Royal Australasian
College of Surgeons

The Western Australian Audit of Surgical Mortality (WAASM)

2023 Report

5-year review
Jan 2018 - Dec 2022

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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 365 Excel.

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Clinical Director's report

Since the last report, there have been a number of important developments that will have implications for the Western Australian Audit of Surgical Mortality (WAASM).

In January 2023, the Australian Commission for Safety and Quality in Health Care (ACSQHC) circulated a draft version of its revised Framework for Australian Clinical Quality Registries (CQR).[1] This document was in keeping with the Federal Health Department 2020 to 2030 Strategy for CQR.[2] Its aims and processes were clearly laid out, very worthy and should be supported. They included near real time data collection and its timely sharing in an open and transparent manner. It emphasised the importance of full case ascertainment and complete, high-quality data.

Whilst there are no specific statements as to how compliance with CQR will be ascertained, one likely mechanism will be through the Australian Council on Healthcare Standards, which commenced mandatory short notice assessments to all applicable National Safety and Quality Heath Service Standards from 1 July 2023. A critical determinant of the success, or otherwise, of the Framework will be whether the political and jurisdiction leadership and funding that has previously been lacking, will be forthcoming.

In its response to the ACSQHC, the Royal Australasian College of Surgeons (RACS) acknowledged it had a professional obligation to provide leadership for matters that lie within its domain.[3] Options included linking surgeon compliance with its Mortality and Morbidity guidelines to their continuing professional development (CPD) and participation in CQRs, where they exist, with hospital accreditation. The Royal College of Surgeons of England has very clearly defined the requirements for its Fellows.[4]

Also in January 2023, the Australian Health Practitioner Regulation Agency introduced the concept of CPD Homes.[5] Previously, surgeons completed the RACS CPD program and reported their compliance to the Medical Board when renewing their membership. Unless selected for audit by RACS, there was no confirmatory check. With the advent of CPD Homes, this has changed. The onus will now be on RACS to report CPD compliant surgeons to the Medical Board.

One of the RACS CPD requirements is that surgeons complete their WAASM/Australian and New Zealand Audit of Surgical Mortality (ANZASM) obligations in a timely manner. When the RACS CPD year closes on 31 December each calendar year, there are always surgeons with outstanding surgical case forms (SCFs). RACS will be unable to report as compliant, those surgeons who still have SCFs outstanding.

In March 2023, WAASM hosted a half-day workshop titled *Human factors in the management of complex surgical environments.* This was prompted by the success of, and demand for, courses similar to those held by the Queensland Audit of Surgical Mortality/Northern Territory Audit of Surgical Mortality. The workshop was oversubscribed, indicating a clear demand in WA. There is enough expertise in WA for future workshops to be held within the state at minimal cost.

In this WAASM report, 2 sections are particularly important. The first summarises the clinical management issues (CMIs) reported by second-line assessors (Section 4.4). Surgeons should note that 6 of the 10 most frequent CMIs reflect issues with clinical care. The second relates to COVID-19 (Section 5.1).

Outside this report, there are 2 national observations that second-line assessors appear to be reporting more frequently. The first relates to surgery in very high-risk patients that is unlikely to be successful or beneficial, now frequently described as futile.[6] This may be emergency surgery in very high-risk patients or elective surgery in patients in whom the risks almost certainly outweigh the benefits. With an aging population, the balance between risk and benefit will become an increasingly frequent topic of discussion.

WAASM has previously noted that whilst it is almost always possible to establish what happened, it is often very difficult to understand the decision-making process that led to surgery. WAASM urges surgeons to provide details of such decision-making, and to attach letters and other documents that will assist the second-line assessors.

The second national observation, is the assessors' views that some cases would have benefited from direct, personal input by the consultant surgeon.[7] In many cases, the assessor's concern was not related to the reporting surgeon but to, for example, an assessment in the emergency department or by a physician. However, for emergency and high-risk patients, care should be consultant-based. Addressing this may require reorganisation of emergency services. A precedent for this was the separation of emergency and elective General Surgery in WA prompted by WAASM in 2006. Consultant surgeons should discuss the delivery of consultant-based care with colleagues and, if necessary, the hospital.

One of ANZASM's undoubted successes over the last 4 years has been the emailed *Case of the Month*. To misquote Michael McIntyre, the *Case of the Month* has been an unexpected star of the show. The case is selected from a pool of contributions submitted by each state audit; because the case is then truly anonymised, it is possible to use more 'controversial' cases. The resulting feedback, both directly to ANZASM but also in other forums, has often been substantial and frequently very robust. Surgeons are urged to read the *Case of the Month* even if not directly related to their specialty.

The 2022 WAASM Report included a section that reviewed WAASM data over the first 20 years. This prompted 2 national reports. The first, was a longitudinal analysis of national data using standardised mortality ratios, which showed a progressive and highly significant fall in deaths under a consultant surgeon.[8] This was observed in all states and across all specialties. It is difficult to think of any change to surgical care over the last 10 years that has had such a universal impact.

The second national report, examined the elapsed time from operation to death after an emergency laparotomy, using data from the Australian and New Zealand Emergency Laparotomy Audit.[9] Emergency laparotomy studies from the United Kingdom and the United States have suggested that many of those who had an early death (defined as within 4 days) were very high-risk; for some, the risk was so high that their surgery was predictably unlikely to be successful.[9] The early mortality after an emergency laparotomy in Australia was half of that seen overseas. It is likely this is a reflection of ANZASM's long-term interest in the avoidance of futile surgery. This observation is explored further in Section 5.2 of this report.

I once again need to express my sincere thanks to the WAASM staff – Franca Itotoh, Natalie Zorbas and Katie Morgan. It would be difficult to overstate how their long-standing commitment, service and corporate knowledge has benefitted all WA surgeons.

RJ Aitken

WAASM Clinical Director

Abbreviations

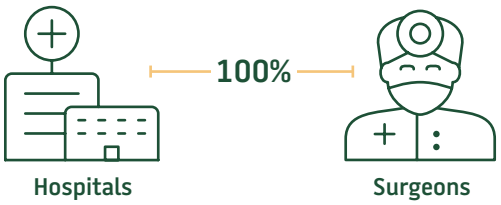
ACSQHC	Australian Commission for Safety and Quality in Health Care
ANZASM	Australian and New Zealand Audit of Surgical Mortality
ASA	American Society of Anesthesiologists
ASERNIP-S	Australian Safety and Efficacy Register of New Interventional Procedures – Surgical
CCU	Critical care unit
CMI	Clinical management issue
CNR	Case note review
CPD	Continuing professional development
CQR	Clinical quality registry
DVT	Deep vein thrombosis
FLA	First-line assessment
HDU	High dependency unit
ICU	Intensive care unit
RAAS	Research, Audit and Academic Surgery
RACS	Royal Australasian College of Surgeons
SCF	Surgical case form
SLA	Second-line assessment
SMR	Standardised mortality ratio
TED	Thromboembolic deterrent
WA	Western Australia/n
WAASM	Western Australian Audit of Surgical Mortality

Snapshot

This snapshot covers cases reported to WAASM from **1 January 2018 to 31 December 2022**.

Note: Differences in denominators are due to incomplete information provided in surgical case forms and assessment forms, resulting in missing data.

Participation



Analysis and audit numbers

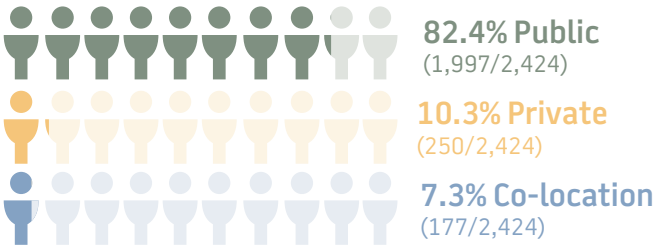
Reported cases meeting WAASM criteria

Completed cases (2,388/2,825)

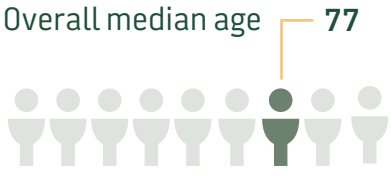
Cases in progress (57/2,825)

Excluded terminal care cases (363/2,825)

Cases lost to follow-up (17/2,825)

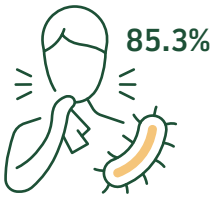


Risk profile



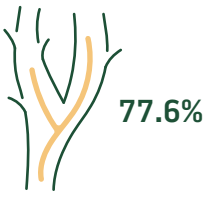
Ages
(range 1 day to 104 years)

Male (1,592/2,825)
Female (1,233/2,825)

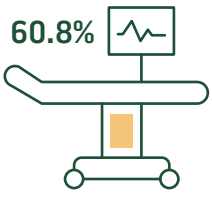


Comorbidities
(2,066/2,423)

Fluid balance issues
(99/2,417)



DVT prophylaxis use
(1,870/2,409)



CCU use
(1,472/2,420)

Patient transfers

30.9% Patients transferred (743/2,408)

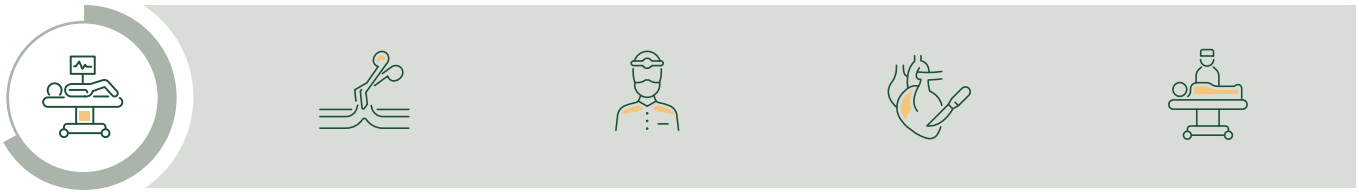
11.0% Delay in transfer (80/729)

5.1% Inappropriate transfer (37/730)

5.1% Insufficient clinical information (37/728)

2.9% Inappropriate level of care (21/726)

Operations



65.2% Patients had surgery (1,581/2,424)

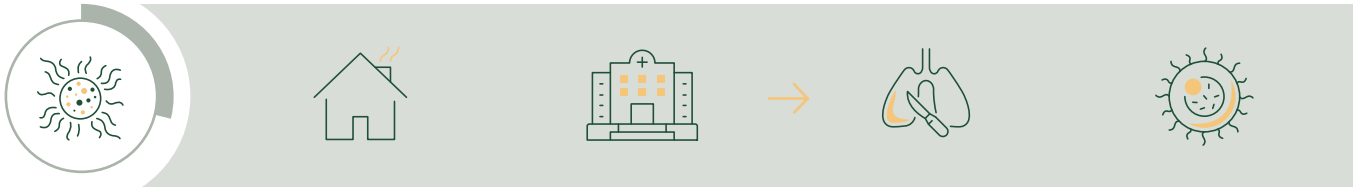
93.8% Consultant surgeons who made the decision to operate (2,008/2,141)

67.4% Consultant surgeons who performed the surgery (1,442/2,141)

15.8% Unplanned returns to theatre (249/1,579)

4.4% Operations abandoned on finding a terminal situation (92/2,108)

Infection



29.9% Patients with clinically significant infection (724/2,420)

54.5% Infection acquired prior to admission (394/723)

45.5% Infection acquired during admission (329/723)

59.5% Pneumonia (195/328)

30.5% Intra-abdominal sepsis/Septicaemia (100/328)

Peer-review outcomes

15.7% Cases with one or more clinical management issues (374/2,388)

601 Number of clinical management issues

12.6% Adverse events (76/601)

53.9% Adverse events that caused death (41/76)

43.9% Definitely preventable adverse events that caused death (18/41)

Review of 2022 recommendations

2022 Recommendations	Progress
Education	
Investigate options for presenting a WAASM webinar, including identification of relevant topics and potential speakers.	Following consultation with the WAASM Management Committee and other experienced facilitators in the subject area, WAASM delivered the half-day workshop *Human factors in the management of complex surgical environments* in March 2023. A face-to-face format was chosen over a webinar, given the nature of the topic and the value of interaction among participants. Five facilitators from a range of medical specialties worked alongside the 20 attendees to explore issues relating to situational awareness; decision-making in critical situations; leadership, communication and teamwork; and task management. Those in attendance were encouraged to share their own experiences. Participant evaluation provided valuable feedback on directions and topics for future workshops.
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 reporting period 2018–2022, an unplanned return to theatre was reported in 15.8% of operative cases (249/1,579). Figure A.1a in Appendix A.1 shows the breakdown by year. Males accounted for 53.8% (134/249) and females 46.2% (115/249) of these cases. Of the total unplanned returns to theatre, 15.3% of patients (38/249) were age ≤50 years, 30.9% (77/249) were age 51–70 years and 53.8% (134/249) were age >70 years. Of those cases with an unplanned return to theatre, 84.7% (211/249) were in public hospitals, with 10.8% (27/249) and 4.4% (11/249) in private and co-location hospitals, respectively. Emergency admissions accounted for 68.7% of cases (171/249) and elective admissions 31.3% (78/249). The rate of return to theatre for elective admissions was relatively high compared to the overall proportion of elective admissions where an operation was reported (18.5%; 293/1,580). This could be related to the higher proportion of elective patients with postoperative complications (51.2%; 150/293) compared to emergency patients (21.5%; 277/1,287) (Figure 15). Figure A.1b in Appendix A.1 shows groupings by surgical specialty, with General Surgery (32.1%; 80/249), Neurosurgery (21.7%; 54/249), and Cardiothoracic Surgery (20.9%; 52/249) making up the majority of cases. Obstetrics and Gynaecology was the only specialty not to have an unplanned return to theatre (noting that obstetric cases are not included in the audit process; only gynaecological cases are audited).

