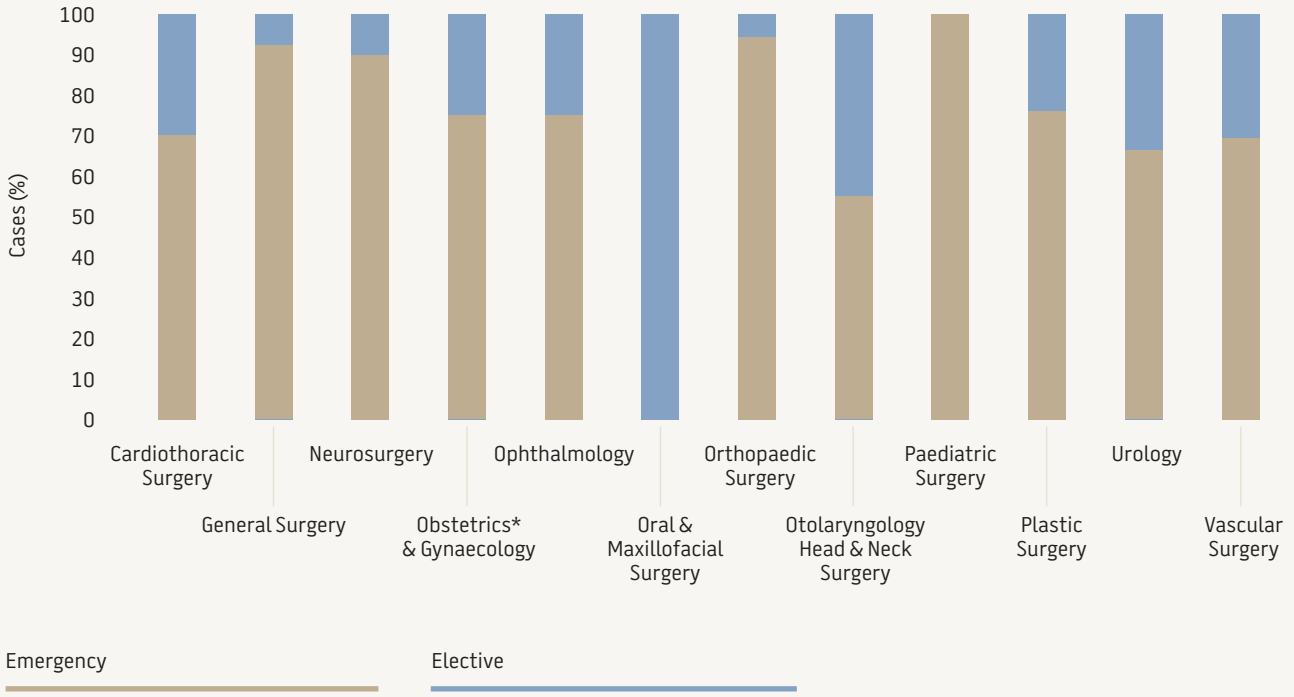
WAASM: Western Australian Audit of Surgical Mortality.
*Obstetric cases are not included in the audit process; only gynaecological cases are audited.
Refer to Appendix D.1 for further information on data.

Emergency admissions accounted for 86.4% (1,953/2,261) and elective admissions for 13.6% (308/2,261) of hospital admissions in the period 2017 to 2021.

The majority of specialties had more emergency admissions compared to elective admissions, with the exception of Oral and Maxillofacial Surgery (Figure 6).

3.3 Surgeon participation (continued)

Figure 6: Deaths by surgical specialty and hospital admission



*Obstetric cases are not included in the audit process; only gynaecological cases are audited.
Refer to Appendix D.2 for further information on data.

3.4 Age and sex distribution

The median age at death for all patients and the age breakdown by sex are presented in Table 3. Males accounted for 56.2% (1,576/2,803) and females 43.8% (1,227/2,803) of all deaths.

Table 3: Median age by sex

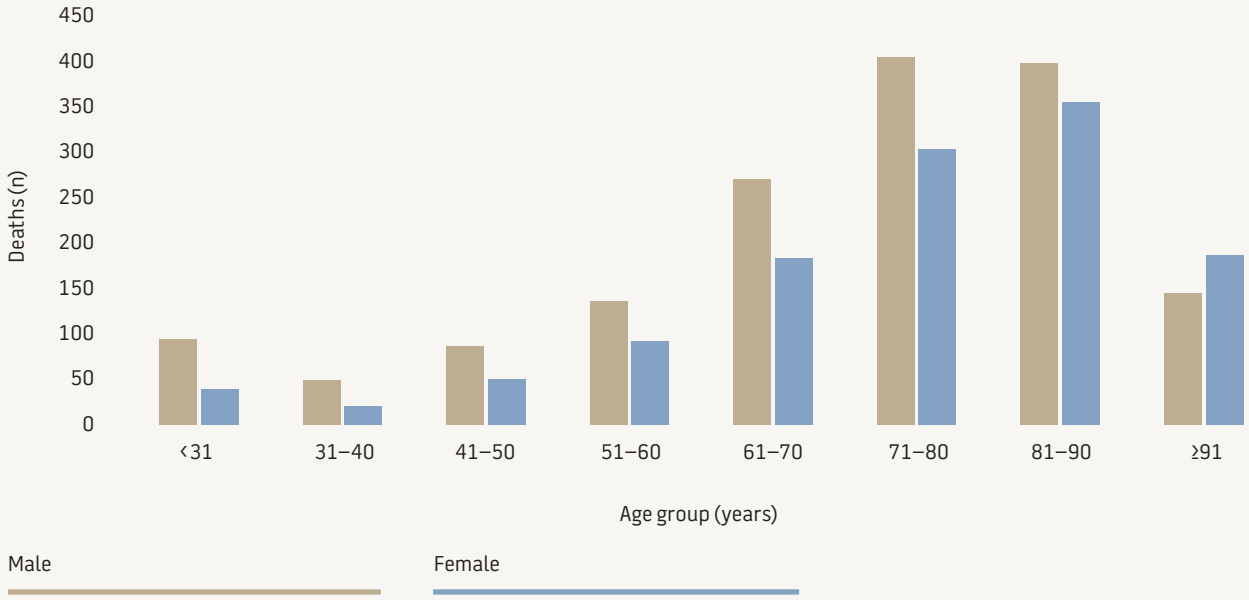
Sex	Number of cases	Median age (years)	Interquartile range (years)
All patients	2,803	76	64–86
Males	1,576	75	62–84
Females	1,227	78	67–87

Refer to Appendix D.1 for further information on data.

3.4 Age and sex distribution (continued)

The distribution of deaths by age group and sex is displayed in Figure 7. Males represented a greater proportion of deaths than females in those patients age 90 years or younger. This trend reversed in patients age 91 years and older, where females represented the larger proportion of deaths. This is not surprising given that there are more females over the age of 90 years in the WA population.[10] A rise in the number of deaths is noted after the age of 50 years, with 51.7% of deaths (1,450/2,803) occurring in patients age 71–90 years. The decrease in deaths after the age of 90 years (11.8%; 330/2,803) is possibly attributed to the smaller population in this age group.

Figure 7: Deaths by age group and sex

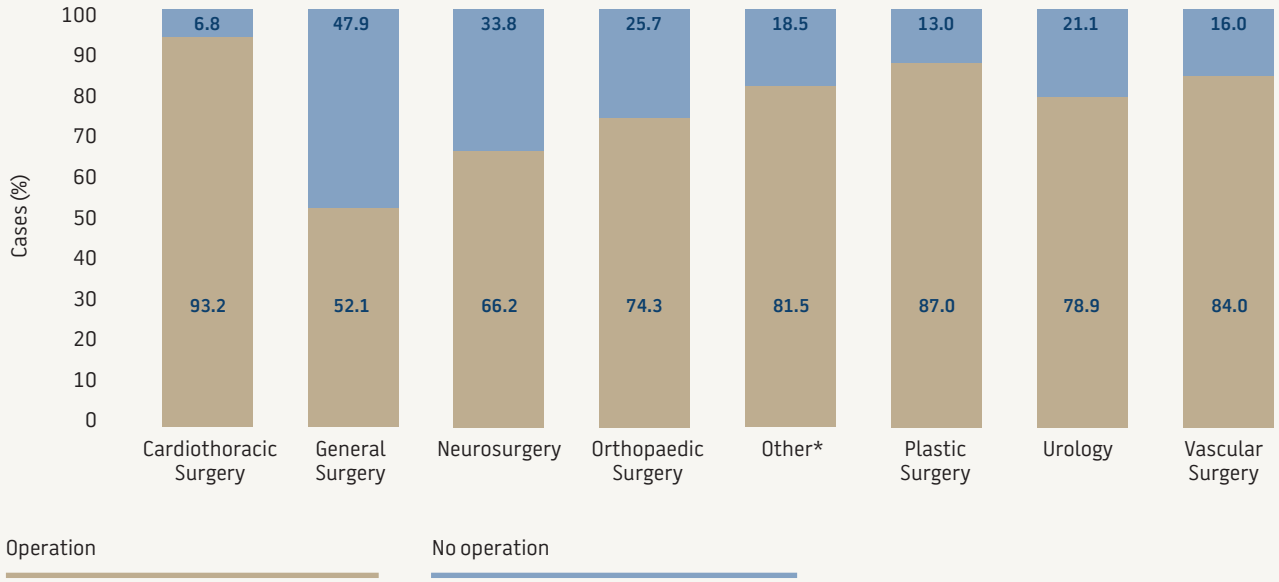


Refer to Appendix D.2 for further information on data.

3.5 Operative and nonoperative cases

In the period 2017 to 2021, most patients (67.0%; 1,517/2,265) underwent one or more operations. Figure 8 shows that Cardiothoracic Surgery reported the highest operation rate (93.2%; 178/191) while General Surgery had the lowest operation rate (52.1%; 468/899).

Figure 8: Operative and nonoperative cases by specialty



*Other includes Otolaryngology, Head & Neck Surgery, Ophthalmology, Paediatric Surgery, Obstetrics# & Gynaecology and Oral/Maxillofacial Surgery.

#Obstetric cases are not included in the audit process; only gynaecological cases are audited.

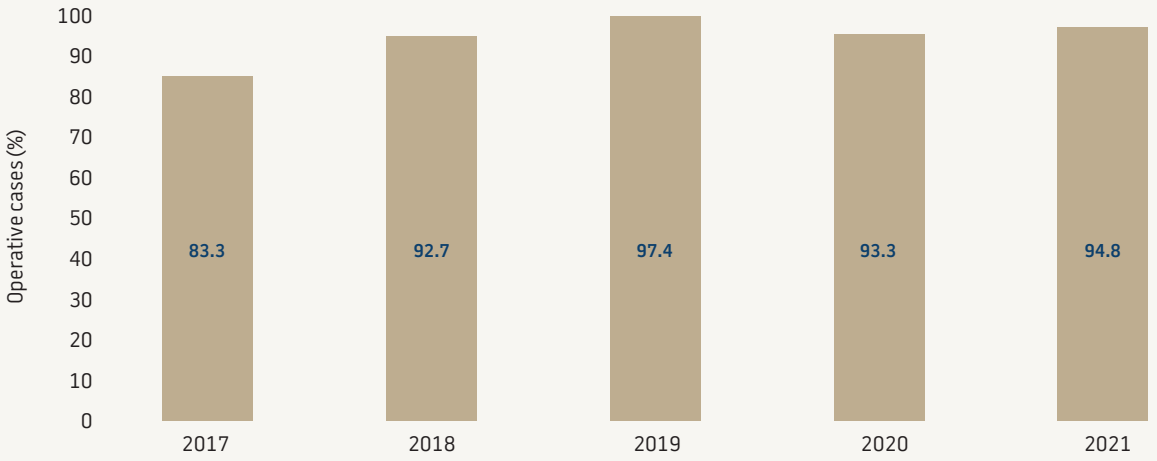
Refer to Appendix D.2 for further information on data.

The proportion of emergency and elective admissions involving an operation remained relatively steady in the period 2017 to 2021, with 80.7% of patients (1,221/1,513) admitted as an emergency.

Overall, 2,114 operations were performed on 1,517 patients between 2017 and 2021. In 92.0% of reported operations (1,945/2,114), a consultant surgeon made the decision to proceed to surgery (Figure 9). A consultant surgeon performed the surgery in 67.6% of operations (1,429/2,114) (Figure 10).

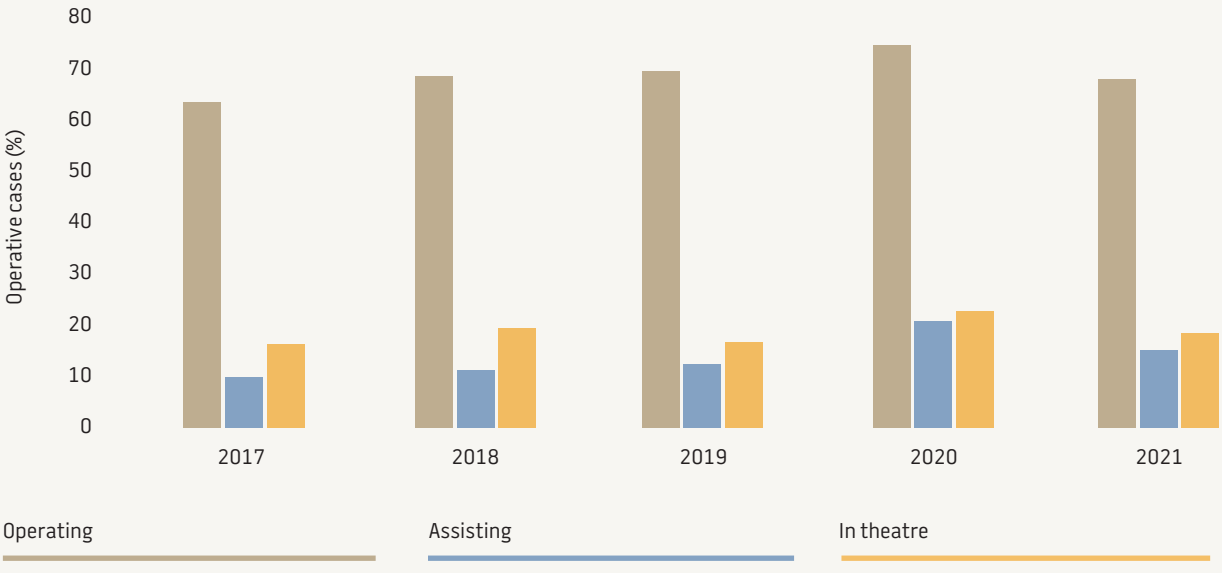
3.5 Operative and nonoperative cases (continued)

Figure 9: Consultant surgeon making the decision to operate, by year



Note: Some 2021 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

Figure 10: Consultant surgeon involvement in operations, by year

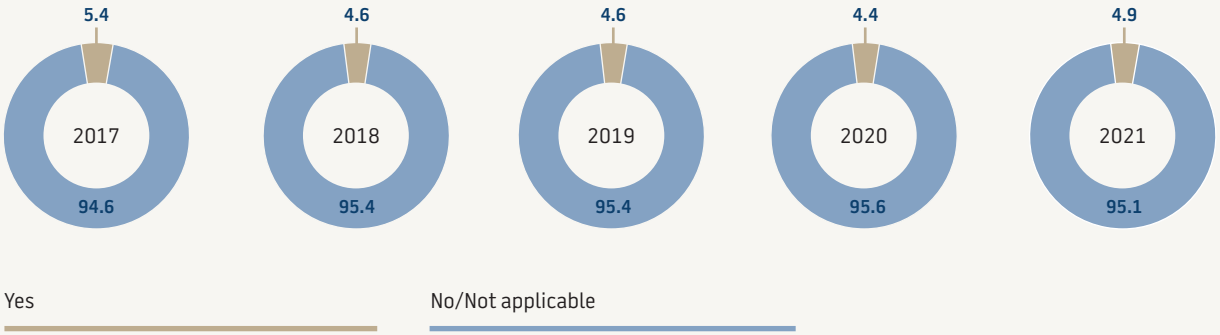


Note: Some 2021 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.5 Operative and nonoperative cases (continued)

Overall, an operation was abandoned upon finding a terminal situation in 4.8% of operations (98/2,048) (Figure 11).

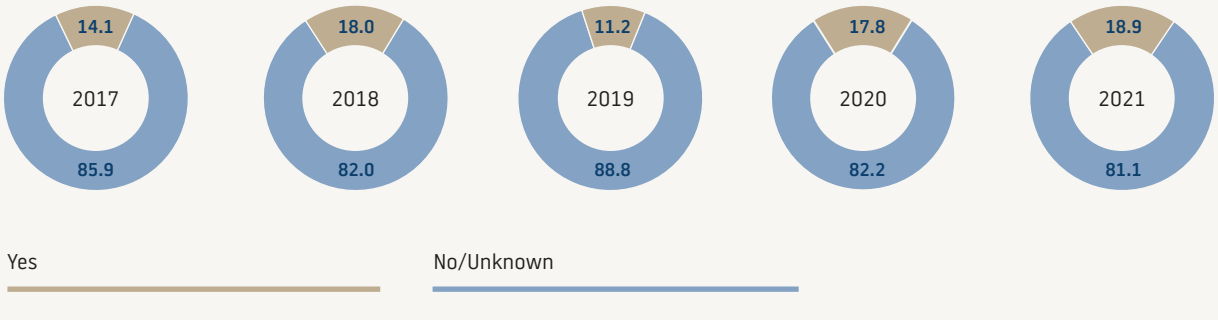
Figure 11: Operations abandoned on finding a terminal situation, by year



Note: Some 2021 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

In the period 2017 to 2021, 16.0% of operative cases (242/1,515) had an unplanned return to the operating theatre (Figure 12). The annual rate varied between 11.2% (2019) and 18.9% (2021).

Figure 12: Unplanned return to operating theatre, by year



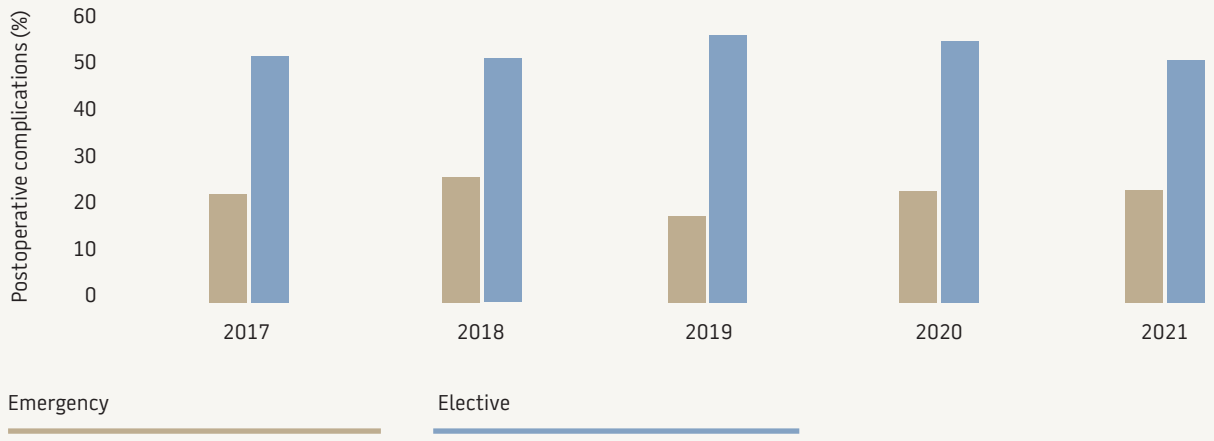
Refer to Appendix D.2 for further information on data.

3.5 Operative and nonoperative cases (continued)

A postoperative complication occurred in 28.8% of operative patients (437/1,515) between 2017 and 2021. There was a total of 559 postoperative complications among 437 operative patients. (Patients may have more than one postoperative complication listed.) The most frequently reported postoperative complications were postoperative bleeding (16.7%; 73/437), tissue ischaemia (11.4%; 50/437) and sepsis (8.5%; 37/437). These data make a strong case for a consultant surgeon to be present when a patient is returned to theatre for postoperative bleeding.

Figure 13 shows the distribution of postoperative complications by hospital admission and year. A higher proportion of elective patients (53.1%; 155/292) had a postoperative complication compared to emergency patients (23.1%; 282/1,221) between 2017 and 2021.

Figure 13: Postoperative complications by hospital admission and year

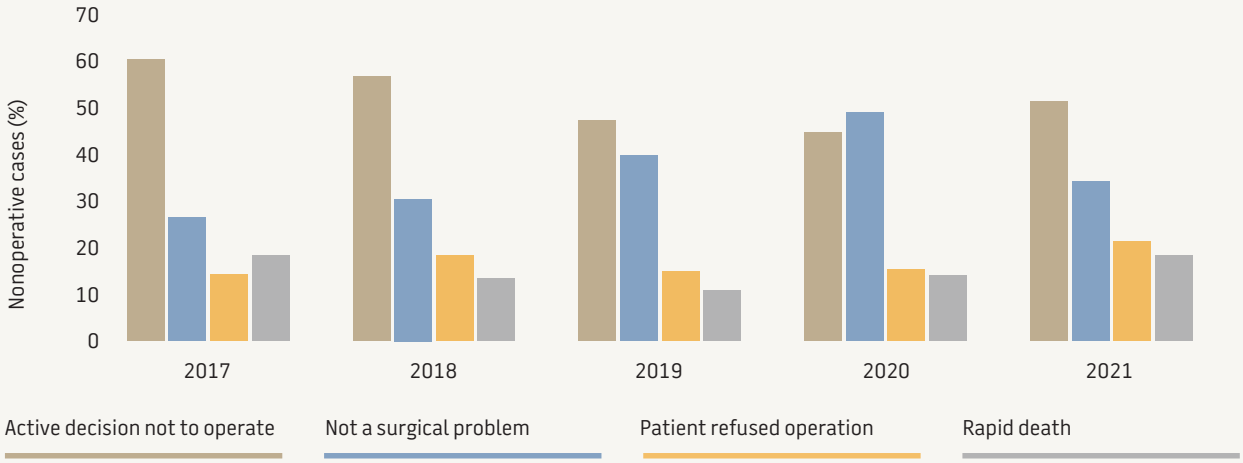


Note: Some 2021 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

Not all patients underwent surgery (33.0%; 748/2,265). Figure 14 illustrates some reasons why patients did not undergo an operation. Some cases reported more than one reason for not operating. Most nonoperative cases were emergency admissions (97.9%; 732/748).

3.5 Operative and nonoperative cases (continued)

Figure 14: Reasons for not operating, by year

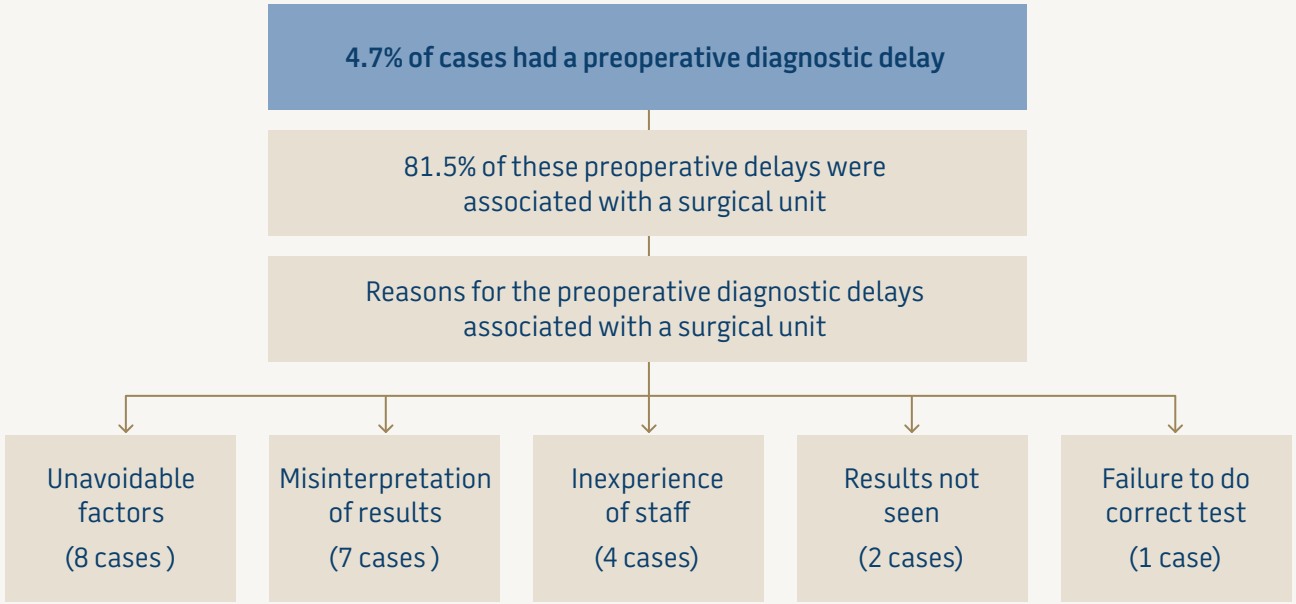


Note: Some 2021 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.6 Preoperative diagnostic delays

In the period 2017 to 2021, a preoperative delay in diagnosis was recorded by the consultant surgeon in 4.7% of cases (106/2,264). Of these delays, 81.5% (22/27; missing data = 79) were associated with the surgical unit. The 2 most common reasons stated for preoperative diagnostic delays associated with a surgical unit were 'unavoidable factors' and 'misinterpretation of results', reporting 8 and 7 cases respectively (Figure 15).

Figure 15: Cases with preoperative diagnostic delays

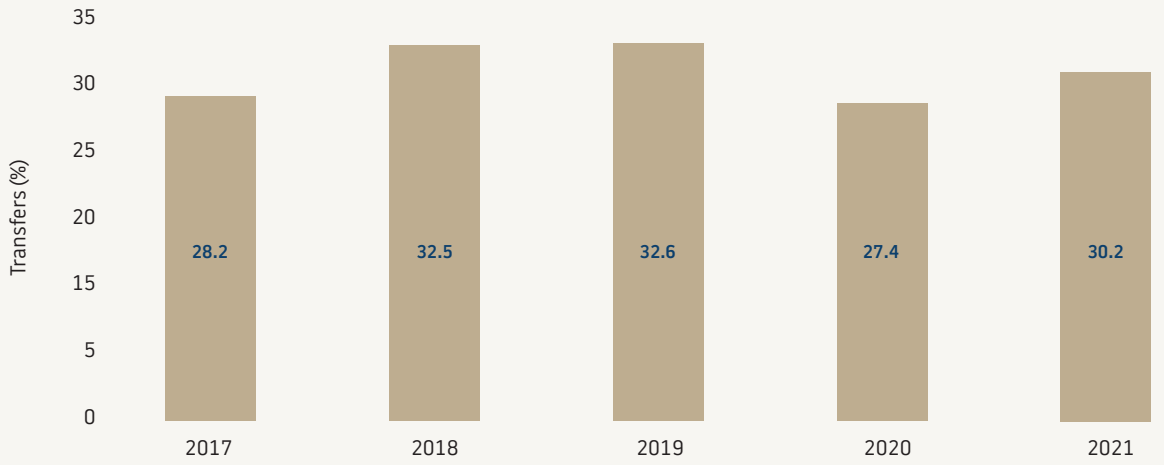


Refer to Appendix D.2 for further information on data.

3.7 Hospital transfers

Between 2017 and 2021, preoperative hospital transfers occurred for 30.2% of patients (676/2,238). Emergency admissions accounted for 97.2% (656/675) of this group.

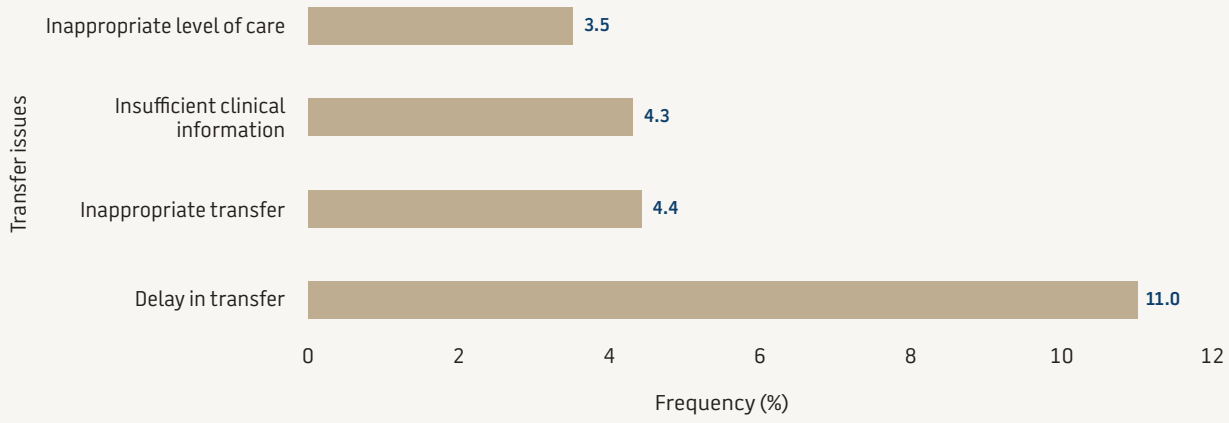
Figure 16: Hospital transfers, by year



Note: Some 2021 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

In the period 2017 to 2021, there were a range of concerns related to transfers (Figure 17). The most frequently reported transfer issue was 'delay in transfer' (11.0%; 72/657).

Figure 17: Hospital transfer issues

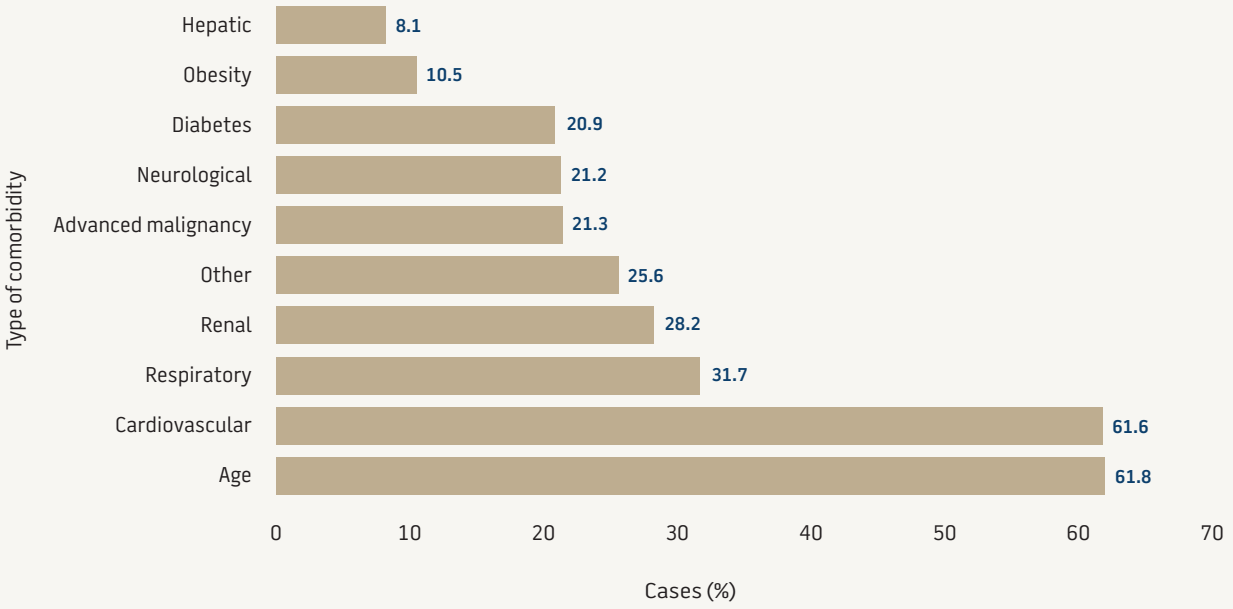


Refer to Appendix D.2 for further information on data.