Review of 2022 recommendations (continued)

2022 Recommendations	Progress
Clinical management	
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).	For the reporting period 2018–2022, an unplanned readmission within 30 days was reported in 3.6% of cases (87/2,416). Figure A.2a in Appendix A.2 shows the breakdown by year. Males accounted for 59.8% (52/87) and females 40.2% (35/87) of these cases. Of the total unplanned readmissions within 30 days, 8.0% of patients (7/87) were age ≤50 years, 29.9% (26/87) were age 51–70 years and 62.1% (54/87) were age >70 years. Of those cases with an unplanned readmission within 30 days, 79.3% (69/87) were in public hospitals, with 13.8% (12/87) and 6.9% (6/87) in private and co-location hospitals, respectively. Emergency admissions accounted for 74.7% of cases (65/87) and elective admissions 25.3% (22/87). Figure A.2b in Appendix A.2 shows groupings by surgical specialty, with General Surgery (26.4%; 23/87) and Orthopaedic Surgery (26.4%; 23/87) making up the majority of cases. Paediatric Surgery was the only specialty not to have an unplanned readmission within 30 days.
Research and reporting on audit data	
Continue analysis of deaths occurring in elective cases in patients age ≤50 years or in regional hospitals (where complex cases are predominantly transferred to metropolitan tertiary hospitals), which are considered unexpected.	This analysis is still in progress and will be reported in the 2024 WAASM Report.
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.	Section 5.1 provides a review of the impact of COVID-19 on deaths under the care of a surgeon in WA.

2023 recommendations

Education

- Cross-promote ANZASM webinars across all regions to facilitate access to a range of educational opportunities for WA surgeons.

Clinical management

- For the 2024 WAASM Report, continue to monitor and report any trends observed in unplanned returns to theatre.
- For the 2024 WAASM Report, continue to monitor and report any trends observed in unplanned readmissions within 30 days of surgery.

Research and reporting on audit data

- Continue analysis of unexpected deaths occurring in elective cases in patients age ≤50 years or in regional hospitals (where complex cases are predominantly transferred to metropolitan tertiary hospitals).

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 is protected by federal legislation. The Australian and New Zealand Audit of Surgical Mortality (ANZASM) receives legislative protection under the Commonwealth Qualified Privilege Scheme, under part VC of the Health Insurance Act 1973 (gazetted 24 April 2022).

Participation in WAASM was mandated by the Royal Australasian College of Surgeons (RACS) in 2010 and has been part of the RACS Continuing Professional Development (CPD) program since 2013.

WAASM is a patient safety and quality improvement intiative, designed to identify and monitor the quality of surgical care through the collection and analysis of patient mortality data. This is achieved through an educational peer-review process, of which the 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 clinical management issues (CMIs) 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 WAASM Management Committee, which monitors the structures and processes involved in the WAASM quality assurance activity (Appendix B). The WAASM Management Committee reports to the ANZASM Steering Committee, which coordinates all regional audits of surgical mortality.

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 their medical records departments. Any consultant surgeon involved in the care of a patient may also self-report a patient 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, regardless of whether the patient underwent a surgical procedure. Case details and cause of death are recorded in the surgical case form (SCF) by the consultant surgeon. This information is based on the patient's diagnosis during the last admission, incorporating test results, operations and postmortem 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:

- **Individual feedback**

  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, the national *Case of the Month* is emailed to consultant surgeons each month.

2.3 Providing feedback (continued)

- **Annual report**

  An annual report is published in October and made available on the WAASM website. It is circulated to all WA consultant surgeons and 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 2023 report covers deaths reported to WAASM from **1 January 2018 to 31 December 2022** (census date 17 April 2023).

The full audit process can take 3 months or longer from the initial notification of death, so some 2022 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 of cases completed after the relevant census dates.

Data are entered and stored in the bi-national audits of surgical mortality system database. Since not all data are complete 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 2018 to 2022:

- **2,825 deaths met WAASM criteria**
- **98.7% of SCFs returned**
- **65.2% of patients had one or more operations**
- **30.9% of patients had a preoperative transfer**
- **85.3% of cases had one or more comorbidities present**
- **29.9% of cases had a clinically significant infection.**

3.1 Surgical deaths reported to WAASM

Between 1 January 2018 and 31 December 2022, there were 2,944 deaths reported to WAASM. Of these, 119 deaths were excluded for not meeting WAASM inclusion criteria. As a result, a total of 2,825 deaths were included for the current report (Table 1).

Table 1: Deaths reported to WAASM, by year

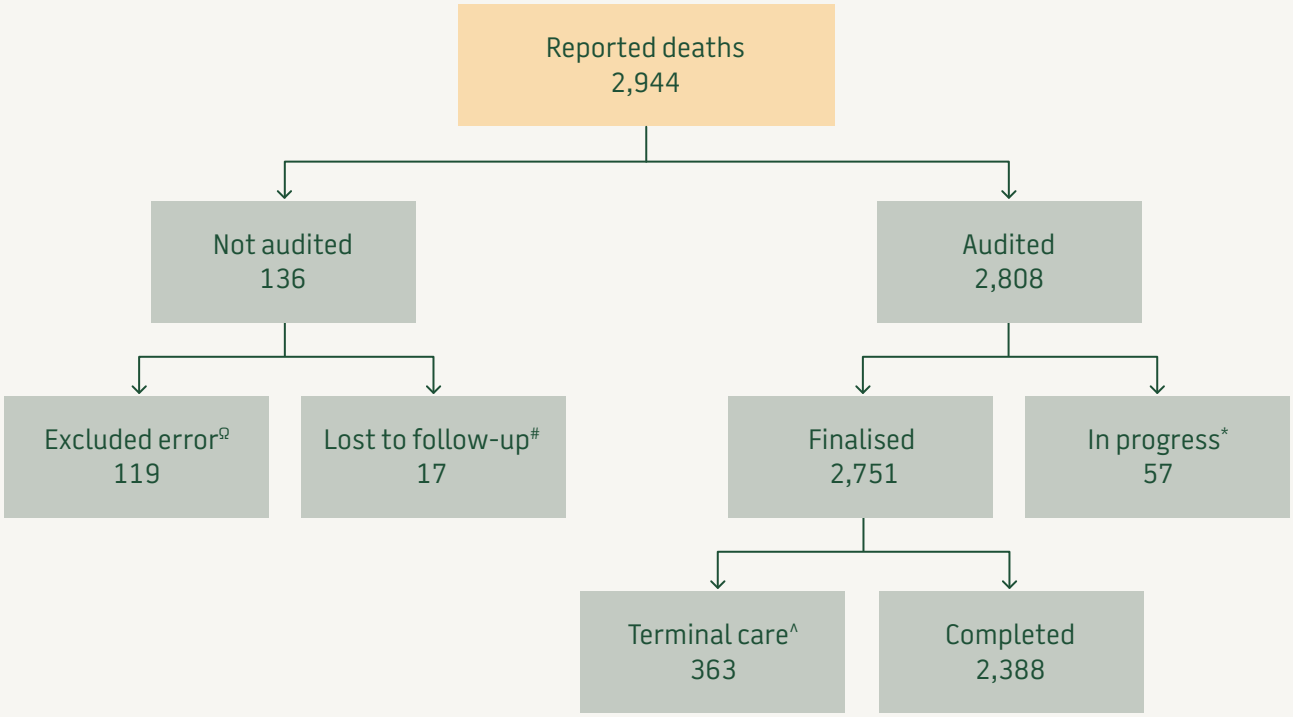
Year	Number of deaths reported	Deaths not meeting criteria*	Deaths meeting criteria#
2018	584	29	555
2019	562	10	552
2020	556	22	534
2021	616	22	594
2022	626	36	590
Total	**2,944**	**119**	**2,825**

WAASM: Western Australian Audit of Surgical Mortality.
*Deaths not meeting criteria: reported deaths subsequently found not to have involved a surgeon.
#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 audited in the period 2018 to 2022.

Figure 1: Deaths audited by WAASM



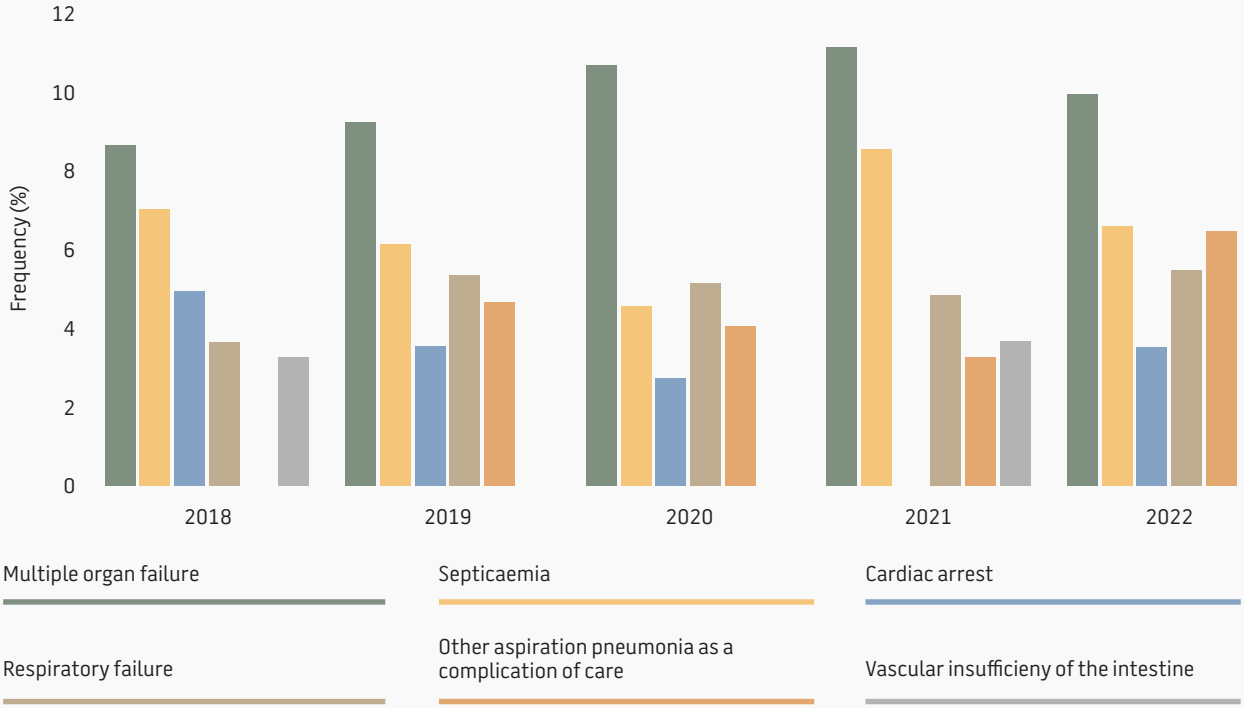
[Ω]Excluded error: reported deaths not meeting WAASM inclusion criteria.
[#]Lost to follow-up: cases remaining incomplete for a period of 2 years or more.
[*]In progress: cases that have not completed the full audit process.
[^]Terminal care: patients admitted specifically for terminal care are excluded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

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

There can be more than one cause of death listed for some cases. Overall, the most frequently reported causes of death were multiple organ failure (10.0%; 372/3,716) and septicaemia (6.7%; 250/3,716). In 2022, other aspiration pneumonia as a complication of care (6.6%; 53/801) and respiratory failure (5.6%; 45/801) have increased compared to earlier years. Figure 2 shows the most common causes of death by year.