3.8 Comorbidities

The majority of patients (85.2%; 1,928/2,264) had at least one comorbidity, with more than one comorbidity noted in 82.7% (1,594/1,928) of patients. As shown in Figure 18, the 2 most commonly reported comorbidities among these patients were age (61.8%; 1,191/1,928) and cardiovascular disease (61.6%; 1,187/1,928).

Figure 18: Cases with specific comorbidities



Note: 'Other' includes comorbidities other than those listed on the surgical case form, which may include the presence of other chronic illnesses, haematological or drug-related conditions, vasculopathy, hypertension, dementia, malnutrition, alcoholism and cachexia.
Refer to Appendix D.2 for further information on data.

Patients are assigned grades according to the American Society of Anesthesiologists (ASA) grading system, which is an internationally recognised measure of a patient's physical status.[11] (ASA grade definitions are listed in Appendix D.3.)

As presented in Figure 19, patients were most commonly assigned ASA grade 4, defined as a patient with severe systemic disease that is a constant threat to life (44.9%; 908/2,023). ASA grade 3, defined as a patient with severe systemic disease, was the second most frequently assigned (26.6%; 538/2,023).

3.8 Comorbidities (continued)

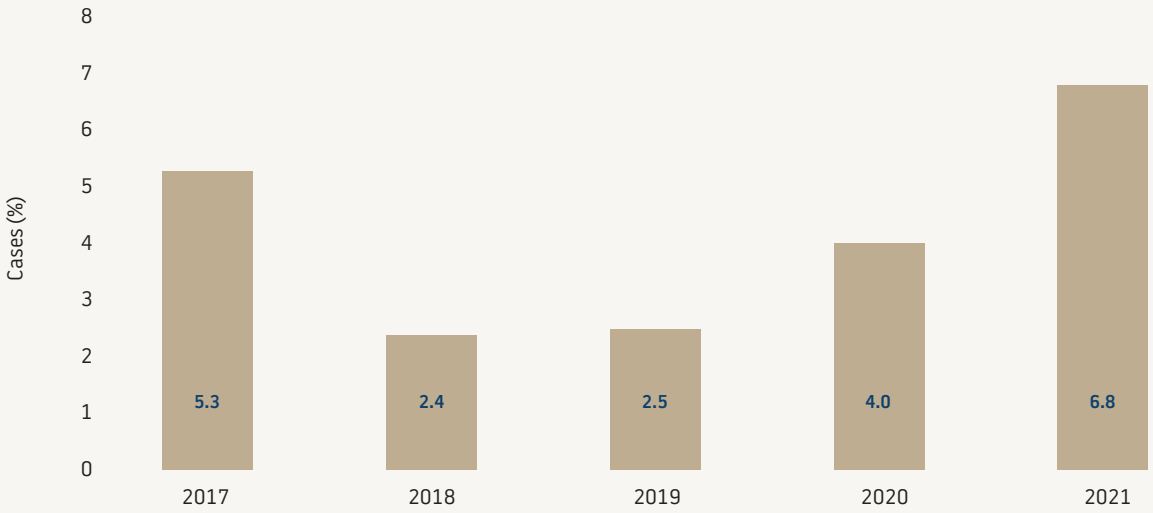
Figure 19: Frequency of ASA grades

ASA: American Society of Anesthesiologists.
Refer to Appendix D.2 for further information on data.
Refer to Appendix D.3 for definitions of ASA grades.

3.9 Fluid balance

Consultant surgeons indicated that there was an issue with fluid balance in 4.2% of cases (95/2,257) between 2017 and 2021. Figure 20 shows the frequency of these cases by year.

Figure 20: Cases with fluid balance issues, by year



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

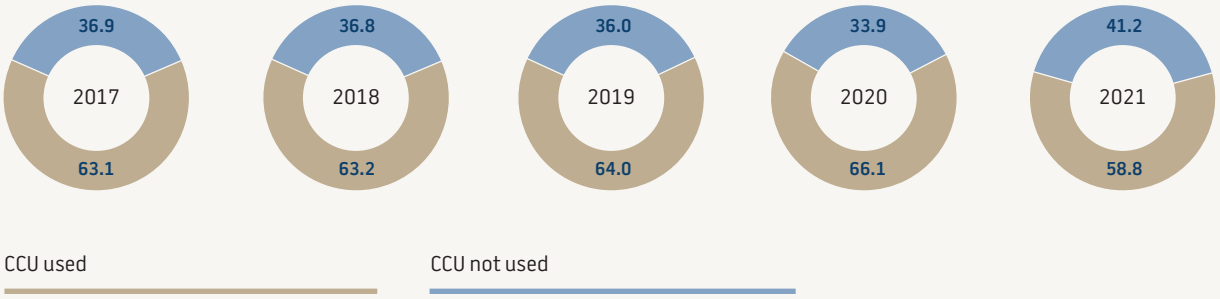
Emergency and elective admissions accounted for 83.0% (78/94) and 17.0% (16/94) of cases with fluid balance issues, respectively. Operative cases (4.8%; 73/1,509) had more fluid balance issues than did nonoperative cases (2.9%; 22/748).

3.10 Critical care units

Between 2017 and 2021, critical care units (CCU) were utilised in 63.0% of cases (1,423/2,259) (Figure 21).

Emergency and elective admissions accounted for 84.9% (1,206/1,420) and 15.1% (214/1,420) of CCU use, respectively.

Figure 21: CCU use, by year

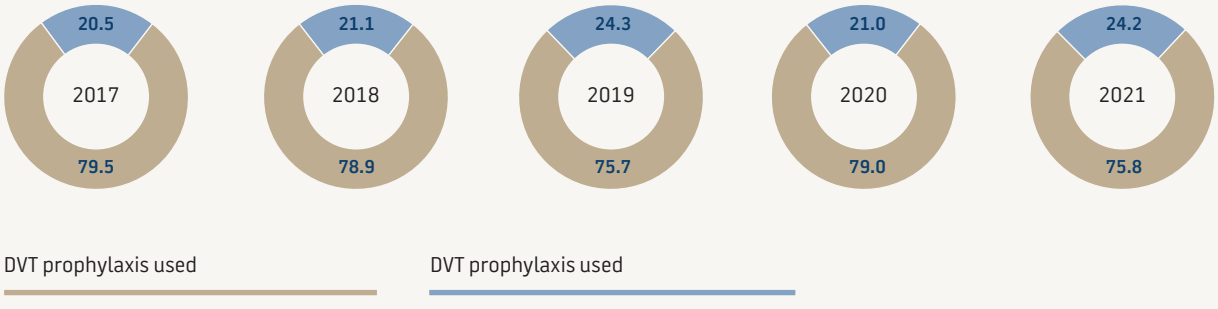


CCU: critical care units.
Note: Some 2021 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.11 Deep vein thrombosis prophylaxis

Consultant surgeons reported the use of deep vein thrombosis (DVT) prophylaxis in 77.8% of cases (1,747/2,246). The use and non-use of DVT prophylaxis by year is presented in Figure 22.

Figure 22: DVT prophylaxis use, by year



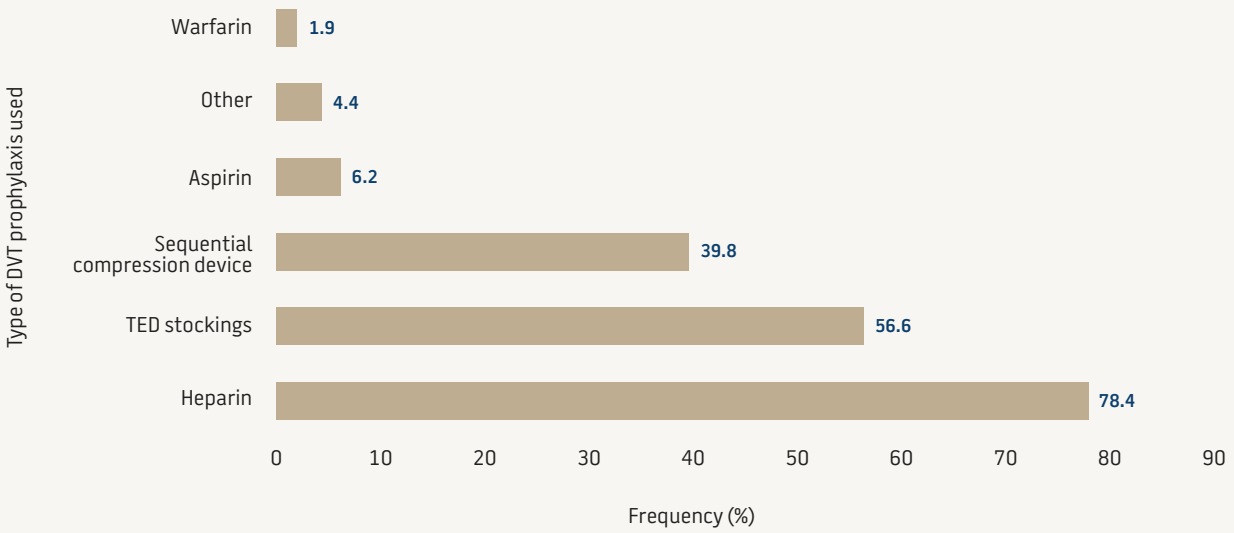
DVT: deep vein thrombosis.
Note: Some 2021 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.11 Deep vein thrombosis prophylaxis (continued)

In many cases, more than one type of DVT prophylaxis was used. Heparin (78.4%; 1,370/1,747) and TED (thromboembolic deterrent) stockings (56.6%; 988/1,747) were the most frequently used DVT prophylaxis types (Figure 23).

DVT prophylaxis was not used in 22.2% of cases (499/2,246). This was because it was either not appropriate (65.0%; 323/497), there was an active decision to withhold it (32.8%; 163/497), or it was not considered (2.2%; 11/497).

Figure 23: Type of DVT prophylaxis used



DVT: deep vein thrombosis, TED: thromboembolic deterrent.

Note: 'Other' could include enoxaparin sodium, clopidogrel bisulfate, danaparoid sodium, and enoxaparin sodium combined with early mobilisation.

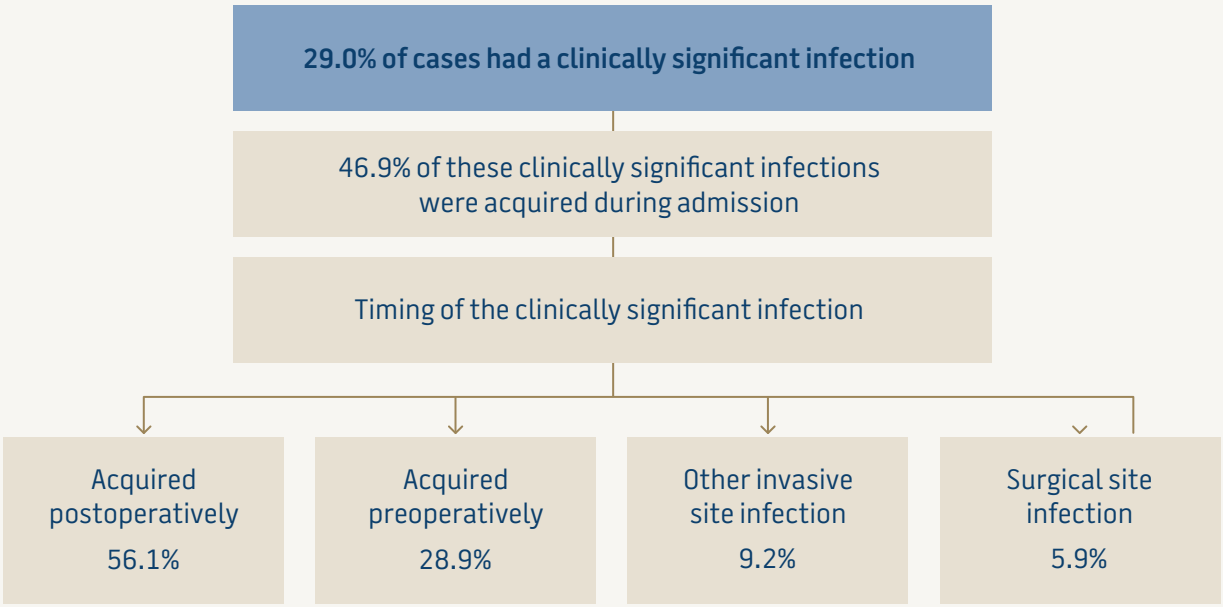
Refer to Appendix D.2 for further information on data.

3.12 Infections

Between 2017 and 2021, 29.0% of patients (656/2,259) died with a clinically significant infection. Figure 24 shows the stage at which these clinically significant infections were acquired.

The clinically significant infection was acquired prior to admission in 53.1% of cases (348/655). In 46.9% of cases (307/655) the clinically significant infection was acquired during admission, and of these infections, more than half were acquired postoperatively (56.1%; 171/305).

Figure 24: Clinically significant infections



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

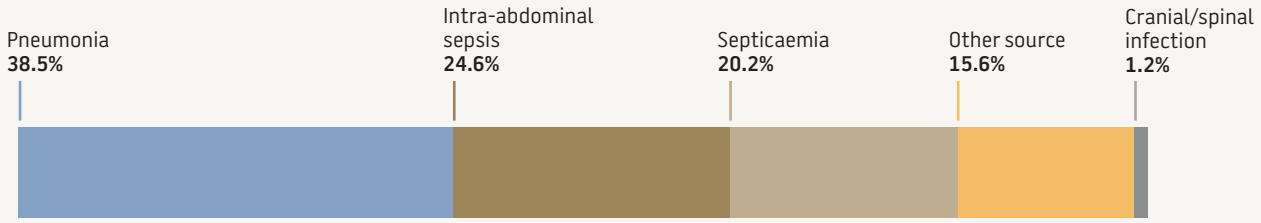
3.12 Infections (continued)

Figure 25 shows the types of clinically significant infections reported by consultant surgeons prior to or during admission, in the period 2017 to 2021.

Pneumonia was the most common clinically significant infection reported, accounting for 38.5% of cases (252/655). Intra-abdominal sepsis accounted for 24.6% of cases (161/655), followed by septicaemia (20.2%; 132/655). 'Other source' and cranial/spinal infection accounted for 15.6% (102/655) and 1.2% (8/655) of cases, respectively.

Where information was provided, consultant surgeons reported that the antibiotic regime was appropriate in 95.1% of cases of clinically significant infections (621/653). In 4.7% of cases (31/653) the appropriateness of the antibiotic regime was unknown, and in 0.2% (1/653) it was considered inappropriate.

Figure 25: Type of clinically significant infection reported



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

4. Outcomes of peer-review assessment

Key results for the period 2017 to 2021:

- 15.4% of cases were referred for second-line assessment
- 84.7% of cases had appropriate use/non-use of DVT prophylaxis
- 571 CMI were identified in 365 cases
- 12.8% (73/571) of CMI were classified as adverse events
- 60.3% (44/73) of adverse events were deemed to have caused the death of the patient
- 40.9% (18/44) of adverse events that caused the death of a patient were considered definitely preventable.

4.1 Second-line assessment

All cases (except terminal care cases) are sent for peer-review assessment. Many cases are closed after the initial first-line assessment (FLA), particularly when adequate information has been provided in the SCF. However, some are identified as requiring a more detailed review; these are recommended for second-line assessment (SLA).

Between 2017 and 2021, the rate of FLA returns was 98.9% (2,242/2,266). Of the 2,242 FLAs returned, 15.4% (345/2,242) were referred for SLA (Table 4).

Table 4: Peer-review assessments, by year

Year	FLAs returned	Cases referred for SLA	
		Number	Percentage (%)
2017	473	82	17.3
2018	470	76	16.2
2019	444	62	14.0
2020	424	70	16.5
2021	431	55	12.8
Total	**2,242**	**345**	**15.4**

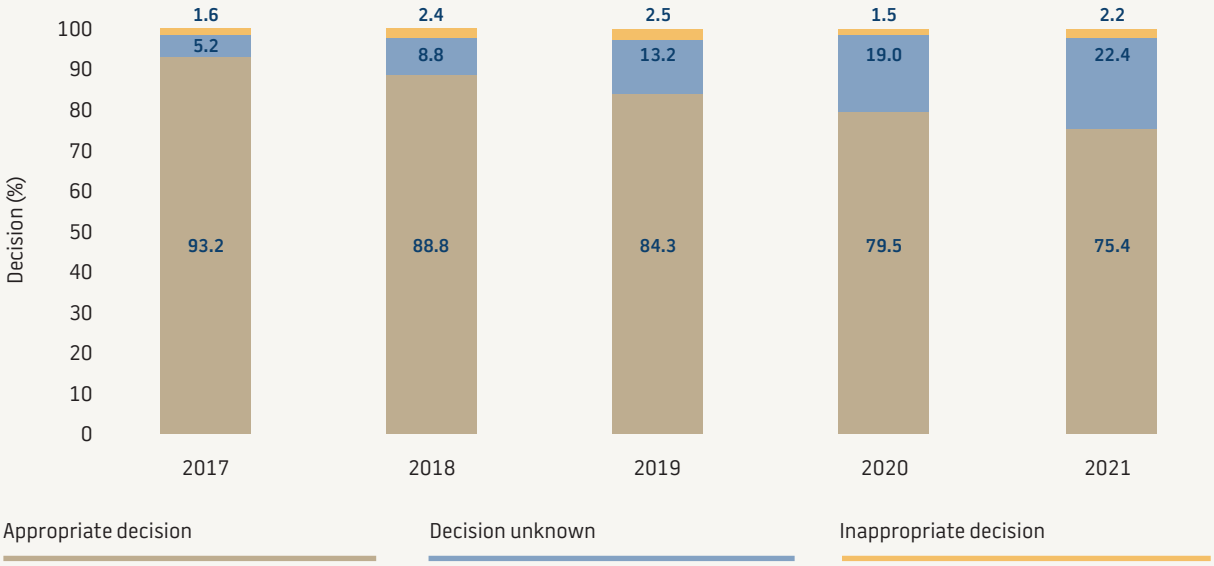
FLA: first-line assessment, SLA: second-line assessment.
Note: Some 2021 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.1 for further information on data.

4.2 Decision on deep vein thrombosis prophylaxis

Assessors are asked to report whether they think the decision on DVT prophylaxis use/non-use was appropriate. Figure 26 shows assessors' opinions on the appropriateness of DVT prophylaxis per year.

Between 2017 and 2021, assessors indicated that the decision to use or withhold DVT prophylaxis was appropriate in 84.7% of cases (1,502/1,774). In 2.0% of cases (36/1,774), assessors reported that there had been an inappropriate decision on the use/non-use of DVT prophylaxis. Assessors could not comment on the appropriateness of the DVT prophylaxis decision in 13.3% of cases (236/1,774).

Figure 26: Assessor opinion on appropriateness of DVT prophylaxis decision, by year



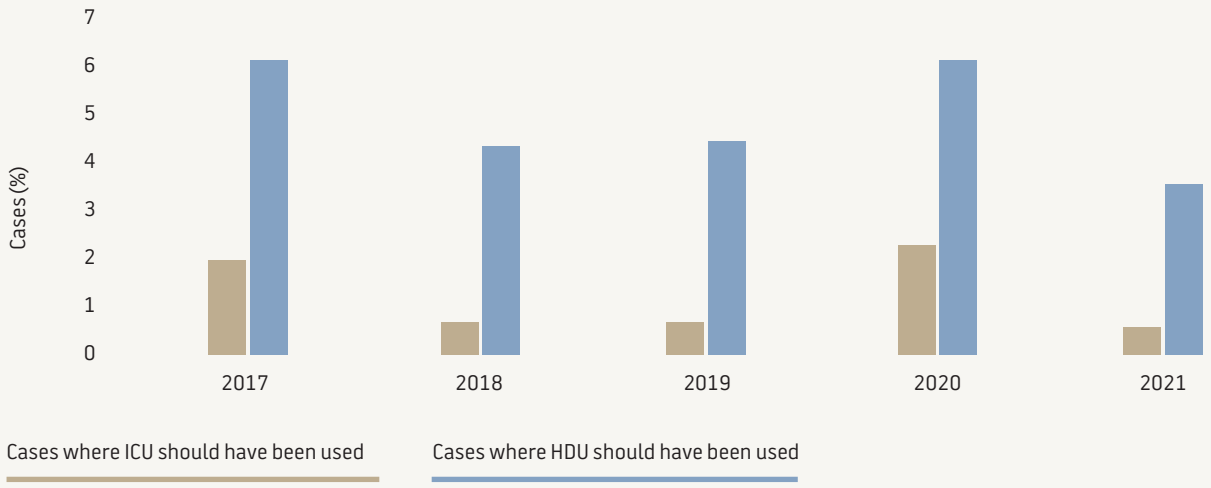
DVT: deep vein thrombosis.
Refer to Appendix D.2 for further information on data.

4.3 Non-use of critical care units

When consultant surgeons indicate on the completed SCF that CCU was not accessed in the management of a patient, assessors are asked to consider whether the patient would have benefited from its use. Figure 27 summarises assessors' opinions on the non-use of CCUs.

Assessors were of the opinion that 1.3% (9/715) and 4.9% (35/711) of patients would have benefited from the use of ICU and high dependency unit (HDU), respectively, between 2017 and 2021.

Figure 27: Assessor opinion on non-use of CCU, by year



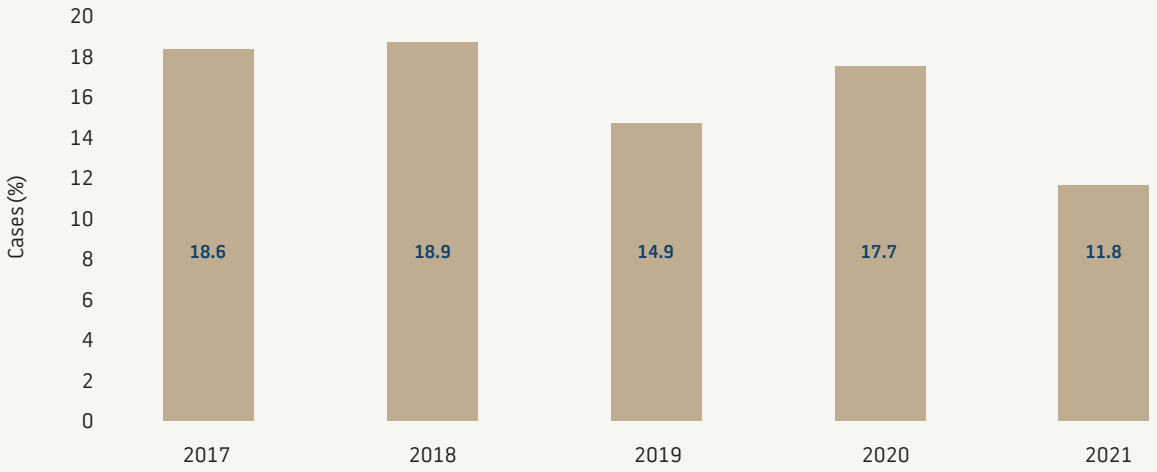
CCU: critical care unit, HDU: high dependency unit, ICU: intensive care unit.
Refer to Appendix D.2 for further information on data.

4.4 Clinical management issues

The peer-review process determines whether CMI occurred. CMI are classified into an area for consideration, an area of concern, or an adverse event (Appendix C: WAASM audit process).

The proportion of cases in which CMI were identified is shown in Figure 28. (Where cases underwent both FLA and SLA, the analysis in this section uses data from the SLA. Data from the FLA are used for cases not referred for SLA. Some 2021 cases are still undergoing the review process, meaning this data is incomplete.)

Figure 28: Cases with CMI, by year



CMI: clinical management issues.
Note: Some 2021 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

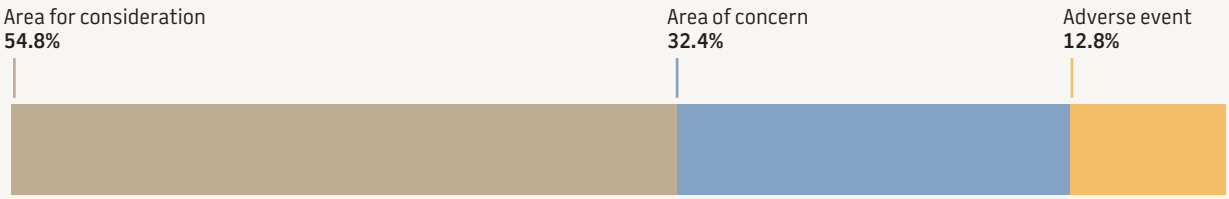
4.4 Clinical management issues (continued)

One or more CMI were identified in 16.5% of cases (365/2,213) in the period 2017 to 2021. There were no CMI identified in 83.5% of cases (1,848/2,213).

Assessors may identify several CMI for each patient. Figures 29 to 31 show data based on the number of CMI, not the number of patients.

Assessors reported 571 CMI in 365 cases (Figure 29). Between 2017 and 2021 more than half (54.8%; 313/571) of the CMI identified were areas for consideration. Areas of concern and adverse events comprised 32.4% (185/571) and 12.8% (73/571) of CMI, respectively.

Figure 29: Categories of CMI



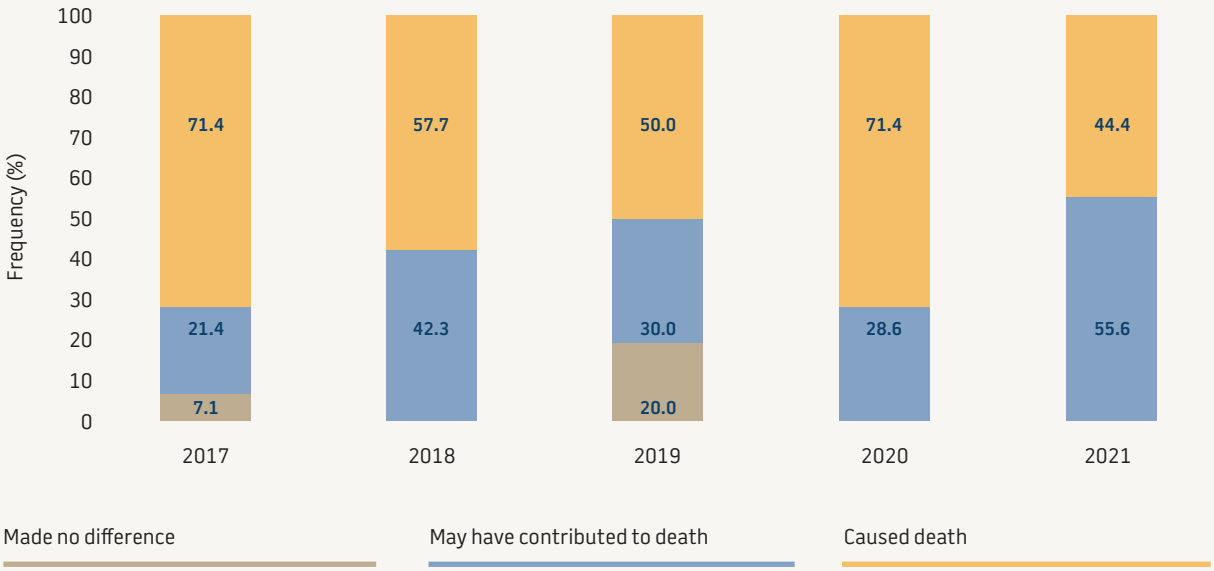
CMI: clinical management issues.
Refer to Appendix D.2 for further information on data.

4.4 Clinical management issues (continued)

When an adverse event is identified, assessors are asked to indicate the degree of impact this may have had on the clinical outcome. Assessors' perceptions of the impact of adverse events on clinical outcomes, per year, is shown in Figure 30.

In the period 2017 to 2021, assessors perceived that 35.6% of the reported adverse events (26/73) may have contributed to the death and 60.3% (44/73) caused the death of the patient. For 4.1% of reported adverse events (3/73), assessors perceived that it made no difference to the outcome of the patient. This varied widely by year.

Figure 30: Assessor perception of impact of adverse event on clinical outcome, by year



Note: Some 2021 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

4.4 Clinical management issues (continued)

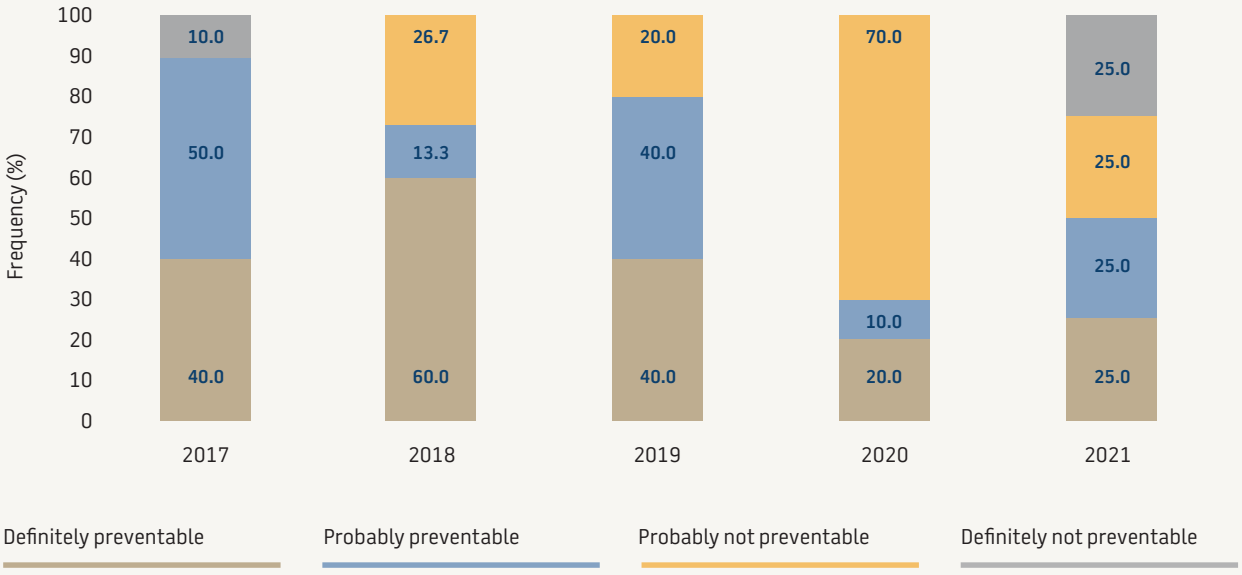
Assessors also report on the preventability of any adverse event that caused the death of a patient (Figure 31).

Assessors indicated that 4.5% of adverse events (2/44) that caused the death of a patient were definitely not preventable. In 29.5% of adverse events (13/44) that caused the death of a patient, assessors stated that the deaths were probably not preventable.

Assessors considered that 25.0% of adverse events (11/44) that resulted in the death of a patient were probably preventable. In 40.9% of adverse events (18/44) that caused the death of a patient, assessors indicated that the deaths were definitely preventable.

In 2021, assessors indicated that an adverse event caused the death of 4 patients. Assessors considered that each of these adverse events were definitely not preventable; probably not preventable; probably preventable and definitely preventable.

Figure 31: Assessor perception of preventability of adverse event causing death, by year



Note: Some 2021 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

4.4 Clinical management issues (continued)

The 15 most common CMI are shown in Figure 32.

Assessors identified several CMI in some patients. Decision to operate (15.1%; 55/365) and delay to surgery (11.0%; 40/365) were the 2 most frequently reported CMI.

Figure 32: Most frequently reported CMI

CMI: clinical management issues.

*READ codes are surgical diagnoses categorised using a coded thesaurus of clinical terms (READ codes). READ codes form a clinical decision tree containing terms, synonyms and abbreviations covering all aspects of patient care.