3.1 Surgical deaths reported to WAASM (continued)

Figure 2: Most common causes of death (READ codes*), by year



*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 2022 cases still undergoing review so case data unavailable for this report.

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

As of the census date (17 April 2023), 84.5% of cases (2,388/2,825) had completed the audit process and 2.0% (57/2,825) were in progress, with cases from 2022 constituting the largest proportion of those incomplete (1.8%; 52/2,825).

Patients admitted specifically for terminal care are excluded from the full audit process and consultant surgeons do not have to complete the SCF. Over the reporting period (2018–2022), terminal care accounted for 12.8% of cases (363/2,825).

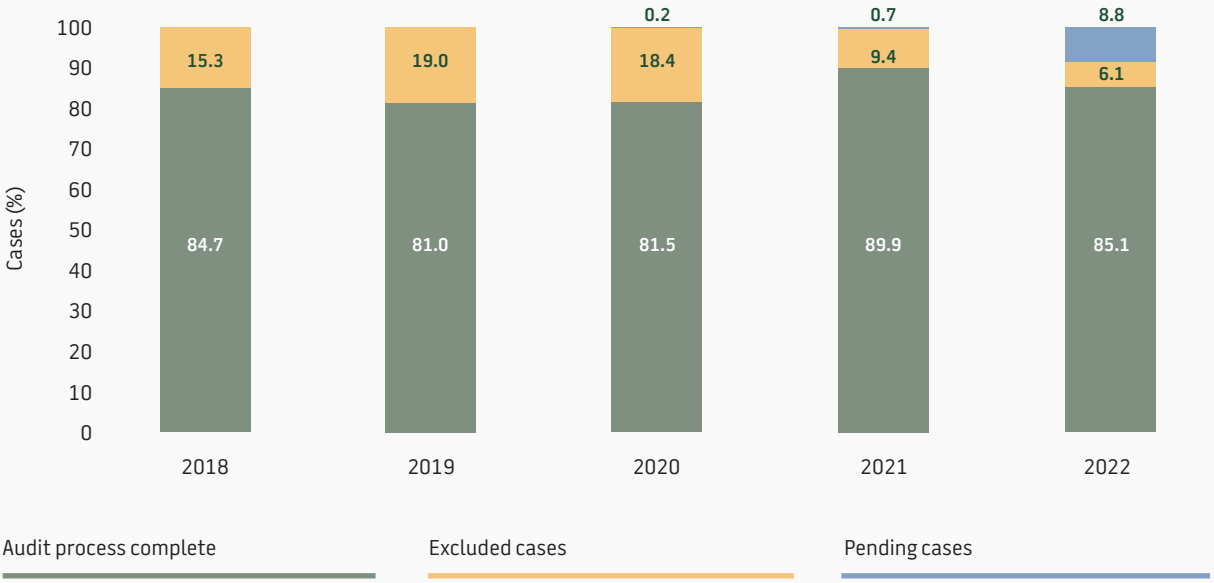
The proportion of terminal care cases has gradually decreased over the reporting period (13.2%, 2018; 18.1%, 2019; 18.4%, 2020; 9.4%, 2021 and 6.1%, 2022). This can be attributed to the detailed review of terminal care cases that WAASM has undertaken since 2021 to ensure that incorrect terminal care classifications are identified and SCFs are returned to consultant surgeons for completion.

Previously, cases not received by WAASM within 2 years were defined as 'lost to follow-up'. This practice changed as of 31 December 2020. All outstanding cases and assessments now continue to be followed until they are received. For the years 2018 and 2019, 'lost to follow-up' cases accounted for 2.2% (12/555) and 0.9% (5/552) of cases, respectively. The total proportion of cases deemed 'lost to follow-up' over this 2-year period was 1.5% (17/1,107).

Overall, a total of 13.5% of cases (380/2,825) were excluded from the audit for being terminal care admissions or 'lost to follow-up' (Figure 3).

3.1 Surgical deaths reported to WAASM (continued)

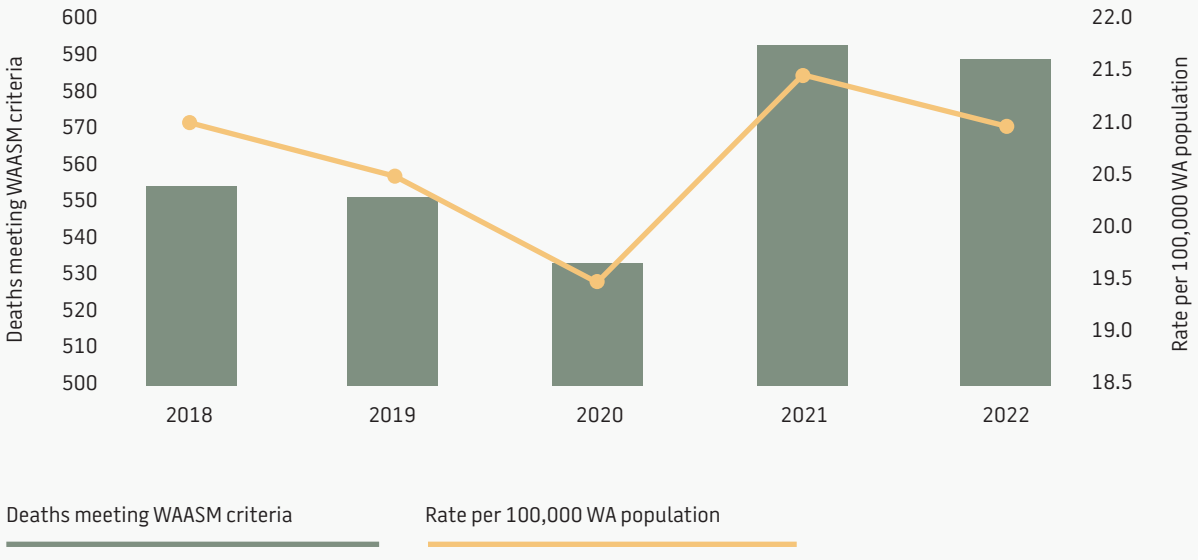
Figure 3: Case status, by year



Note: Some 2022 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

The rate of deaths under the care of a consultant surgeon per 100,000 WA population decreased between 2018 and 2020, followed by an increase in 2021 and a slight drop in 2022 (Figure 4).[10] Figure 35 shows the same data over a 15-year period (2007–2022).

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



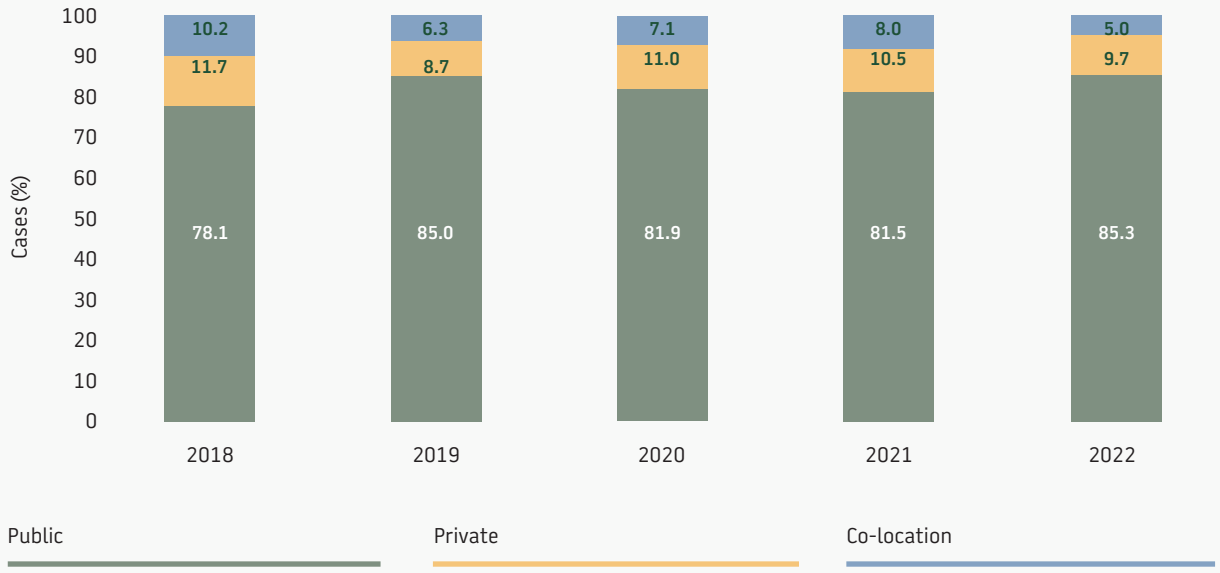
Note: Some 2022 cases still undergoing review, so case data unavailable for this report.
WAASM: Western Australian Audit of Surgical Mortality, WA: Western Australia.
Refer to Appendix D.2 for further information on data.

3.2 Hospital participation

All hospitals in WA where surgery is performed currently participate in the audit. Between 2018 and 2022, there were 26 hospitals (of 52) associated with the 2,825 deaths meeting the WAASM criteria.

Between 2018 and 2022, public hospitals accounted for 82.4% of admissions (1,997/2,424), with private and co-location hospitals accounting for 10.3% (250/2,424) and 7.3% (177/2,424) of admissions, respectively (Figure 5). (Co-location hospitals are those that provide both privately and publicly funded surgical services. Data for co-location hospitals include public and private patients.)

Figure 5: Deaths by hospital status, by year



Note: Some 2022 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 98.7% (2,788/2,825), an increase of 3.2% from last year's report (95.5%, 2017–2021).

Table 2 shows WAASM deaths for each surgical specialty in the period 2018 to 2022. General Surgery reported the most deaths at 42.6% (1,203/2,825), followed by Neurosurgery and Orthopaedic Surgery at 17.5% (494/2,825) and 17.2% (487/2,825), respectively.