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

Overall, 30.9% of the CMI related to whether the assessor thought an operation should have been undertaken, or that there was a different and, by implication, better option. Both are decisions that firmly lie in the remit of the consultant surgeons. Another 19.8% of CMI related to some sort of delay. Therefore, 50.7% of all CMI related to the decision to operate, the choice of operation or delay.

5. A closer look: 20 years of a mortality audit

This section reviews WAASM data since it commenced in 2002. It considers some overall themes, followed by specific specialties that have a high surgical mortality. When reviewing these data, there are some important general observations.

- There can be substantial year-on-year variation. It is the trend that is important.
- There will have been many healthcare changes over this period, and there are obvious difficulties in determining the impact of each.
- While WAASM can demonstrate clear examples where it has impacted and improved care, its major impact is likely to have been much more subtle and therefore less easy to demonstrate.

Some background issues need to be considered. The 3 examples below would be expected to increase the number of deaths. However, that did not occur.

- During the 20 years, the WA population increased from 1.9 to 2.6 million (36.8%).
- There was a substantial increase in the older population,[(10)] who tend to have greater operative risk.
- The increased older population could be associated with an increase in comorbidities known to adversely impact outcome (e.g. diabetes and obesity).

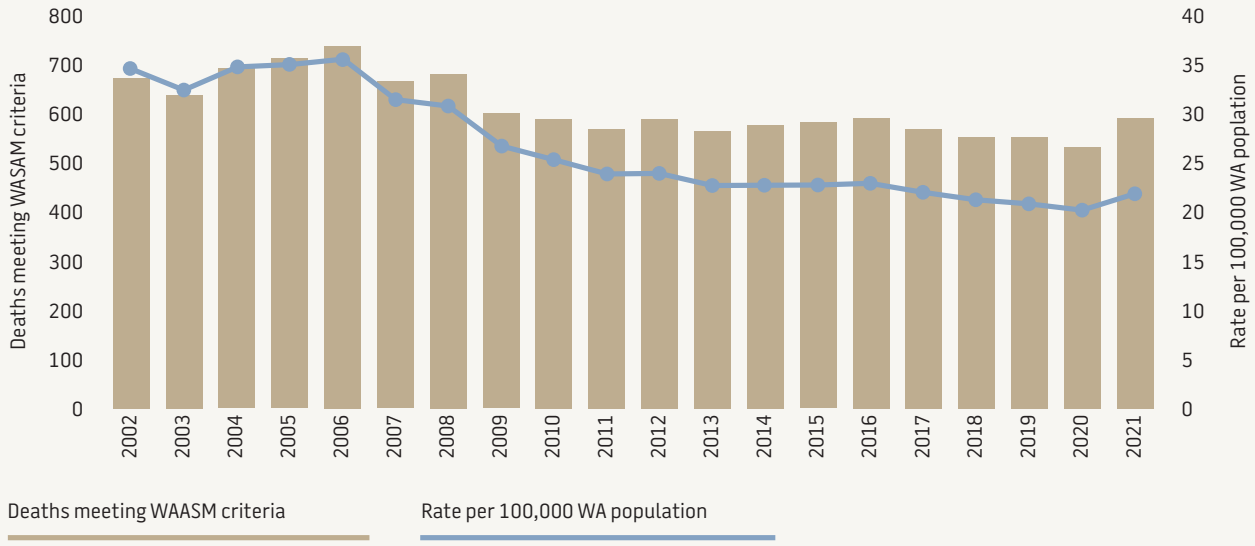
The completeness of the data can also be a factor in interpretation. In some analysis, the denominator (case ascertainment) is the number of cases notified to WAASM. The notification process to WAASM is detailed and it sometimes incorrectly attributes some deaths to surgeons, these deaths are excluded. Once included in WAASM, the analysis depends on the completeness of individual data fields. Some cases have to be excluded because the surgeon has not yet returned the SCFs. In some of the SCFs returned, the surgeon has not fully completed the questions asked in the form. The importance of full case ascertainment, data completeness and proper classification of terminal care cases has been covered elsewhere in this report.

5.1 Overall deaths

In the early years, participation in WAASM was voluntary. The higher proportion of deaths prior to 2006 likely reflects increasing participation. From 713 and 740 deaths per year in 2005 and 2006, there was a fall of 18.5%, to 592 deaths in 2012, that has since plateaued. When corrected for the greater population, over the 20 years, the number of deaths has continued to fall (from 34.7 to 22.0 deaths per 100,000 WA population, a decrease of 36.6%) as shown in Figure 33.

5.1 Overall deaths (continued)

Figure 33: WAASM deaths and mortality rate per 100,000 WA population, 2002–2021

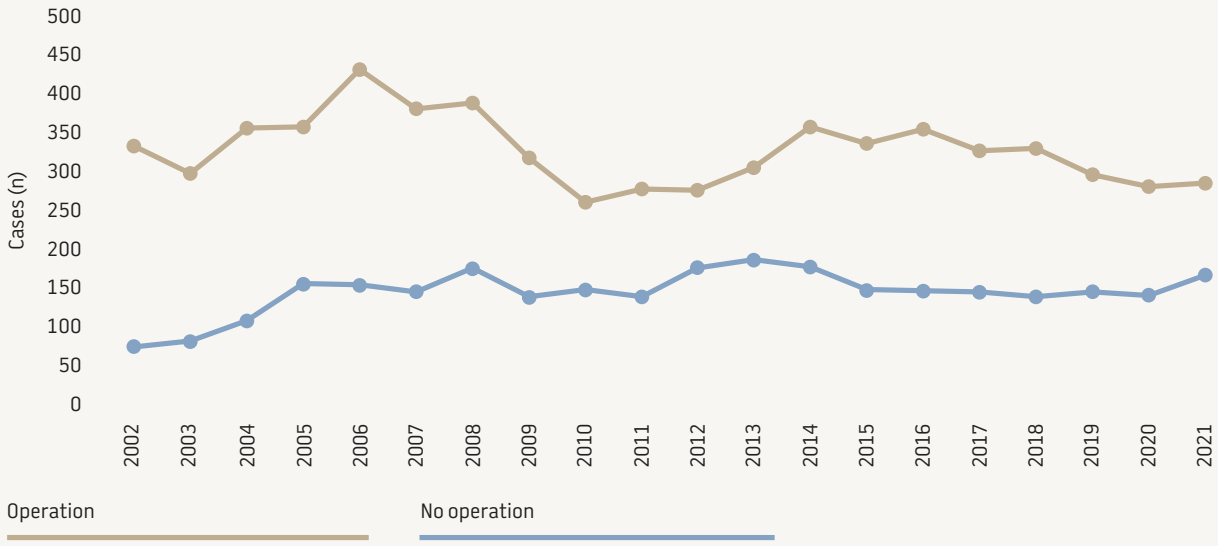


Note: All cases, including terminal care cases, were included in this analysis.
Refer to Appendix D.2 for further information on data.

5.1 Overall deaths (continued)

Over the first 10 years, there was an increase in the number of patients who died under the care of a surgeon but who did not have an operation (Figure 34). This suggests a greater recognition of the limitations of surgery and may reflect WAASM's long-term interest in, and reporting of, futile surgery. There has been increased attention given to end-of-life care and defining goals of care. This was the theme of the 2016 WAASM symposium.

Figure 34: Operative and nonoperative cases, 2002–2021



Note: All terminal care and pending cases were excluded in this analysis.
Refer to Appendix D.2 for further information on data.

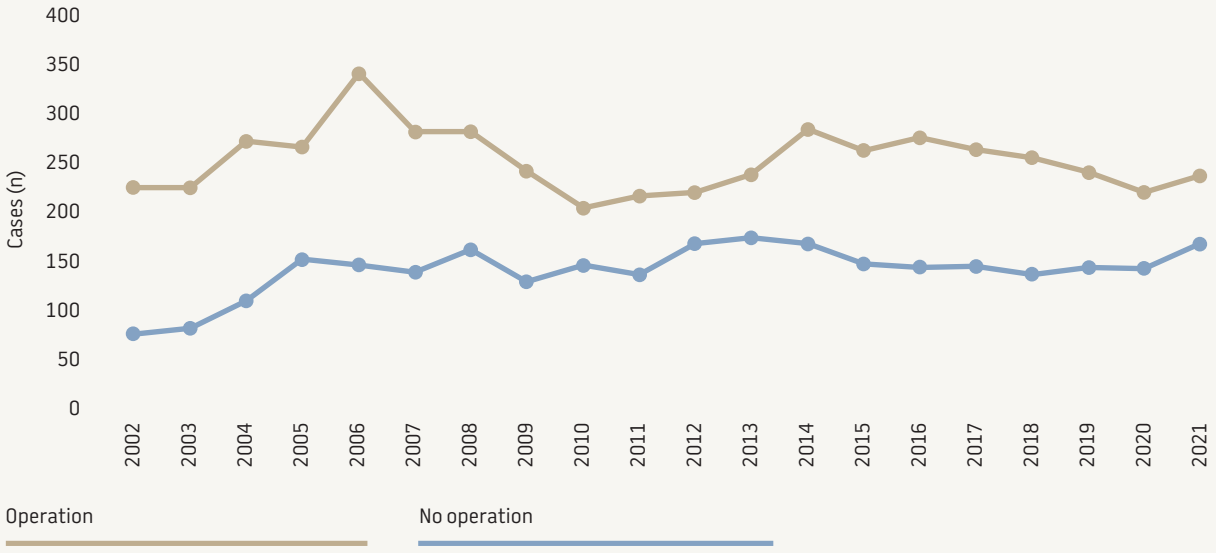
5.1 Overall deaths (continued)

In more recent years, the number of nonoperative deaths has remained relatively unchanged. The reasons for patients not having an operation will vary. It might be because with different and perhaps better care, some patients previously not offered an operation are now being offered surgery. For example, patients with a ruptured aortic aneurysm who previously may not have been offered an operation may now be offered a 'lower risk' endovascular procedure. If these patients die, they would appear as a postoperative mortality rather than having died without an operation.

On the other hand, septic patients with an abdominal abscess who may previously have been offered very high risk surgery and died might now be managed with improved antibiotics and percutaneous drainage and survive. These patients would not appear as a postoperative mortality and would not be included in WAASM data as they did not die. Alternatively, where a nonoperative interventional procedure by another specialty results in a complication, it may be a surgeon who is called to rescue the patient. If the patient subsequently dies, this will be counted as a postoperative mortality under the surgeon. WA surgeons sympathise with their colleagues – 'It is not always my fault, but it is always my death'.

Many emergency surgical admissions are not offered surgery. Over the 20 year period, the overall proportion managed without surgery has increased from 24.7% (74/300) to 41.2% (167/405). At the same time, the proportion of emergency postoperative deaths has fallen from 75.3% (226/300) to 58.8% (238/405) (Figure 35).

Figure 35: Emergency admissions operative and nonoperative cases, 2002–2021

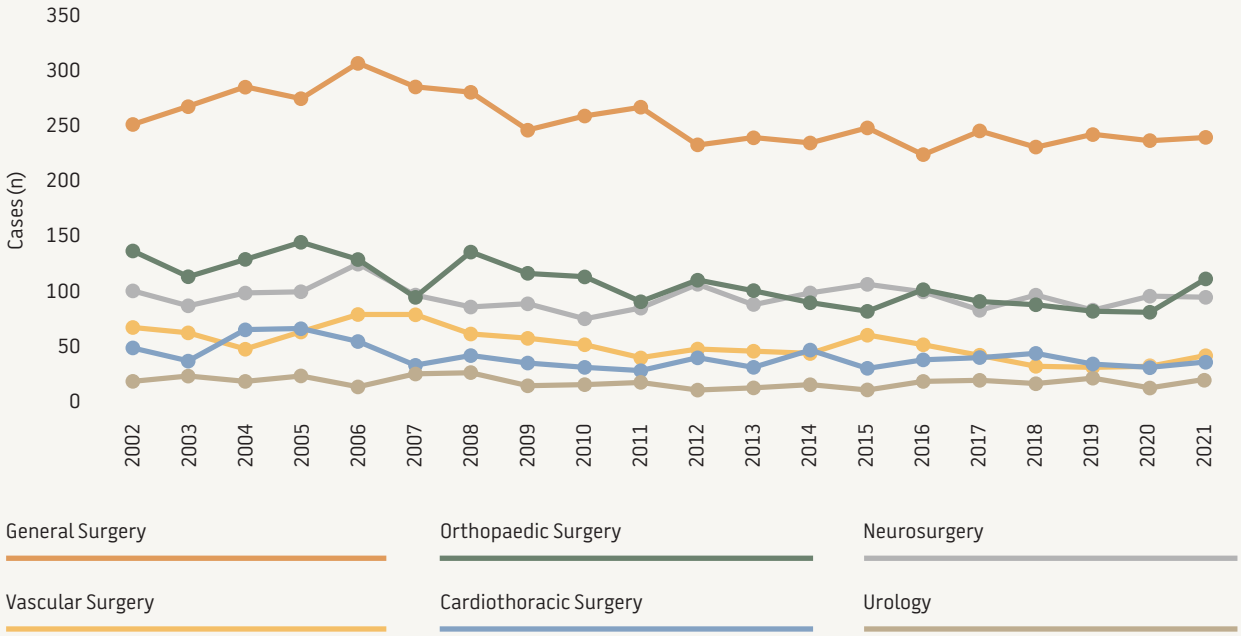


Note: All terminal care and pending cases were excluded in this analysis.
Refer to Appendix D.2 for further information on data.

5.1 Overall deaths (continued)

The number of deaths varies by specialty (Figure 36).

Figure 36: Number of deaths in the major specialties, 2002–2021

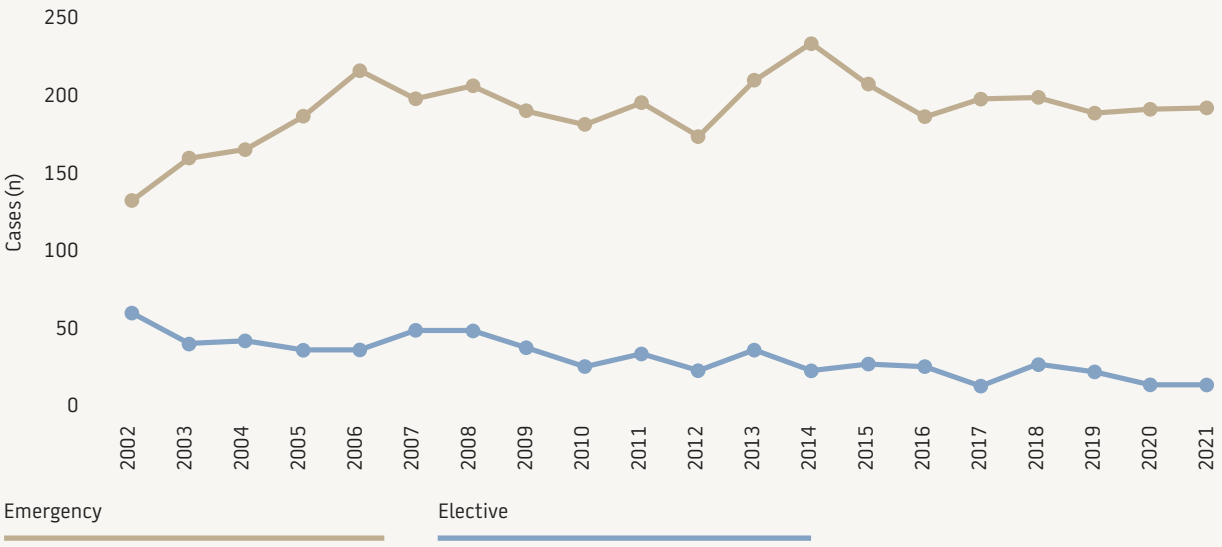


Note: All cases, including terminal care cases, were included in this analysis.
Refer to Appendix D.2 for further information on data.

5.2 General Surgery

The overall data is dominated by General Surgery, which is responsible for 41.9% of all deaths (5,147/12,280). In the early years, there were an average of 37 deaths per annum following an elective General Surgery admission. Over the last 4 years, there has been an average of 16 deaths per annum (Figure 37). During the same period, deaths following an emergency General Surgery admission have remained unchanged. This needs to be considered against the increasing and ageing population.