Table 2: WAASM deaths by surgical specialty

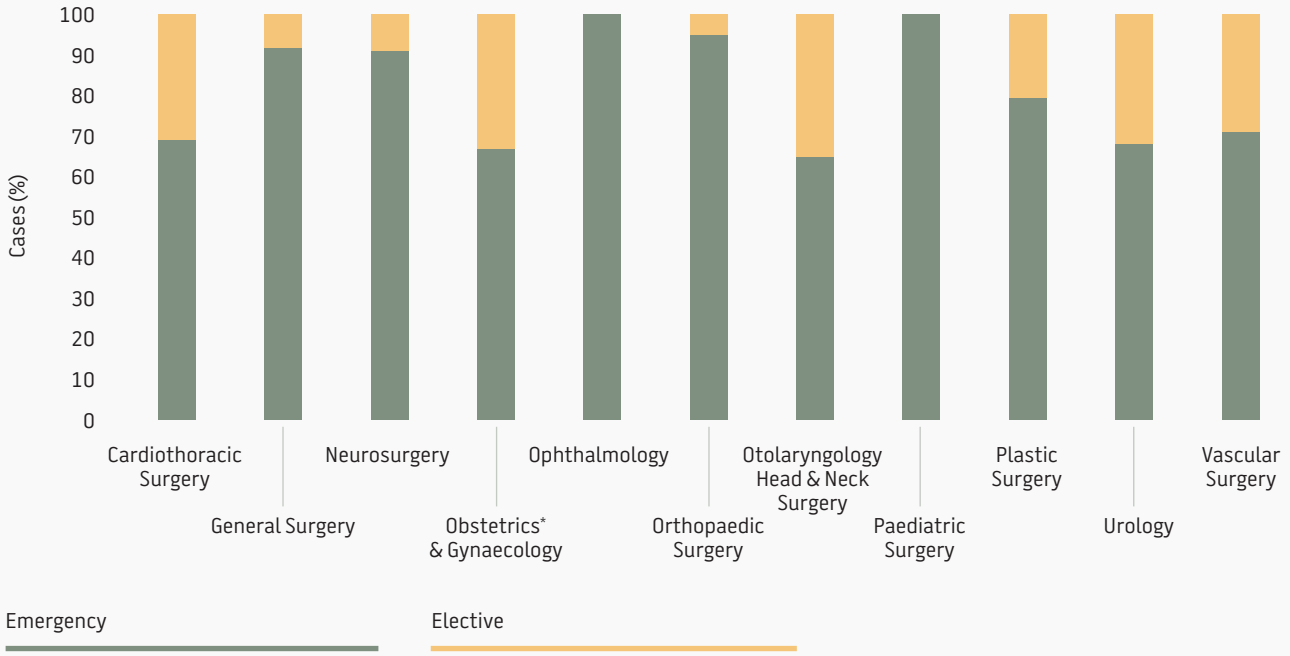
Surgical specialty	Number of deaths	Percentage (%)
General Surgery	1,203	42.6
Neurosurgery	494	17.5
Orthopaedic Surgery	487	17.2
Vascular Surgery	214	7.6
Cardiothoracic Surgery	195	6.9
Urology	108	3.8
Plastic Surgery	52	1.8
Otolaryngology Head & Neck Surgery	43	1.5
Paediatric Surgery	15	0.5
Obstetrics* & Gynaecology	12	0.4
Ophthalmology	2	0.07

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 87.1% (2,110/2,422) and elective admissions for 12.9% (312/2,422) of hospital admissions in the period 2018 to 2022. All specialties had more emergency admissions compared to elective admissions (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 56.4% (1,592/2,825) and females 43.6% (1,233/2,825) of all deaths.

Table 3: Median age by sex

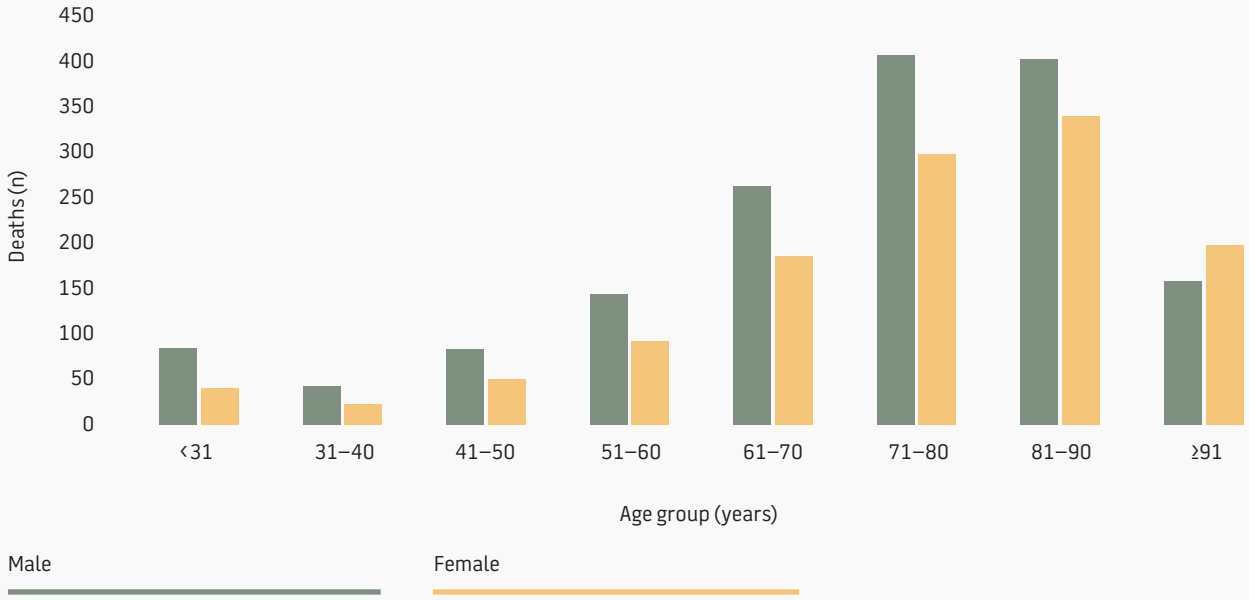
Sex	Number of cases	Median age (years)	Interquartile range (years)
All patients	2,825	77	64–86
Males	1,592	75	63–84
Females	1,233	78	66–87

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 all patients up to age 90. This trend reversed in patients age 91 years and older, where females represented the larger proportion of deaths. This corresponds with the greater number of females in the total WA population older than 90 years.[11] An overall rise in the number of deaths is noted after age 50, with 51.3% of all deaths (1,450/2,825) occurring in patients age 71–90 years. The decrease in deaths after age 90 (12.7%; 358/2,825) is possibly attributed to the smaller population in this age group.

Figure 7: Deaths by age group and sex

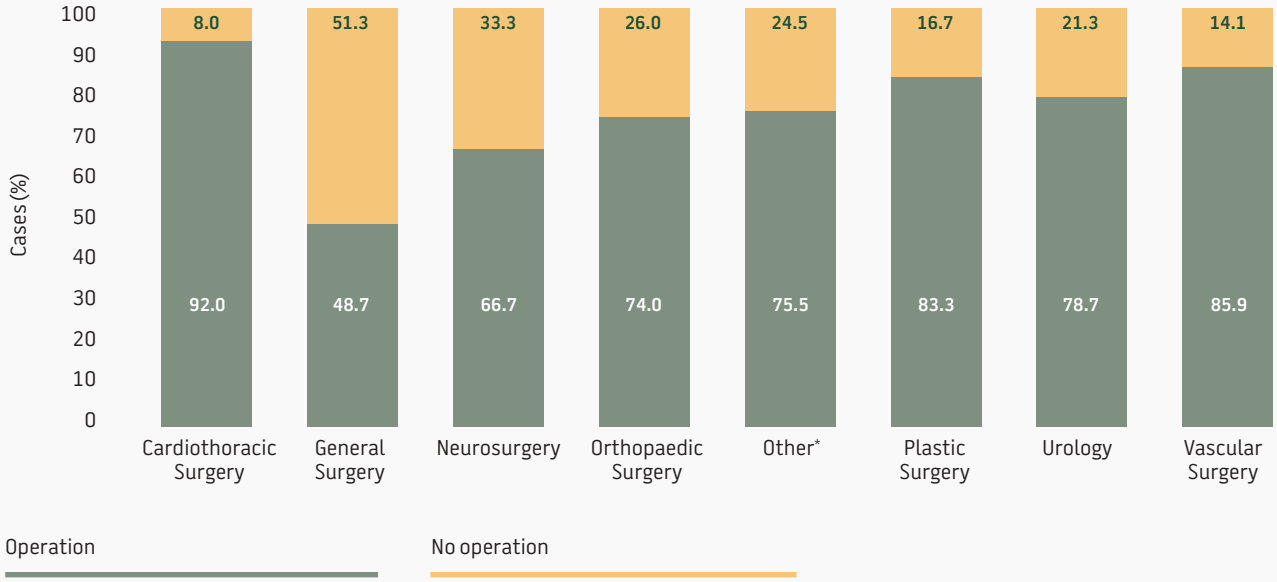


Refer to Appendix D.2 for further information on data.

3.5 Operative and nonoperative cases

In the period 2018 to 2022, 65.2% (1,581/2,424) of patients underwent one or more operations. Figure 8 shows that Cardiothoracic Surgery reported the highest operation rate (92.0%; 172/187) while General Surgery had the lowest operation rate (48.7%; 477/979).

Figure 8: Operative and nonoperative cases by specialty

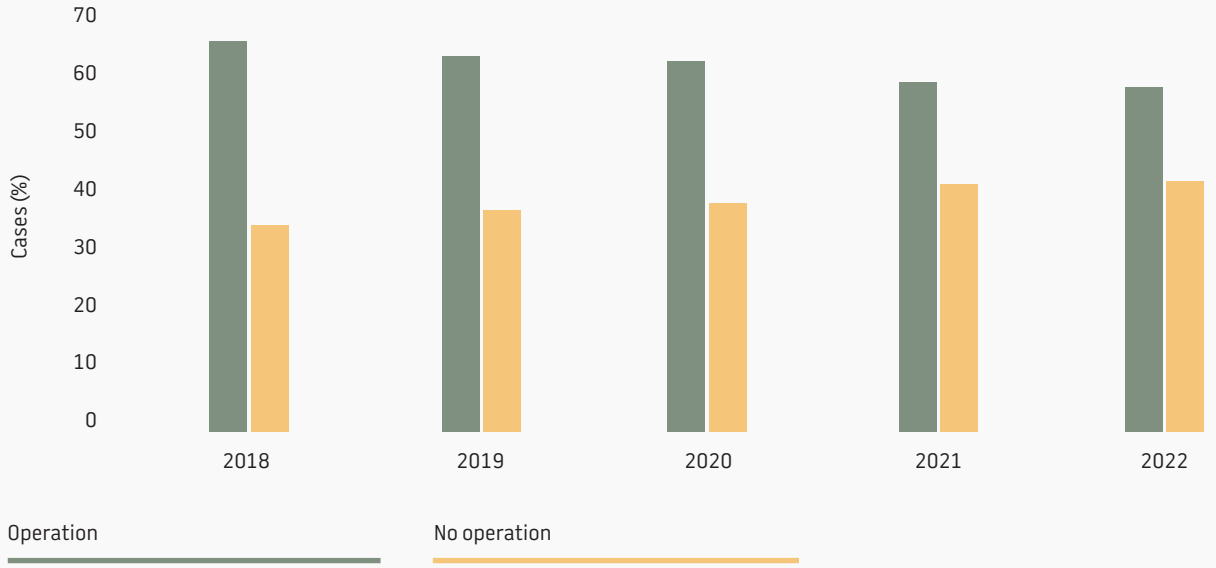


*Other includes Otolaryngology, Head & Neck Surgery, Ophthalmology, Paediatric Surgery and Obstetrics# & Gynaecology.
#Obstetric cases are not included in the audit process; only gynaecological cases are audited.
Refer to Appendix D.2 for further information on data.

The proportion of emergency and elective admissions involving an operation remained relatively steady in the period 2018 to 2022, with 81.5% of patients (1,287/1,580) admitted as an emergency. Emergency and elective operative and nonoperative cases by year, are shown in Figures 9 and 10.

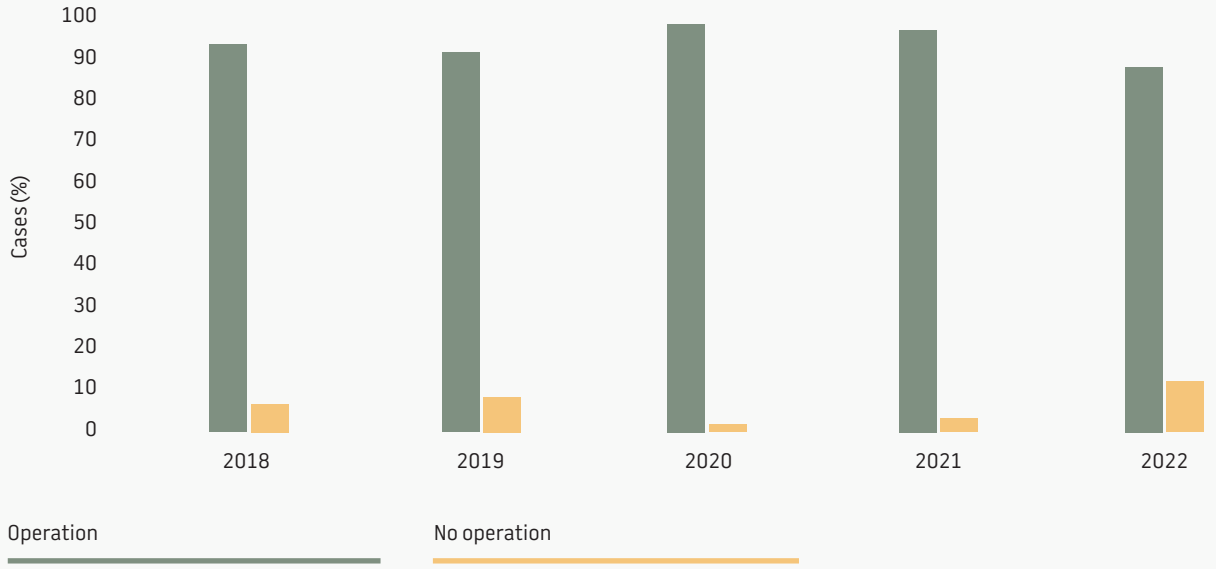
3.5 Operative and nonoperative cases (continued)

Figure 9: Emergency operative and nonoperative cases, by year



Note: Some 2022 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

Figure 10: Elective operative and nonoperative cases, by year

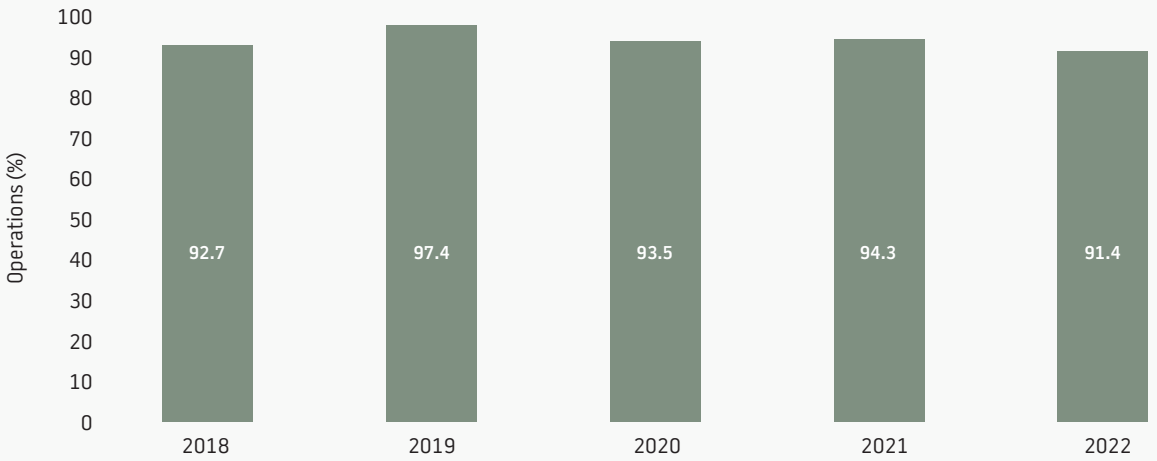


Note: Some 2022 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.5 Operative and nonoperative cases (continued)

Overall, 2,141 operations were performed on 1,581 patients between 2018 and 2022. For 93.8% of reported operations (2,008/2,141), a consultant surgeon made the decision to proceed to surgery (Figure 11). A consultant surgeon performed the surgery in 67.4% of operations (1,442/2,141) (Figure 12).

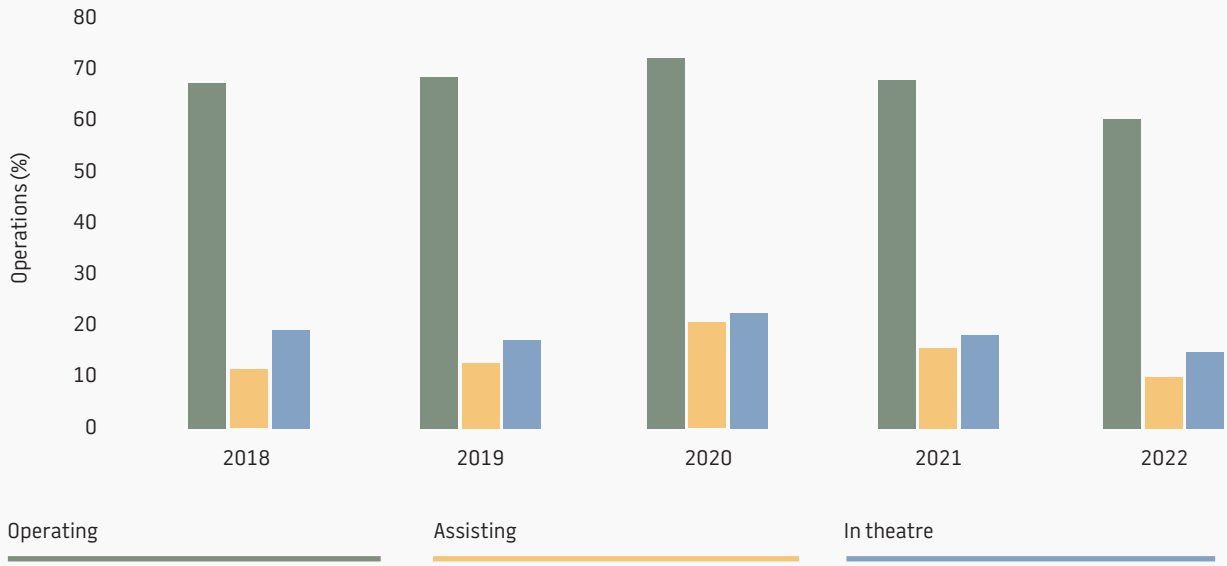
Figure 11: Consultant surgeon making the decision to operate, by year



Note: Some 2022 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)

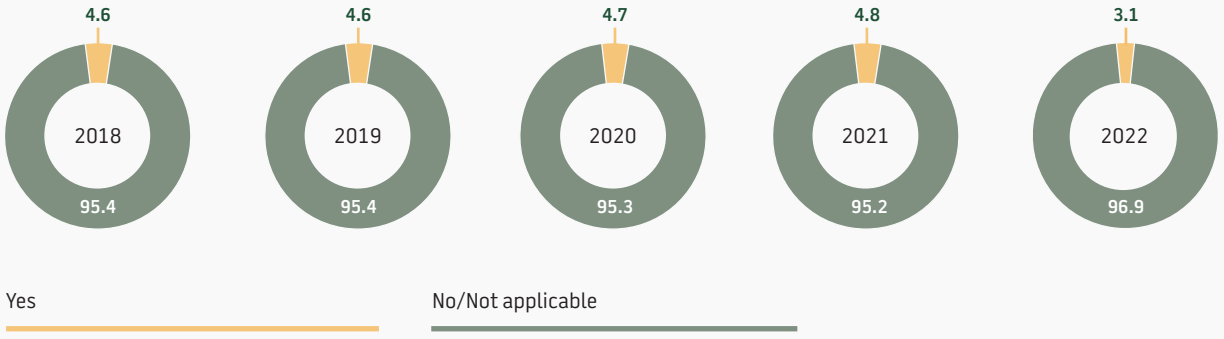
Figure 12: Consultant surgeon involvement in operations, by year



Note: Some 2022 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

Overall, an operation was abandoned upon finding a terminal situation in 4.4% of operations (92/2,108) (Figure 13).

Figure 13: Operations abandoned on finding a terminal situation, by year

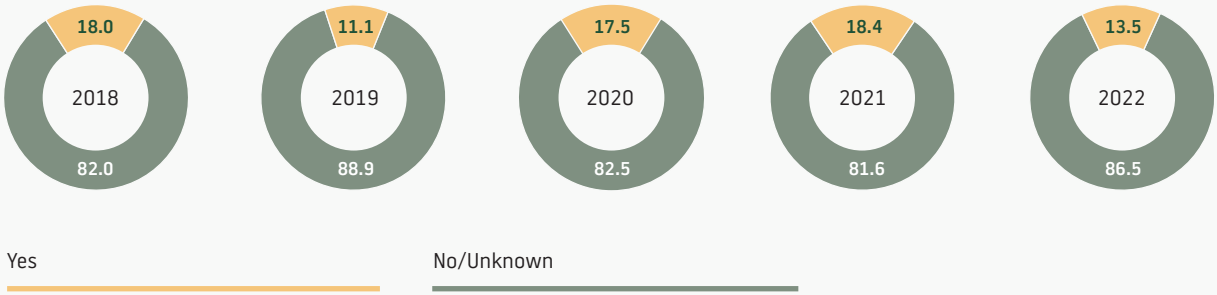


Note: Some 2022 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

In the period 2018 to 2022, 15.8% of operative cases (249/1,579) had an unplanned return to the operating theatre (Figure 14). The annual rate varied between 11.1% (2019) and 18.4% (2021).

3.5 Operative and nonoperative cases (continued)

Figure 14: Unplanned return to operating theatre, by year

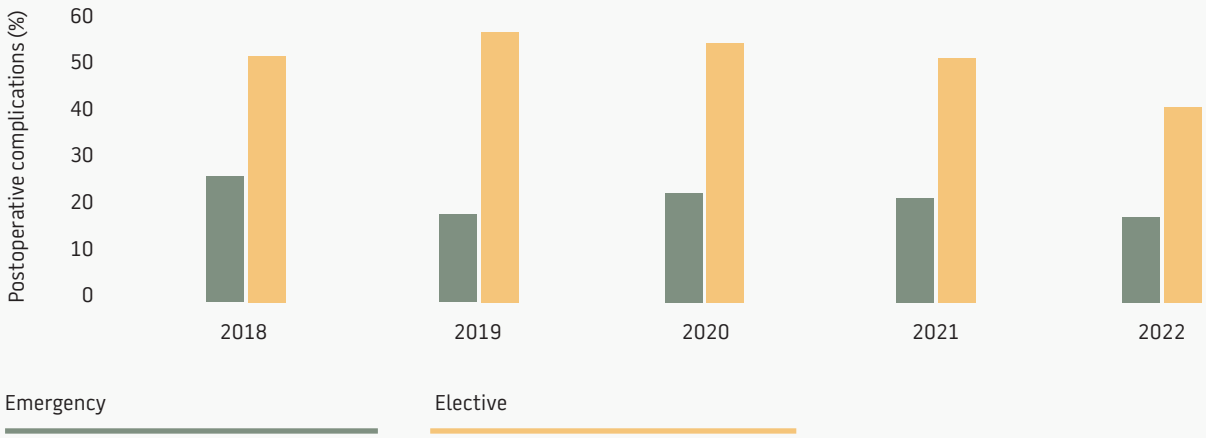


Refer to Appendix D.2 for further information on data.

A postoperative complication occurred in 27.0% of operative patients (427/1,580) between 2018 and 2022. There was a total of 559 postoperative complications among 427 operative patients. (Patients may have more than one postoperative complication listed.) The most frequently reported postoperative complications were postoperative bleeding (16.4%; 70/427), tissue ischaemia (11.7%; 50/427) and sepsis (9.1%; 39/427). These data make a strong case for a consultant surgeon to be present when a patient is returned to theatre for postoperative bleeding.

Figure 15 shows the distribution of postoperative complications by hospital admission and year. A higher proportion of elective patients (51.2%; 150/293) had a postoperative complication compared to emergency patients (21.5%; 277/1,287) between 2018 and 2022.