Figure 37: General Surgery elective and emergency admissions, 2002–2021

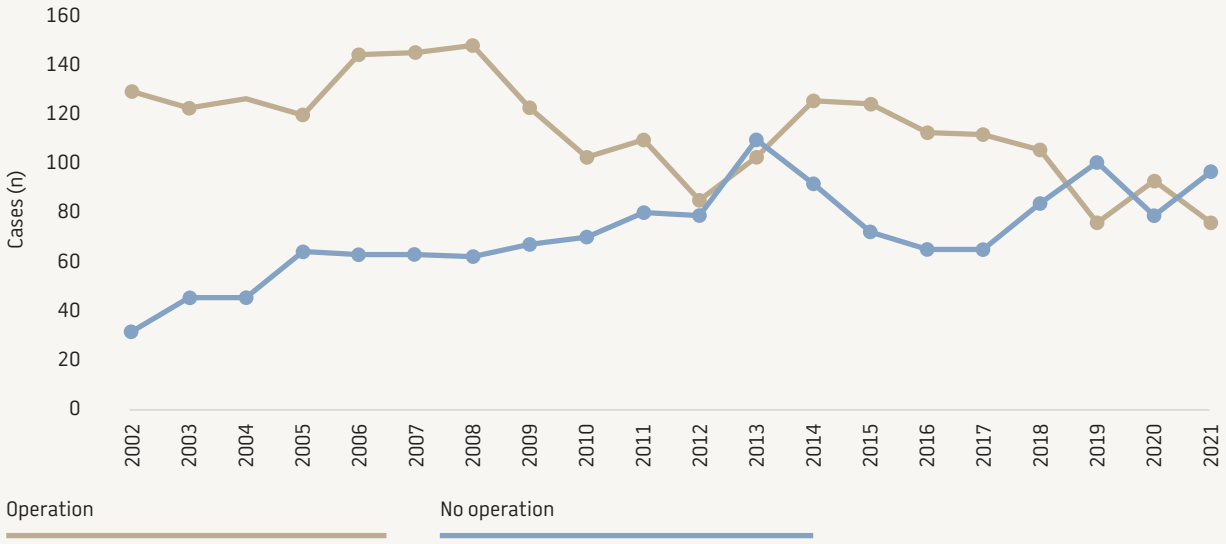


Note: All terminal care and pending cases were excluded in this analysis.
Refer to Appendix D.2 for further information on data.

5.2 General Surgery (continued)

There has been a substantial change in the 'pattern' of General Surgery deaths. In the early years (2002–2004), an average of 24.4% did not have an operation; in the later years (2019–2021), this increased to an average of 53.0% (Figure 38). This change is driven by those patients admitted as an emergency.

Figure 38: General Surgery operative and nonoperative cases, 2002–2021



Note: All terminal care and pending cases were excluded in this analysis.
Refer to Appendix D.2 for further information on data.

There is good reason to believe that WAASM has played an important role in the changes related to General Surgery. One example is emergency General Surgery admissions, where many patients are high risk and the outcome is dependent on timely surgery. In 2006, WAASM data was presented to the WA Department of Health who accepted the case for separating elective and emergency General Surgery, with the latter having access to consultant-led emergency theatres. Perth became the first Australian metropolitan city in which the major hospitals separated emergency and elective General Surgery. Such separation is now a widely recommended organisational arrangement.

A second example is major upper gastrointestinal surgery. Acting on evidence provided by WAASM in 2007 and 2008, the WA Department of Health determined that all major pancreatic resections should only be performed in the 3 tertiary hospitals. A consequence of this was that most other major upper gastrointestinal surgery gravitated to the same hospitals, so all these high-risk operations were concentrated in dedicated units with all the supporting services. The mortality for these operations has since fallen.

In the earlier years, the overall proportion of postoperative deaths in General Surgery fell from 80.4% (2002) to 69.7% (2007). The fall in postoperative deaths over the last 3 years (2019–2021) compared to the previous 3 years (2016–2018) may reflect the lessons WA has learned from its participation in the emergency laparotomy audits (from 83 to 111, respectively; 25.2% reduction). This reduced mortality is likely to reflect

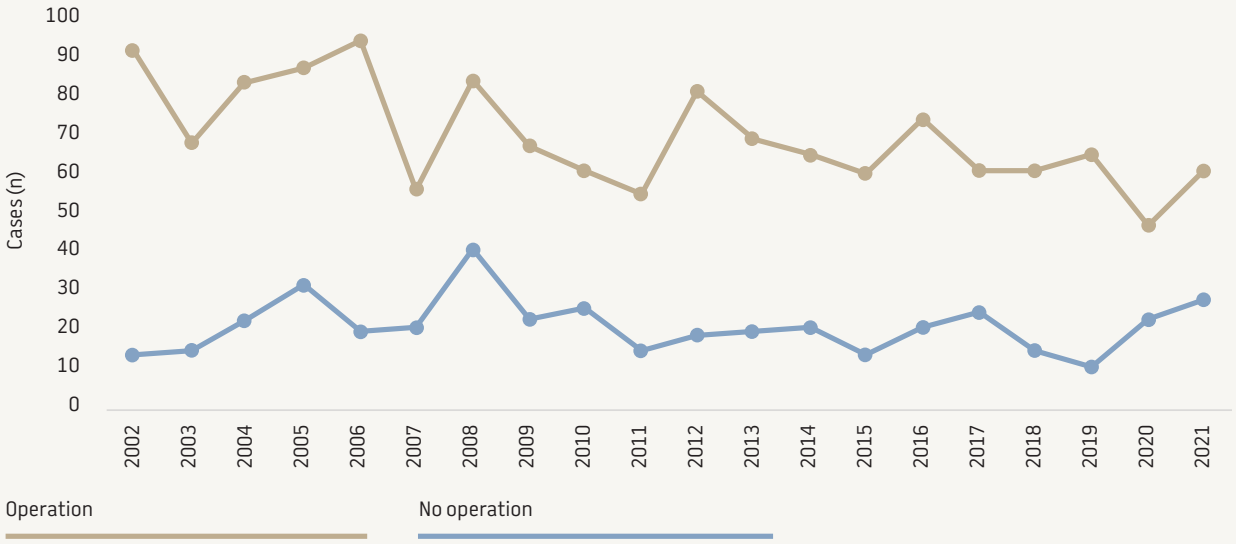
5.2 General Surgery (continued)

both the direct and indirect (Hawthorne) effects. Patients who have an emergency laparotomy performed by a gastrointestinal surgeon with a special interest that is the same as the pathology have a lower mortality.[12] The WA tertiary hospitals where most emergency laparotomies are undertaken, have an informal but active referral process between specialties.

5.3 Orthopaedic Surgery

The number of nonoperative Orthopaedic Surgery deaths has remained at approximately 20 per year. The overall fall in orthopaedic deaths has been driven by a lower postoperative mortality. The Australian and New Zealand Guidelines for Hip Fracture Care was published in 2014 and the first full year of the binational Hip Fracture Registry was 2015, with the Australian Commission on Safety and Quality in Health Care Hip Fracture Clinical Care Standards released in 2016. The average number of postoperative orthopaedic deaths per annum has progressively fallen from 81 to 66 to 61 (2002–2008, 2009–2014 and 2015–2020, respectively; Figure 39).

Figure 39: Orthopaedic Surgery operative and nonoperative cases, 2002–2021



Note: All terminal care and pending cases were excluded in this analysis.
Refer to Appendix D.2 for further information on data.

This was driven by the fall in deaths after an emergency admission. In the 7 years prior to the Hip Fracture audit commencing, the average number of deaths per annum following all emergency admissions was 85 versus 75 in the 7 years after (an 11.8% reduction).

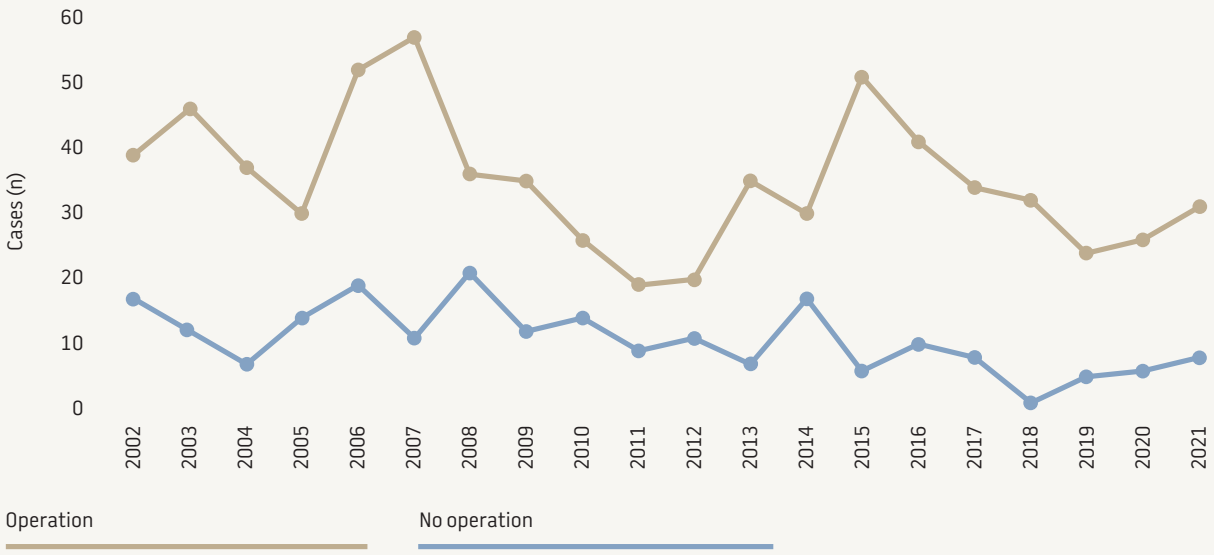
5.4 Vascular Surgery

During the 20 years, there was a huge growth in Vascular Surgery, which peaked in 2007 and 2008 for operative and nonoperative cases, respectively.

It seems there was a fall in operative mortality up to 2012, which presumably reflected the improved endovascular procedure results beyond the learning curve. However, the number of operative deaths then rose towards earlier levels (Figure 40) although the annual variation makes interpretation difficult. The average number of postoperative deaths per year prior to 2012 was 38, and from 2012 onwards was 32, a 15.8% reduction. The average number of postoperative deaths per year in the first and last 6 years was 44 and 31, respectively, a 29.5% reduction.

The average number of deaths without an operation before 2012 was 14 per year, and from 2012 onwards was 8 per year, a 42.9% decrease.

Figure 40: Vascular Surgery operative and nonoperative cases, 2002–2021

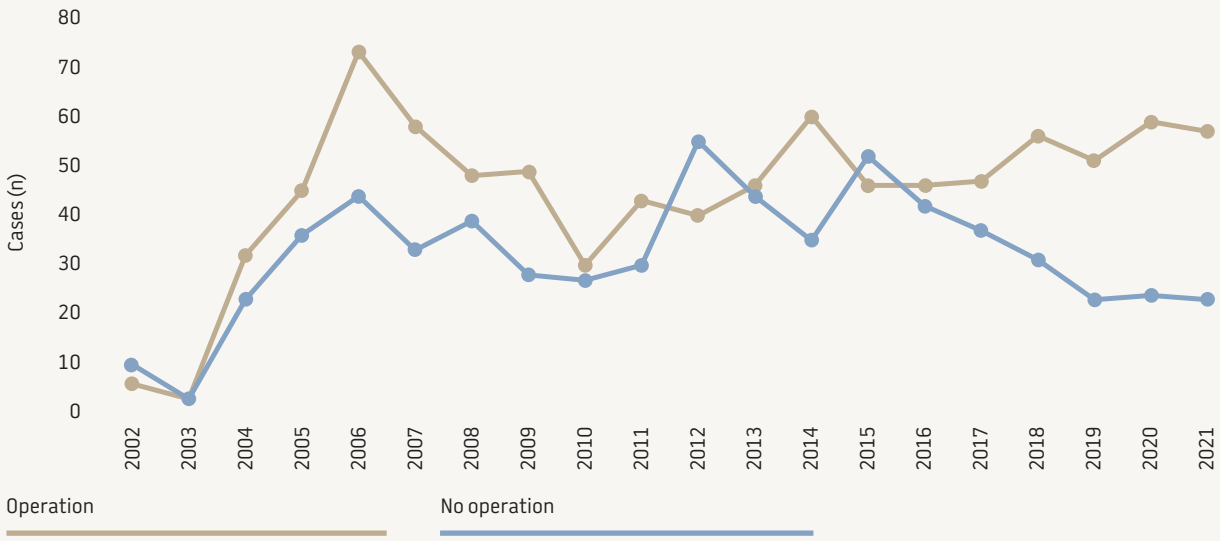


Note: All terminal care and pending cases were excluded in this analysis.
Refer to Appendix D.2 for further information on data.

5.5 Neurosurgery

Since 2015, there has been a fall in the number of Neurosurgery patients who did not have surgery, and an increase in the number of postoperative deaths (Figure 41). One explanation might be that some patients who in the past did not have surgery are now being offered an operation and some of these, presumably very high risk patients, died. The impact of nonoperative interventional procedures is unknown.

Figure 41: Neurosurgery operative and nonoperative cases, 2002–2021



Note: All terminal care and pending cases were excluded in this analysis.
Refer to Appendix D.2 for further information on data.

5.6 Other specialties

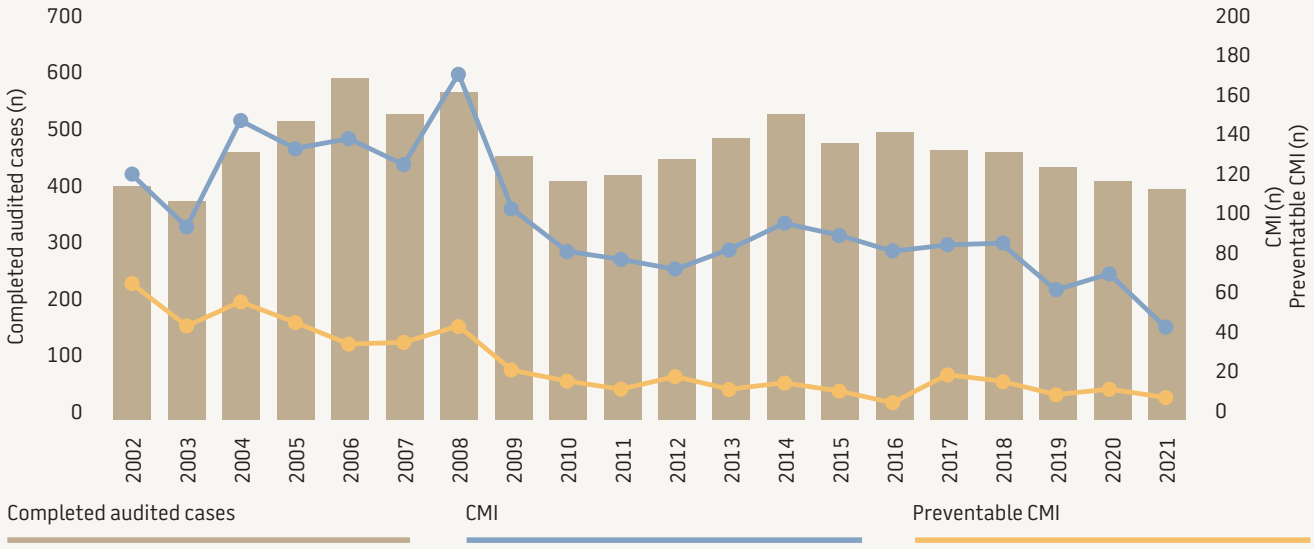
Although Figure 36 references Cardiothoracic Surgery and Urology, further data has not been presented. The number of deaths in these and other specialties is small and makes interpretation difficult.