Figure 15: Postoperative complications by hospital admission and year

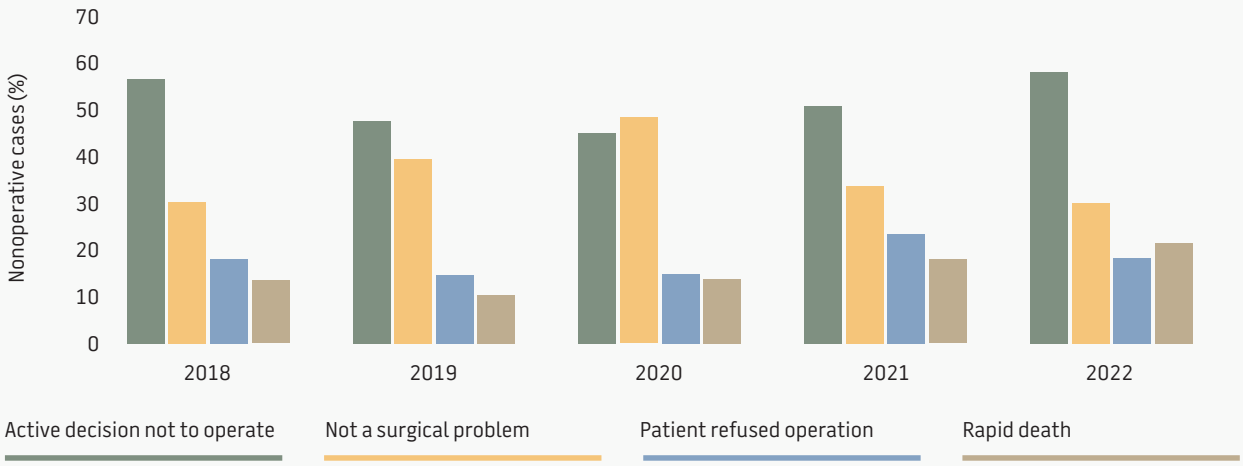


Note: Some 2022 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.5 Operative and nonoperative cases (continued)

Not all patients underwent surgery (34.8%; 843/2,424). Figure 16 shows that some patients did not undergo an operation for reasons such as an active decision by the surgeon not to operate or there not being a surgical problem. Some cases reported more than one reason for not operating. Most nonoperative cases were emergency admissions (97.7%; 823/842).

Figure 16: Reasons for not operating, by year

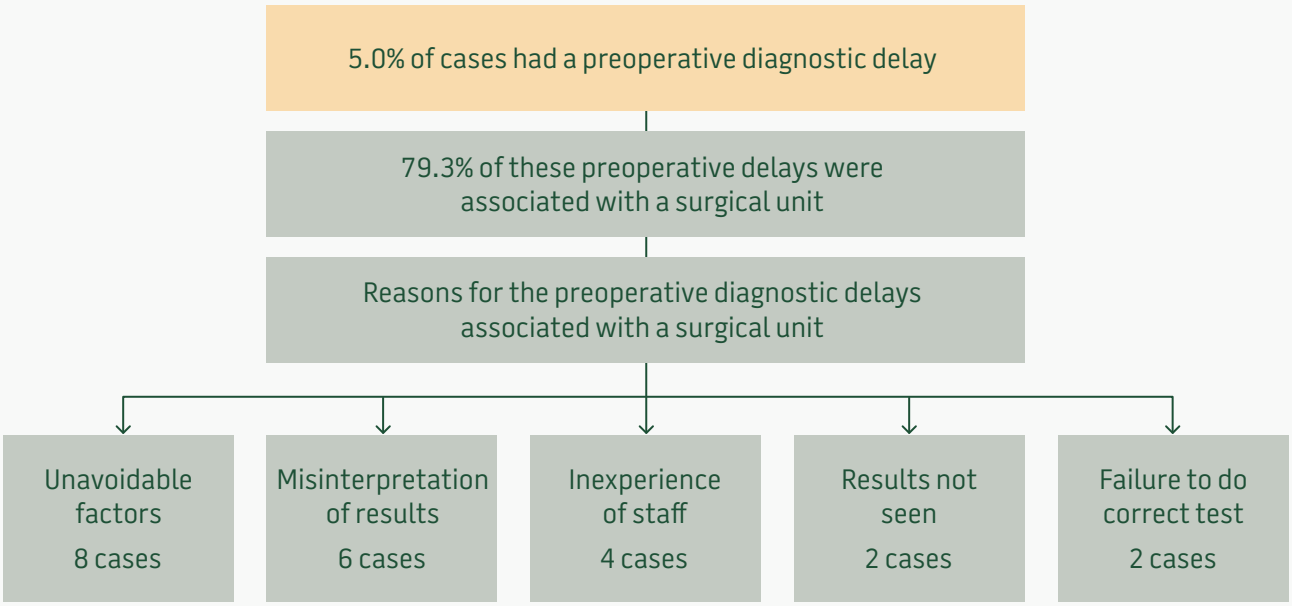


Note: Some 2022 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.6 Preoperative diagnostic delays

In the period 2018 to 2022, a preoperative diagnostic delay was recorded by the consultant surgeon in 5.0% of cases (122/2,423). Of these delays, 79.3% (23/29; missing data = 93) were associated with the surgical unit. The 2 most common reasons stated for preoperative diagnostic delays associated with a surgical unit were 'unavoidable factors' (8 cases) and 'misinterpretation of results' (6 cases) (Figure 17).

Figure 17: Cases with preoperative diagnostic delays

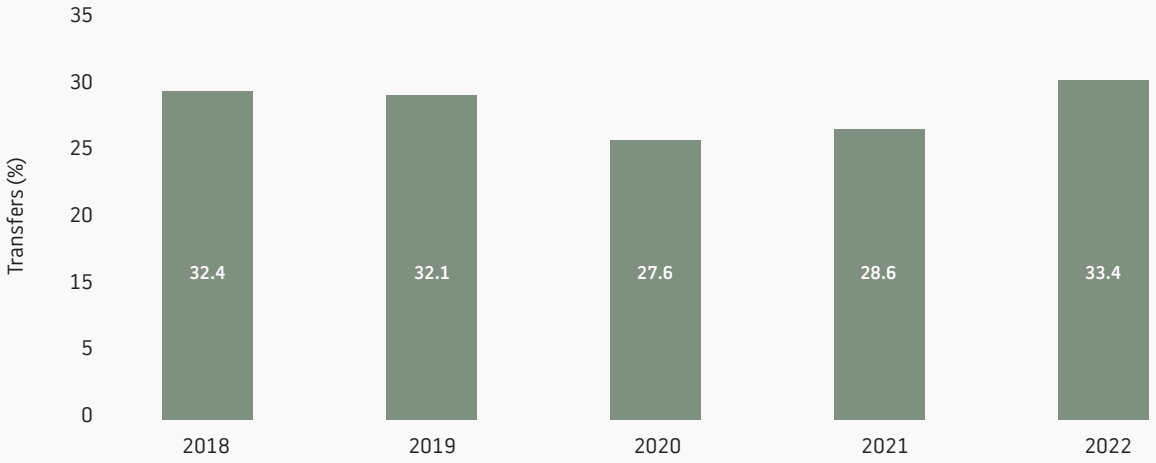


Refer to Appendix D.2 for further information on data.

3.7 Hospital transfers

Between 2018 and 2022, preoperative hospital transfers occurred for 30.9% of patients (743/2,408). Emergency admissions accounted for 96.9% (719/742) of this group.

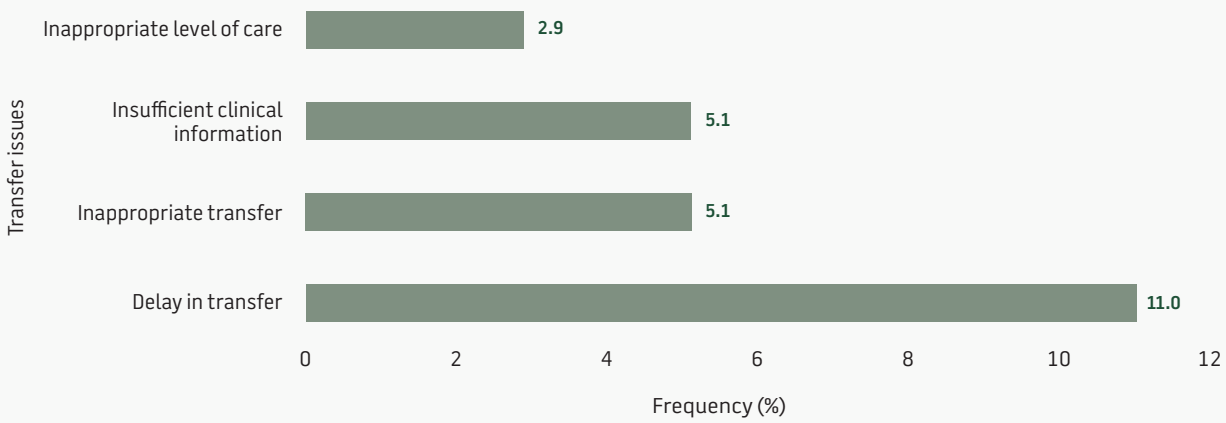
Figure 18: Hospital transfers, by year



Note: Some 2022 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

In the period 2018 to 2022, there was a range of concerns related to transfers (Figure 19). The most frequently reported transfer issue was 'delay in transfer' (11.0%; 80/729).

Figure 19: Hospital transfer issues

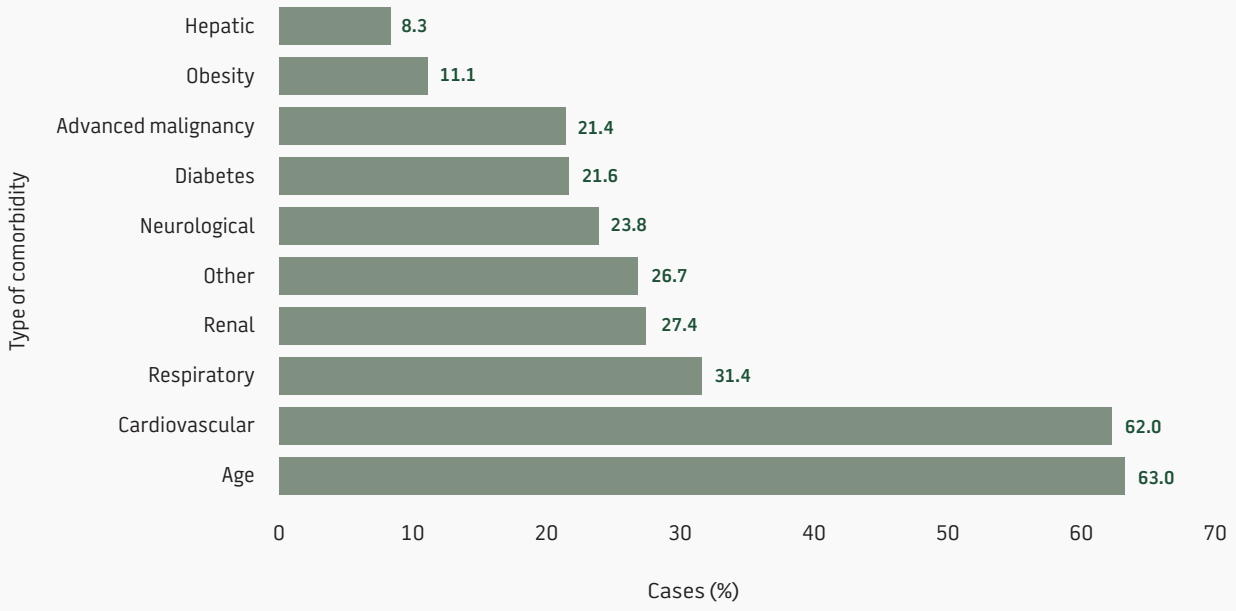


Refer to Appendix D.2 for further information on data.

3.8 Comorbidities

The majority of patients (85.3%; 2,066/2,423) had at least one comorbidity, with 83.7% (1,729/2,066) of patients having more than one comorbidity. As shown in Figure 20, the 2 most commonly reported comorbidities were age (63.0%; 1,302/2,066) and cardiovascular disease (62.0%; 1,280/2,066).

Figure 20: 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) classification system, an internationally recognised measure of a patient's physical status.[12] (ASA grade definitions are listed in Appendix D.3.)

As presented in Figure 21, patients were most commonly assigned ASA grade 4, defined as a patient with severe systemic disease that is a constant threat to life (44.8%; 1,004/2,240). ASA grade 3, defined as a patient with severe systemic disease, was the second most frequently assigned (26.7%; 597/2,240).