5.7 Fall in clinical management issues

There will always be unpreventable deaths, so at some point the number will reach a natural floor and plateau. In WA, that seems to be about 550 deaths per year. This then raises the question as to whether the greater number of deaths (approximately 150) in earlier years was an 'excess' mortality, that has now been eliminated. If that is so, these 'excess' deaths were presumably preventable. There would therefore be an expectation that the number of CMI would fall, and especially the number of preventable CMI.

Over the 20 years, the average number of CMI fell from 123 (2002-2004) to 63 (2019-2021) per year, a 48.8% reduction. The average number of CMI that assessors deemed preventable also fell, from 59 (2002-2004) to 15 (2019-2021) per year, a reduction of 76.4%. The graph suggests this was a slow, gradual but continuous trend and consistent with the learning and education that WAASM promotes (Figure 42).

Figure 42: Association of CMI, preventable CMI and completed audited cases, 2002–2021



Note: Only completed cases were included in this analysis.
Refer to Appendix D.2 for further information on data.

Some will doubtless argue that the fall in deaths and CMI is analogous to the 'chicken or egg'. However, the fall in the number and proportion of CMI was greater and faster than the fall in deaths. This makes a compelling case to support the view that the fall in CMI contributed to the fall in deaths.

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- Royal Australasian College of Surgeons (RACS), for infrastructure and oversight of this project
- Australian and New Zealand Audit of Surgical Mortality (ANZASM) Steering Committee

- **WAASM Management Committee:**

Dr James Aitken	WAASM Clinical Director and general surgical representative
Dr Nicole Leeks	Consultant Orthopaedic Surgeon, orthopaedic surgical representative
Professor Francis Lannigan	Consultant Otolaryngology Head and Neck Surgeon, otolaryngology head and neck surgical representative
Dr Sabu Thomas	Consultant General Surgeon, rural surgical representative
Dr Jennifer Bruce	Consultant Anaesthetist, anaesthetic representative
Dr Richard Murphy	Consultant Obstetrician and Gynaecologist, obstetrics & gynaecology representative
Mr Rasa Subramaniam	Consumer representative

- **WAASM staff:**

Dr Franca Itotoh	Project Manager
Ms Natalie Zorbas	Senior Project Officer
Ms Katie Morgan	Administrative Officer

- **RACS, particularly Research, Audit and Academic Surgery (RAAS) staff:**

Professor Guy Maddern	Chair, ANZASM Steering Committee
A/Professor Wendy Babidge	General Manager, RAAS
Dr Helena Kopunic	Manager, Surgical Audit
Ms Jo Vabolis	Academic Editor

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Appendices

Appendix A: Review of 2021 recommendations data

Figure A.1: Deaths with trauma implicated, 2017–2021

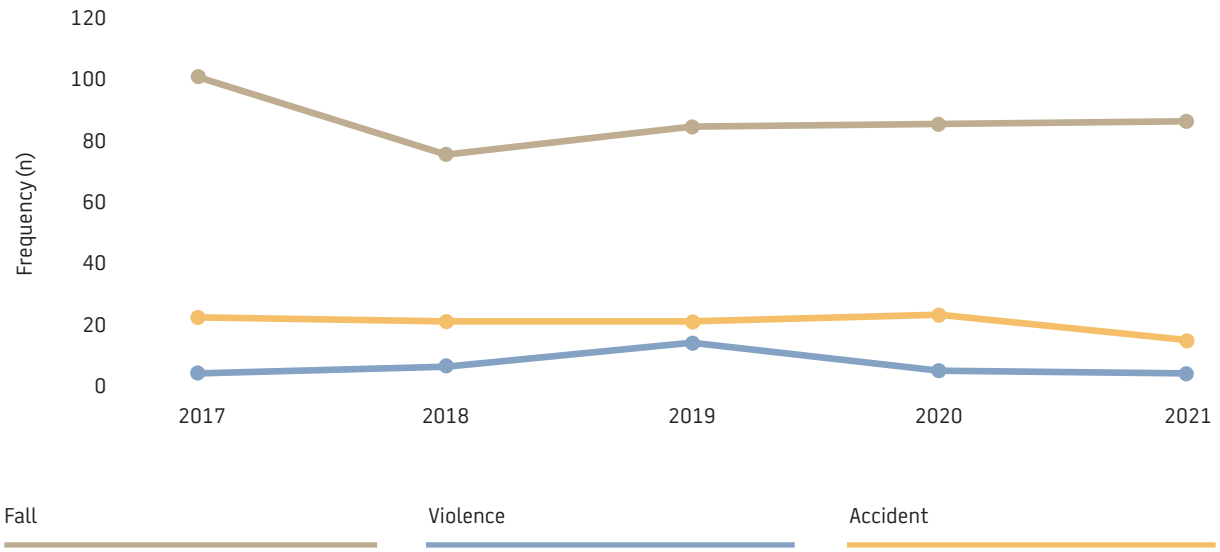
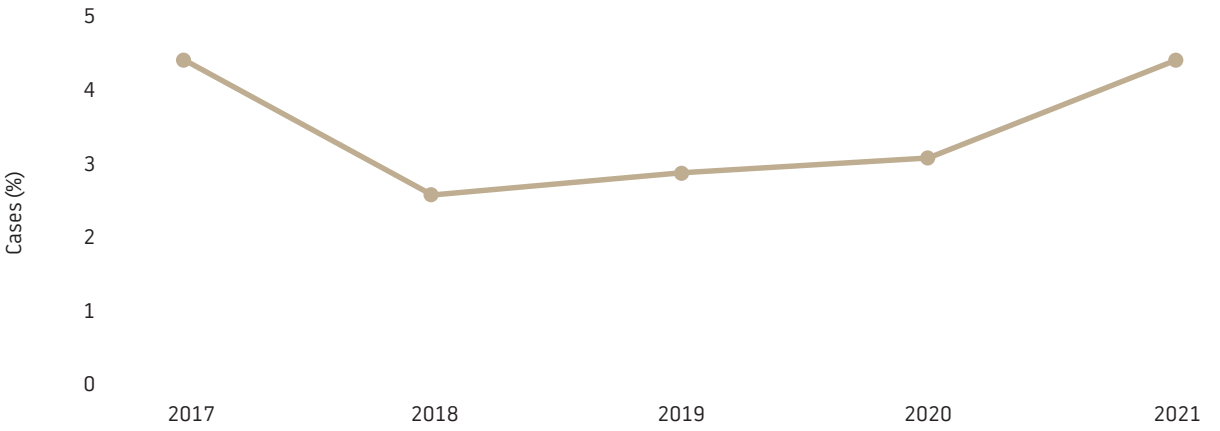
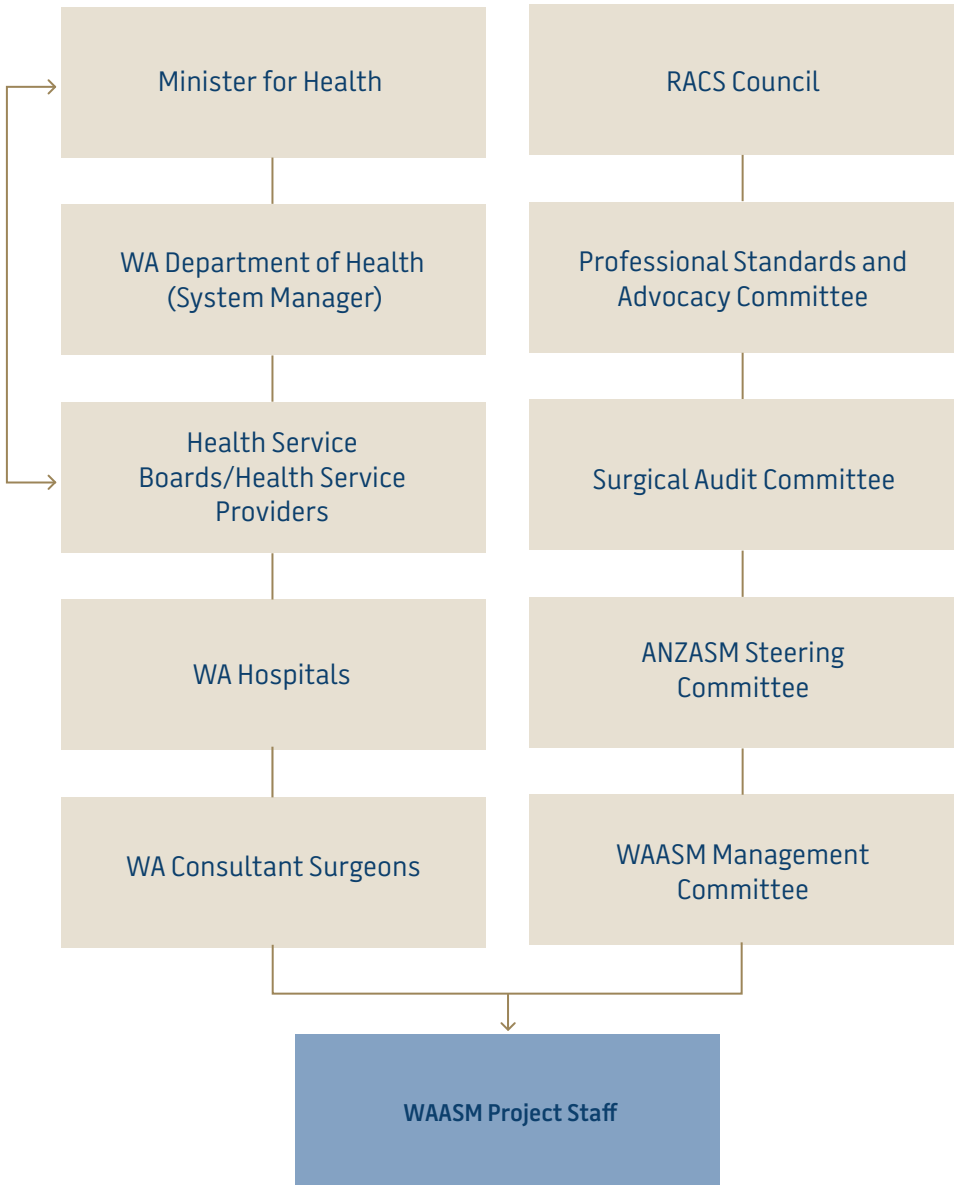


Figure A.2: Deaths with communication issues cited during care, 2017–2021

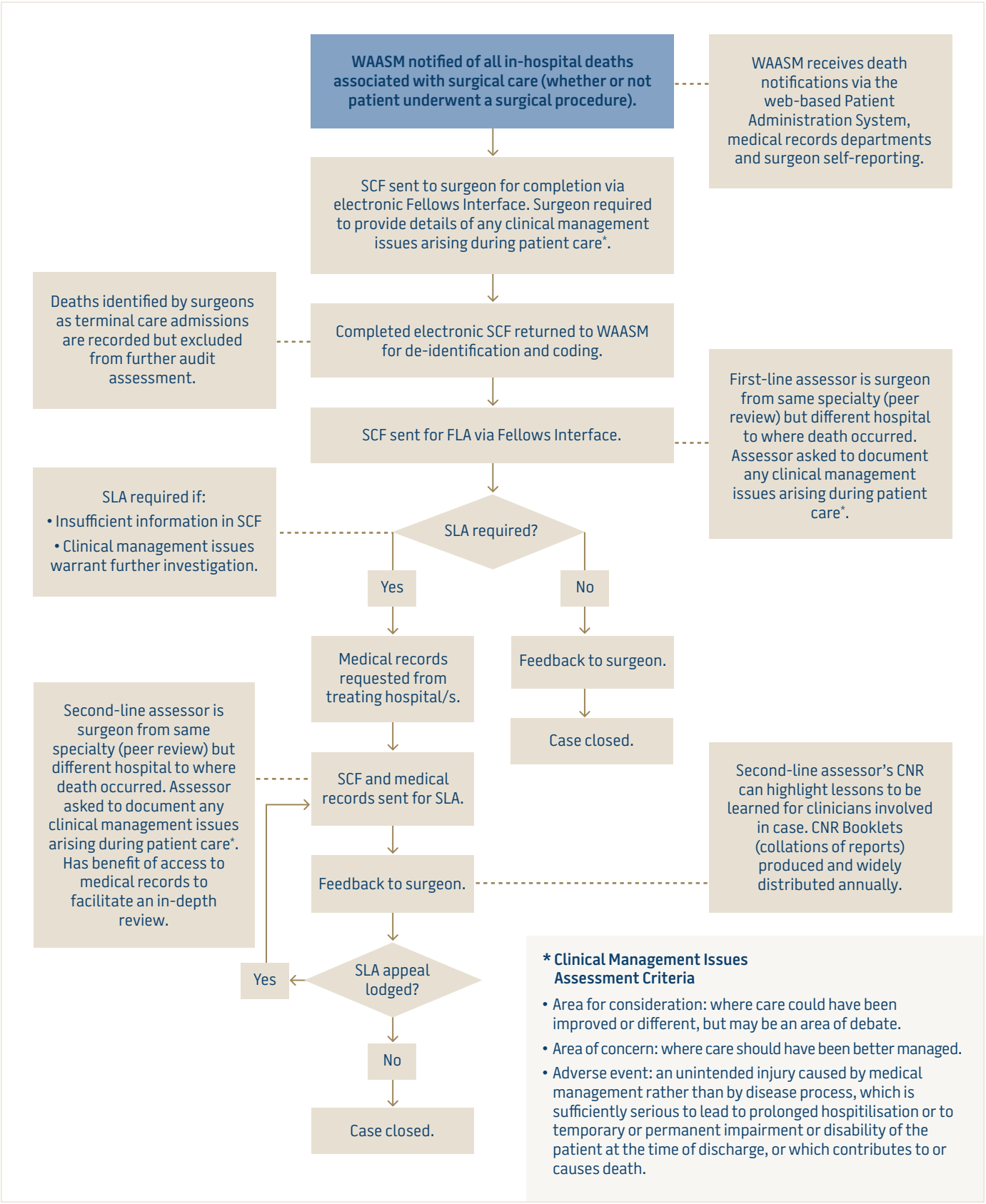


Appendix B: WAASM governance structure



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.

Appendix C: WAASM audit process



WAASM: Western Australian Audit of Surgical Mortality, SCF: surgical case form, FLA: first-line assessment, SLA: second-line assessment, CNR: case note review.

*See Clinical Management Issues Assessment Criteria.

Appendix D: Data definitions

Appendix D.1 Tables

Table 1: Deaths reported to WAASM, by year	
Definition	Counts of deaths reported to WAASM by year.
Data included	All data collected between 2017 and 2021. Total numbers of deaths reported to WAASM, including 'excluded error' cases (n=2,912).
Data excluded	No exclusions.
Table 2: WAASM deaths by surgical specialty	
Definition	Counts and percentages of surgical mortality data in relation to surgeon specialty.
Data included	All deaths falling within WAASM criteria (n=2,803).
Data excluded	All 'excluded error' cases (n=109).
Table 3: Median age by sex	
Definition	Median age by sex for all cases.
Data included	All deaths falling within WAASM criteria (n=2,803).
Data excluded	All 'excluded error' cases (n=109).
Table 4: Peer-review assessments, by year	
Definition	Counts of FLAs returned and counts and percentages of cases where SLAs were recommended.
Data included	All deaths falling within WAASM criteria where an FLA was returned.
Data excluded	All 'excluded error', 'surgical case pending' and 'excluded terminal care' cases.