3.8 Comorbidities (continued)

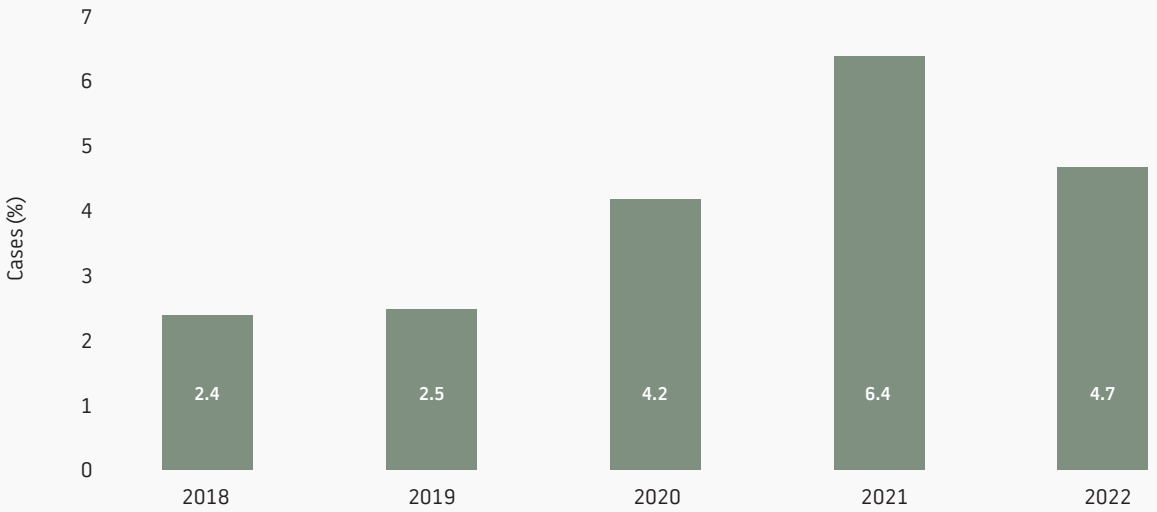
Figure 21: Frequency of ASA grades

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 4.1% of cases (99/2,417) between 2018 and 2022. Figure 22 shows the frequency of these cases by year.

Figure 22: Cases with fluid balance issues, by year



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

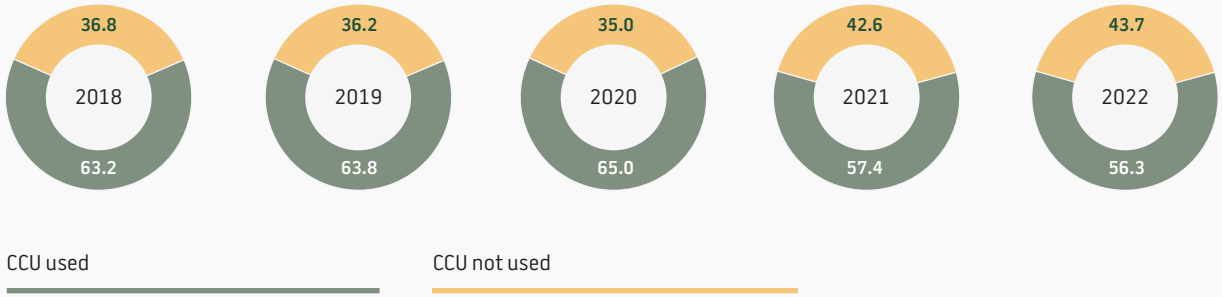
Emergency and elective admissions accounted for 81.8% (81/99) and 18.2% (18/99) of cases with fluid balance issues, respectively. Operative cases (5.0%; 79/1,574) had more fluid balance issues than did nonoperative cases (2.4%; 20/843).

3.10 Critical care units

Between 2018 and 2022, critical care units (CCUs) were utilised in 60.8% of cases (1,472/2,420) (Figure 23).

Emergency and elective admissions accounted for 85.2% (1,254/1,471) and 14.8% (217/1,471) of CCU use, respectively.

Figure 23: CCU use, by year

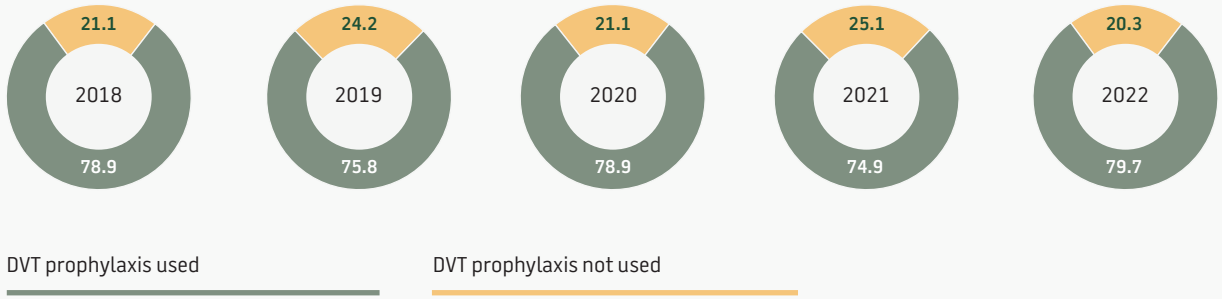


CCU: critical care unit.
Note: Some 2022 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.11 Deep vein thrombosis prophylaxis

Consultant surgeons reported the use of deep vein thrombosis (DVT) prophylaxis in 77.6% of cases (1,870/2,409) between 2018 and 2022. The use and non-use of DVT prophylaxis by year is presented in Figure 24.

Figure 24: DVT prophylaxis use, by year



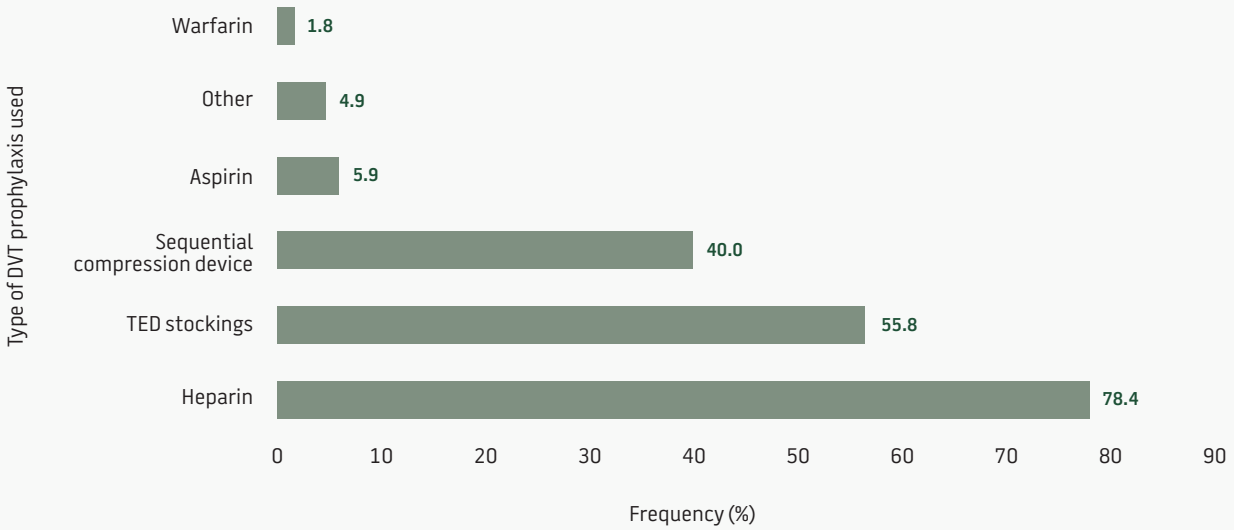
DVT: deep vein thrombosis.
Note: Some 2022 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.11 Deep vein thrombosis prophylaxis (continued)

In many cases, more than one type of DVT prophylaxis was used. Heparin (78.4%; 1,466/1,870) and TED (thromboembolic deterrent) stockings (55.8%; 1,044/1,870) were the most frequently used DVT prophylaxis agents (Figure 25).

DVT prophylaxis was not used in 22.4% of cases (539/2,409). This was because it was inappropriate (63.7%; 342/537), there was an active decision to withhold it (34.8%; 187/537), or it was not considered (1.5%; 8/537).

Figure 25: 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.

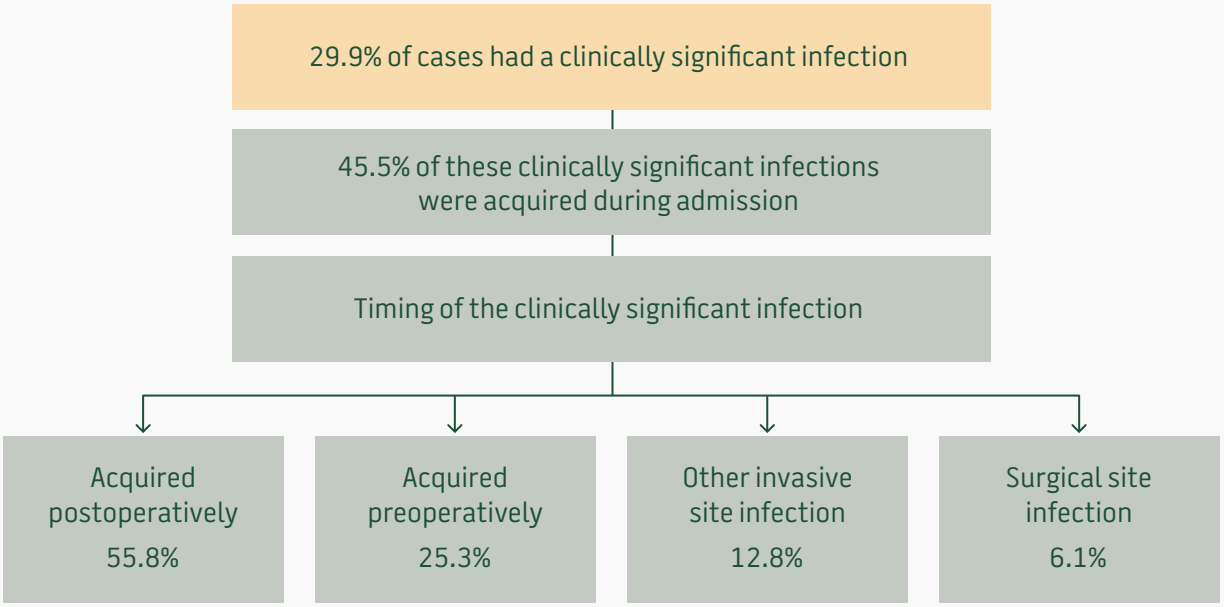
Refer to Appendix D.2 for further information on data.

3.12 Infections

Between 2018 and 2022, 29.9% of patients (724/2,420) died with a clinically significant infection. Figure 26 shows the stage at which these clinically significant infections were acquired.

The clinically significant infection was acquired prior to admission in 54.5% of cases (394/723). In 45.5% of cases (329/723) the clinically significant infection was acquired during admission. Of the infections acquired during admission, pneumonia was the most reported, accounting for 59.5% of cases (195/328). Intra-abdominal sepsis represented 20.1% of cases (66/328), followed by septicaemia (10.4%; 34/328). 'Other source' and cranial/spinal infection accounted for 9.1% (30/328) and 0.9% (3/328) of cases, respectively. Of these infections, more than half were acquired postoperatively (55.8%; 183/328).

Figure 26: Clinically significant infections



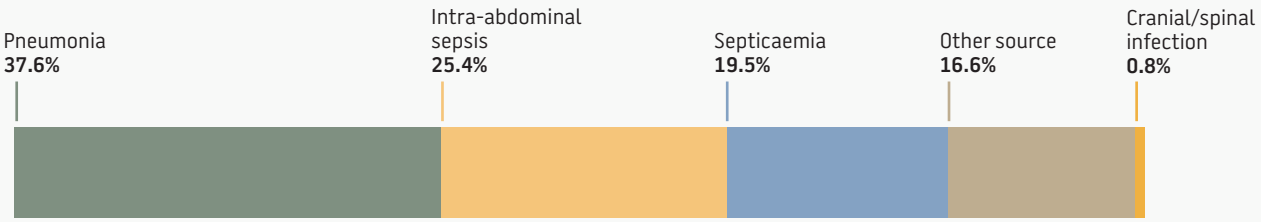
Refer to Appendix D.2 for further information on data.

3.12 Infections (continued)

Figure 27 shows the types of clinically significant infections reported by consultant surgeons prior to or during admission, in the period 2018 to 2022. Pneumonia was the most common clinically significant infection reported, accounting for 37.6% of cases (272/723). Intra-abdominal sepsis represented 25.4% of cases (184/723), followed by septicaemia (19.5%; 141/723). 'Other source' and cranial/spinal infection accounted for 16.6% (120/723) and 0.8% (6/723) of cases, respectively.