Appendix D.2 Figures

Figure 1: Deaths audited by WAASM	
Definition	Counts of deaths reported to WAASM. Not audited comprised 'excluded error' and 'lost to follow up' cases. Audited comprised 'finalised' cases [cases that have completed the entire audit process and terminal care cases] and 'in progress' cases [all 'surgical case pending', 'first-line assessment pending', 'first-line assessment complete', 'second-line assessment pending', 'medical records pending' and 'medical records received' cases].
Data included	All data collected between 2017 and 2021 (n=2,912).
Data excluded	No exclusions.
Figure 2: Most common causes of death	
Definition	Percentages of the 5 most common causes of deaths.
Data included	All deaths falling within WAASM criteria. Some cases had more than one cause of death reported (n=3,466).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases.
Figure 3: Case status, by year	
Definition	Deaths falling within WAASM criteria and audit case status by year. Audit process complete comprised all cases that have completed the entire audit process. Pending cases comprised all 'surgical case pending', 'first-line assessment pending', 'first-line assessment complete', 'second-line assessment pending', 'medical records pending' and 'medical records received' cases. Excluded cases comprised 'excluded terminal care' and lost to follow up' cases.
Data included	All deaths falling within WAASM criteria (n=2,803).
Data excluded	All 'excluded error' cases (n=109).
Figure 4: WAASM deaths and mortality rate per 100,000 WA population, by year	
Definition	Number of deaths falling within WAASM criteria per year and mortality rates per 100,000 WA population.
Data included	All deaths falling within WAASM criteria (n=2,803).
Data excluded	All 'excluded error' cases (n=109).
Figure 5: Deaths by hospital status, by year	
Definition	Percentages of all cases by hospital status per year. Co-location hospitals are those that provide privately and publicly funded surgical services; data for co-location hospitals includes public and private patients.
Data included	All deaths falling within WAASM criteria where hospital status was reported (n=2,265).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases.

Appendix D.2 Figures (continued)

Figure 6: 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 WAASM criteria where hospital admission was reported (n=2,261).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. Data missing=5.
Figure 7: Deaths by age group and sex	
Definition	Counts of deaths by age groups and sex.
Data included	All deaths falling within WAASM criteria (n=2,803).
Data excluded	All 'excluded error' cases (n=109).
Figure 8: Operative and nonoperative cases by specialty	
Definition	Percentages of operative and nonoperative cases by surgical specialty.
Data included	All deaths falling within WAASM criteria where operative and nonoperative status was reported. Cardiothoracic Surgery (n=191), General Surgery (n=899), Neurosurgery (n=408), Obstetrics & Gynaecology (n=4), Ophthalmology (n=4), Otolaryngology Head & Neck Surgery (n=31), Oral/Maxillofacial (n=1), Orthopaedic Surgery (n=397), Paediatric Surgery (n=14), Plastic Surgery (n=46), Urology (n=95), Vascular Surgery (n=175).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. Data missing=1.
Figure 9: Consultant surgeon making the decision to operate, by year	
Definition	Percentages of consultant surgeons making the decision to proceed to surgery per year.
Data included	All deaths falling within WAASM criteria where the number of operations performed was reported (n=2,114).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All cases where an operation was not reported.
Figure 10: Consultant surgeon involvement in operations, by year	
Definition	Percentages of consultant surgeons operating, assisting and supervising in theatre per year.
Data included	All deaths falling within WAASM criteria where the number of operations performed was reported (n=2,114).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All cases where an operation was not reported.

Appendix D.2 Figures (continued)

Figure 11: Operations abandoned on finding a terminal situation, by year	
Definition	Percentages of operations abandoned on finding a terminal situation per year.
Data included	All deaths falling within WAASM criteria where operations abandoned were reported (n=2,048).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All nonoperative cases and all operative cases where a terminal situation was not reported. Data missing=66.
Figure 12: Unplanned return to operating theatre, by year	
Definition	Percentages of unplanned returns to operating theatre per year.
Data included	All deaths falling within WAASM criteria where unplanned returns to operating theatre were reported (n=1,515).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All nonoperative cases and all operative cases where unplanned return to theatre was not reported. Data missing=2.
Figure 13: Postoperative complications by hospital admission and 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 were reported (n=437).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All cases where an operation was not reported and all operative cases where a postoperative complication was not reported.
Figure 14: Reasons for not operating, by year	
Definition	Percentages of cases with reasons for not operating per year. Some cases reported more than one reason for not operating.
Data included	All nonoperative deaths (n=748) falling within WAASM criteria where reasons for no operation were reported.
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All cases where an operation was reported.
Figure 15: Cases with preoperative diagnostic delays	
Definition	Percentages and counts of cases with preoperative diagnostic delays.
Data included	All deaths falling within WAASM criteria where preoperative diagnostic delays were reported (n=2,264).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All cases where no preoperative diagnostic delays were reported. Data missing=2.

Appendix D.2 Figures (continued)

Figure 16: Hospital transfers, by year	
Definition	Percentages of hospital transfers per year.
Data included	All deaths falling within WAASM criteria where transfers were reported (n=2,238).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. Data missing=28.
Figure 17: Hospital transfer issues	
Definition	Percentages of issues associated with hospital transfers.
Data included	All deaths falling within WAASM criteria where transfer issues were reported (n=676).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All cases where transfers and transfer issues were not reported. Data missing: 'inappropriate level of care'=24; 'insufficient clinical information'=23; 'inappropriate transfer'=18; 'delay in transfer'=19.
Figure 18: Cases with specific comorbidities	
Definition	Percentages of cases with comorbidities.
Data included	All deaths falling within WAASM criteria where comorbidities were reported. Some cases reported more than one type of comorbidity.
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All cases where no comorbidities were reported.
Figure 19: Frequency of ASA grades	
Definition	Percentages of cases by ASA grades.
Data included	All deaths falling within WAASM criteria where ASA grades were reported (n=2,023).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All cases where no ASA grades were reported on. Data missing=243.
Figure 20: Cases with fluid balance issues, by year	
Definition	Percentages of cases with fluid balance issues per year.
Data included	All deaths falling within WAASM criteria where presence/non-presence of fluid balance issues were reported (n=2,257).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All cases where presence/non-presence of fluid balance issues were not reported. Data missing=9.

Appendix D.2 Figures (continued)

Figure 21: CCU use, by year	
Definition	Percentages of CCU (ICU and HDU) use/non-use per year.
Data included	All deaths falling within WAASM criteria where use (n=1,423) and non-use (n=836) of CCU was reported.
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. Data missing=7.
Figure 22: DVT prophylaxis use, by year	
Definition	Percentages of DVT prophylaxis use/non-use by year.
Data included	All deaths falling within WAASM criteria where use (n=1,747) and non-use (n=499) of DVT prophylaxis was reported on.
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. Data missing=20.
Figure 23: Type of DVT prophylaxis used	
Definition	Percentages of type of DVT prophylaxis used.
Data included	All deaths falling within WAASM criteria where DVT prophylaxis was used. Some cases reported more than one type of DVT prophylaxis used (n=1,747).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All cases where non-use of DVT prophylaxis and type of DVT prophylaxis were not reported.
Figure 24: Clinically significant infections	
Definition	Percentages and counts of cases with clinically significant infections.
Data included	All deaths falling within WAASM criteria where clinically significant infections were reported (n=2,259).
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=7.
Figure 25: Type of clinically significant infection reported	
Definition	Percentages of type of clinically significant infections reported.
Data included	All deaths falling within WAASM criteria where type of clinically significant infections was reported on (n=655).
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=1.

Appendix D.2 Figures (continued)

Figure 26: Assessor opinion on appropriateness of DVT prophylaxis decision, by year	
Definition	Percentages of appropriateness of DVT prophylaxis decision as reported by assessors by year.
Data included	All deaths falling within WAASM criteria using the highest level of assessment in completed cases where appropriateness of DVT prophylaxis was reported on (n=1,774).
Data excluded	All 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending', 'excluded terminal care', 'medical record pending', 'medical records received' and 'lost to follow up' cases. All Neurosurgery cases. Data missing=31.
Figure 27: Assessor opinion on non-use of CCU, by year	
Definition	Percentages of cases where use of CCU (ICU and HDU) would have been beneficial, as reported by assessors per year.
Data included	All deaths falling within WAASM criteria using the highest level of assessment in completed cases where CCU were reported on (ICU, n=715; HDU, n=711).
Data excluded	All 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending', 'excluded terminal care', 'medical record pending', 'medical records received' and 'lost to follow up' cases; and all Neurosurgery cases. Data missing ICU=30, HDU=34.
Figure 28: Cases with CMI, by year	
Definition	Percentages of cases with CMI, as reported by assessors per year.
Data included	All deaths falling within WAASM criteria using the highest level of assessment in completed cases where CMI were reported (n=2,213).
Data excluded	All 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending', 'excluded terminal care', 'medical record pending', 'medical records received' and 'lost to follow up' cases; and all cases where CMI were not reported.
Figure 29: Categories of CMI	
Definition	Counts and percentages of categories of CMI, as reported by assessors. Based on the number of incidents of CMI, 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 CMI were reported (n=571).
Data excluded	All 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending', 'excluded terminal care', 'medical record pending', 'medical records received' and 'lost to follow up' cases; and all cases where CMI were not reported.

Appendix D.2 Figures (continued)

Figure 30: Assessor perception of impact of adverse event on clinical outcome, by year	
Definition	Percentages of perceived impacts of adverse events, as reported by assessors per year. Based on the number of incidents of CMI, 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=73).
Data excluded	All 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending', 'excluded terminal care', 'medical record pending', 'medical records received' and 'lost to follow up' cases; all cases where CMI were not reported; and all cases where 'areas for consideration' and 'areas of concern' were reported.
Figure 31: Assessor perception of preventability of adverse event causing death, by year	
Definition	Percentages of perceived preventability of adverse events causing death, as reported by assessors per year. Based on the number of incidents of CMI, 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=44).
Data excluded	All 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending', 'excluded terminal care', 'medical record pending', 'medical records received' and 'lost to follow up' cases; all cases where CMI were not reported; all cases where 'areas for consideration' and 'areas of concern' were not reported; and all cases where adverse events not causing death were reported.
Figure 32: Most frequently reported CMI	
Definition	Percentages and descriptions (in READ code) of the 15 most common CMI, as reported by assessors.
Data included	All deaths falling within WAASM criteria where CMI were reported (n=365).
Data excluded	All 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending', 'excluded terminal care', 'medical record pending', 'medical records received' and 'lost to follow up' cases; and all cases where CMI were not reported.
Figure 33: WAASM deaths and mortality rate per 100,000 WA population, 2002–2021	
Definition	Number of deaths falling within WAASM criteria per year and mortality rates per 100,000 WA population.
Data included	All deaths falling within WAASM criteria (n=12,280).
Data excluded	All 'excluded error' cases.

Appendix D.2 Figures (continued)

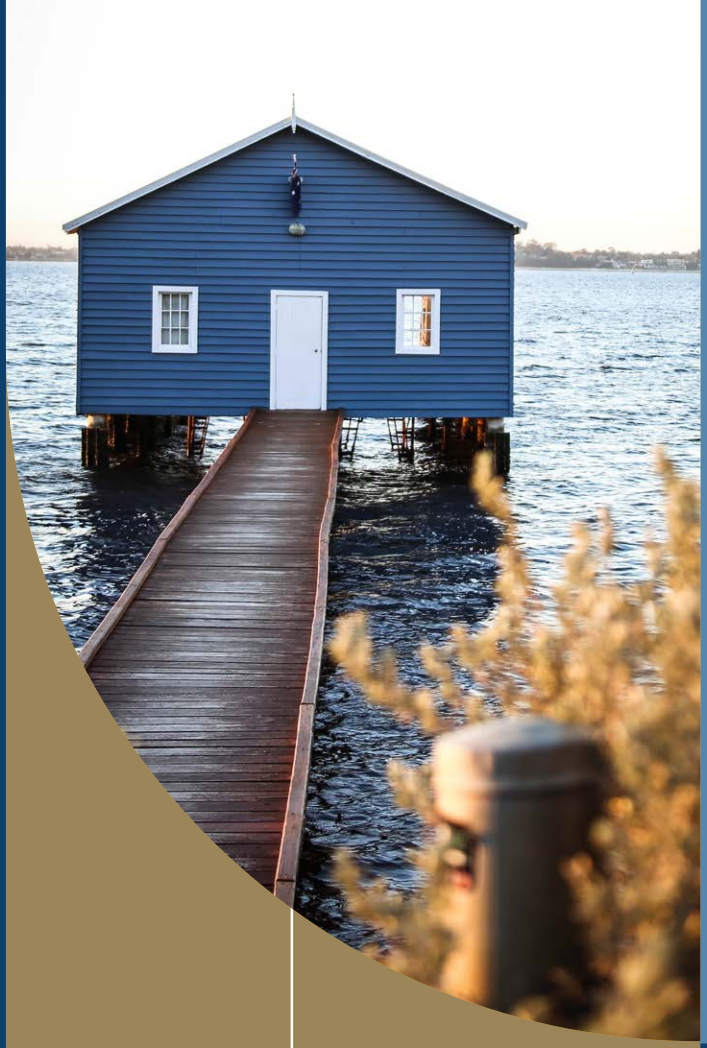
Figure 34: Operative and nonoperative cases, 2002–2021	
Definition	Counts of all operative and nonoperative cases by year.
Data included	All deaths falling within WAASM criteria where operative and nonoperative status was reported (n=9,484).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. Data missing=506.
Figure 35: Emergency admissions operative and nonoperative cases, 2002–2021	
Definition	Counts of emergency admissions operative and nonoperative cases by year.
Data included	All emergency admissions deaths falling within WAASM criteria where operative and nonoperative status was reported (n=7,874).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All cases where elective admissions were reported. Data missing=56.
Figure 36: Number of deaths in the major specialties, 2002–2021	
Definition	Counts of deaths by major surgical specialties. Cardiothoracic Surgery (n=907), General Surgery (n=5,147), Neurosurgery (n=1,977), Orthopaedic Surgery (n=2,219), Urology (n=445), Vascular Surgery (n=1,127).
Data included	All deaths falling within WAASM criteria (n=12,280).
Data excluded	All 'excluded error' cases. All Obstetrics & Gynaecology, Ophthalmology, Otolaryngology Head & Neck Surgery, Oral/Maxillofacial, Paediatric Surgery and Plastic Surgery cases.
Figure 37: General Surgery elective and emergency admissions, 2002–2021	
Definition	Counts of General Surgery elective and emergency admission cases by year.
Data included	All General Surgery cases where elective and emergency admission status was reported (n=3,787).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All other surgical specialties except General Surgery. Data missing=406.
Figure 38: General Surgery operative and nonoperative cases, 2002–2021	
Definition	Counts of General Surgery operative and nonoperative cases by year.
Data included	All General Surgery cases where operative and nonoperative status was reported (n=3,765).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All other surgical specialties except General Surgery. Data missing=418.

Appendix D.2 Figures (continued)

Figure 39: Orthopaedic Surgery operative and nonoperative cases, 2002–2021	
Definition	Counts of Orthopaedic Surgery operative and nonoperative cases by year.
Data included	All Orthopaedic Surgery cases where operative and nonoperative status was reported (n=1,818).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All other surgical specialties except Orthopaedic Surgery. Data missing=21.
Figure 40: Vascular Surgery operative and nonoperative cases, 2002–2021	
Definition	Counts of Vascular Surgery operative and nonoperative cases by year.
Data included	All Vascular Surgery cases where operative and nonoperative status was reported (n=916).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All other surgical specialties except Vascular Surgery. Data missing=6.
Figure 41: Neurosurgery operative and nonoperative cases, 2002–2021	
Definition	Counts of Neurosurgery operative and nonoperative cases by year.
Data included	All Neurosurgery cases where operative and nonoperative status was reported (n=1,534).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All other surgical specialties except Neurosurgery. Data missing=51.
Figure 42: Association of CMI, preventable CMI and completed audited cases, 2002–2021	
Definition	Counts of CMI and preventable CMI, as reported by assessors by year. Counts of completed audited cases by year.
Data included	All deaths falling within WAASM criteria using the highest level of assessment in completed cases where CMI and preventable CMI was reported by assessors.
Data excluded	All 'excluded error', 'surgical case pending', 'first-line assessment pending', 'second-line assessment pending', 'excluded terminal care', 'medical record pending', 'medical records received' and 'lost to follow up' cases; all cases where CMI were not reported.

Appendix D.3 American Society of Anesthesiologists Physical Classification Status

ASA grade	Characteristics
1	A normal healthy patient
2	A patient with mild systemic disease
3	A patient with severe systemic disease
4	A patient with severe systemic disease that is a constant threat to life
5	A moribund patient who is not expected to survive without the operation
6	A declared brain-dead patient whose organs are being removed for donor purposes



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