Where information was provided, consultant surgeons reported that the antibiotic regime was appropriate in 92.5% of cases of clinically significant infections (667/721). In 6.9% of cases (50/721) the appropriateness of the antibiotic regime was unknown, and in 0.6% (4/721) it was considered inappropriate.

Figure 27: 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 2018 to 2022:

- **14.2% of cases were referred for second-line assessment**
- **77.1% of cases had appropriate use/non-use of DVT prophylaxis**
- **601 CMIs were identified in 374 cases**
- **12.6% (76/601) of CMIs were classified as adverse events**
- **53.9% (41/76) of adverse events were deemed to have caused the death of the patient**
- **43.9% (18/41) 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 cases are identified as requiring a more detailed review; these are recommended for second-line assessment (SLA).

Between 2018 and 2022, the rate of FLA returns was 99.5% (2,412/2,425). Of the 2,412 FLAs returned, 14.2% (343/2,412) were referred for SLA (Table 4).

Table 4: Peer-review assessments, by year

Year	FLAs returned	Cases referred for SLA	
		Number	Percentage (%)
2018	470	76	16.2
2019	447	62	13.9
2020	436	71	16.3
2021	536	63	11.8
2022	523	71	13.6
Total	**2,412**	**343**	**14.2**

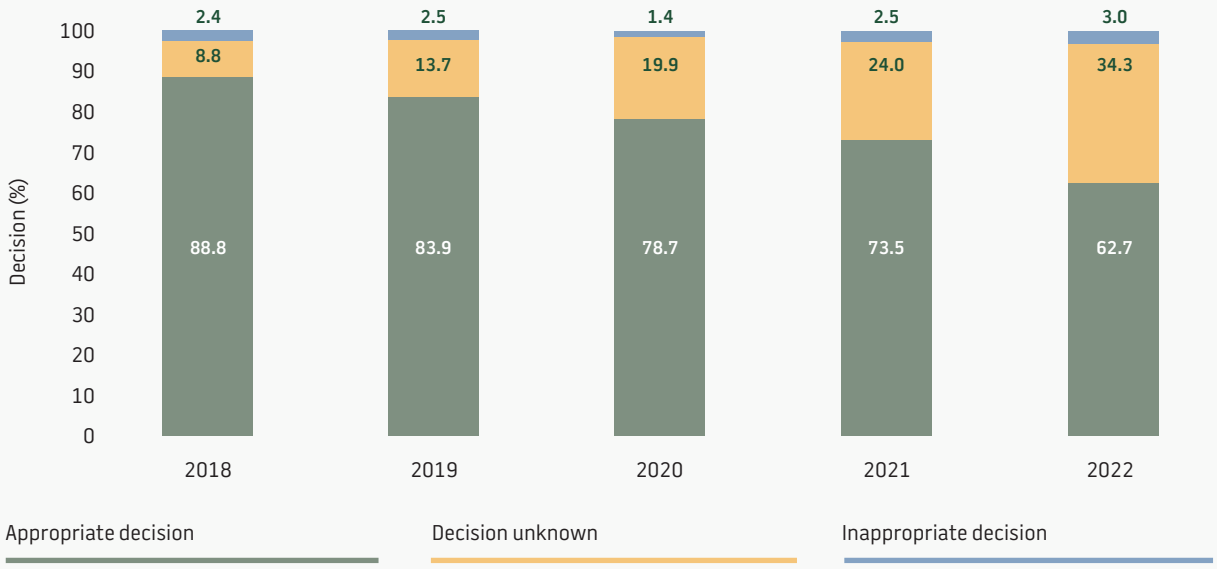
FLA: first-line assessment, SLA: second-line assessment.
Note: Some 2022 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.1 for further information on data.

4.2 Decision on deep vein thrombosis prophylaxis

Assessors report on whether they think the decision on DVT prophylaxis use/non-use was appropriate. Figure 28 shows assessors' opinions on the appropriateness of DVT prophylaxis per year.

Between 2018 and 2022, assessors indicated that the decision to use or withhold DVT prophylaxis was appropriate in 77.1% of cases (1,409/1,932). In 2.4% of cases (46/1,932), 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 20.5% of cases (396/1,932). The rate at which assessors agree with the decision to use or withhold DVT prophylaxis has declined over the reporting period (2018–2022). Conversely, the proportion of assessors unaware of the decision relating to DVT prophylaxis has increased over the same period.

Figure 28: Assessor opinion on appropriateness of DVT prophylaxis decision, by year



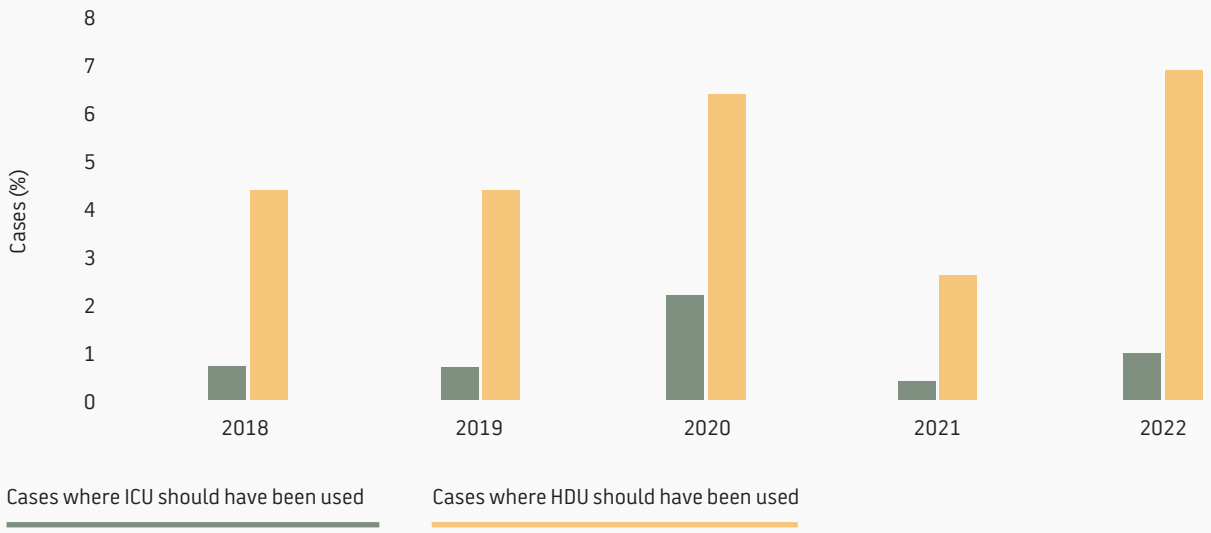
DVT: deep vein thrombosis.
Refer to Appendix D.2 for further information on data.

4.3 Non-use of critical care units

When consultant surgeons indicate on the completed SCF that a 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 29 summarises assessors' opinions on the non-use of CCUs.

Assessors considered that 0.9% (8/847) and 4.9% (41/843) of patients would have benefited from the use of ICU or a high dependency unit (HDU), respectively, between 2018 and 2022.

Figure 29: Assessor opinion on non-use of CCUs, by year



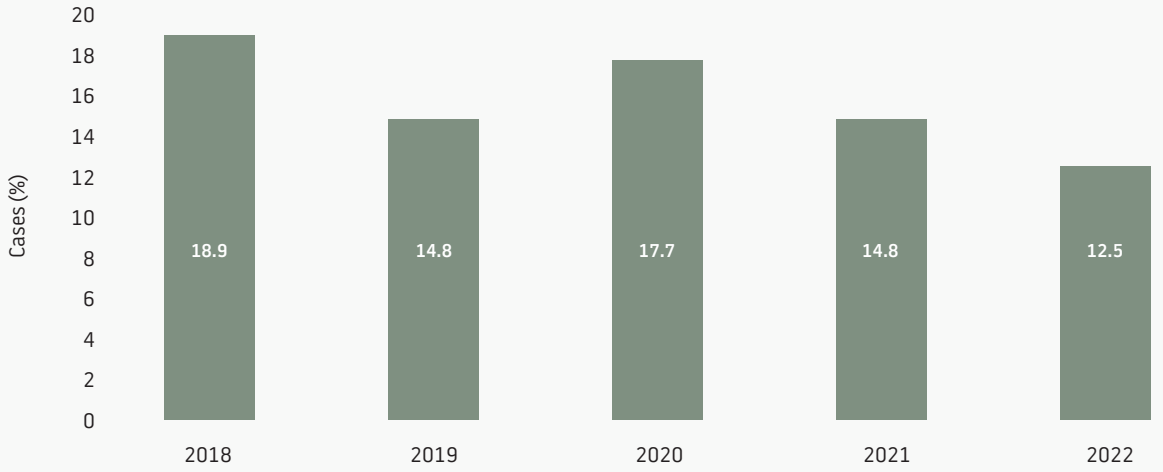
CCU: critical care unit, HDU: high dependency unit, ICU: intensive care unit.
Refer to Appendix D.2 for further information on data.

4.4 Clinical management issues

One of the aims of the peer-review process is to determine whether a CMI occurred. CMIs 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 CMIs were identified is shown in Figure 30. (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 2022 cases are still undergoing the peer-review process, meaning these data are incomplete.)

Figure 30: Cases with CMIs, by year



CMI: clinical management issue.
Note: Some 2022 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

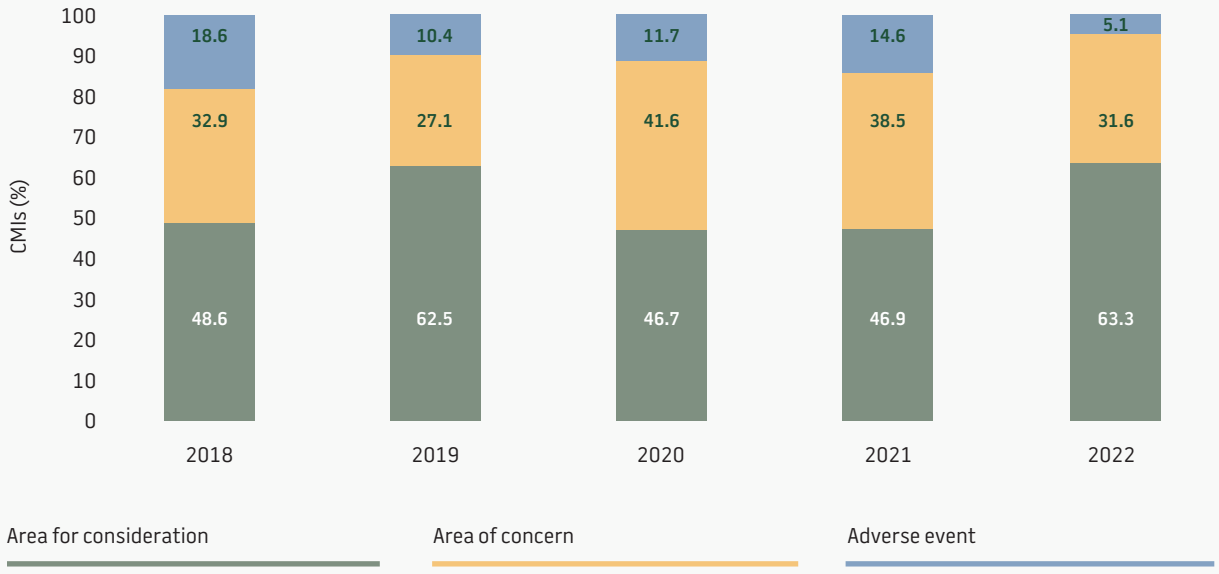
One or more CMIs were identified in 15.7% of cases (374/2,388) in the period 2018 to 2022. No CMIs were identified in 84.3% of cases (2,014/2,388).

Assessors may identify several CMIs for each patient. Figures 31 to 33 show data based on the number of CMIs, not the number of patients.

Assessors reported 601 CMIs in 374 cases (Figure 31). Between 2018 and 2022, more than half (52.4%; 315/601) of the CMIs identified were areas for consideration. Areas of concern and adverse events comprised 34.9% (210/601) and 12.6% (76/601) of CMIs, respectively.

4.4 Clinical management issues (continued)

Figure 31: Categories of CMIs, by year



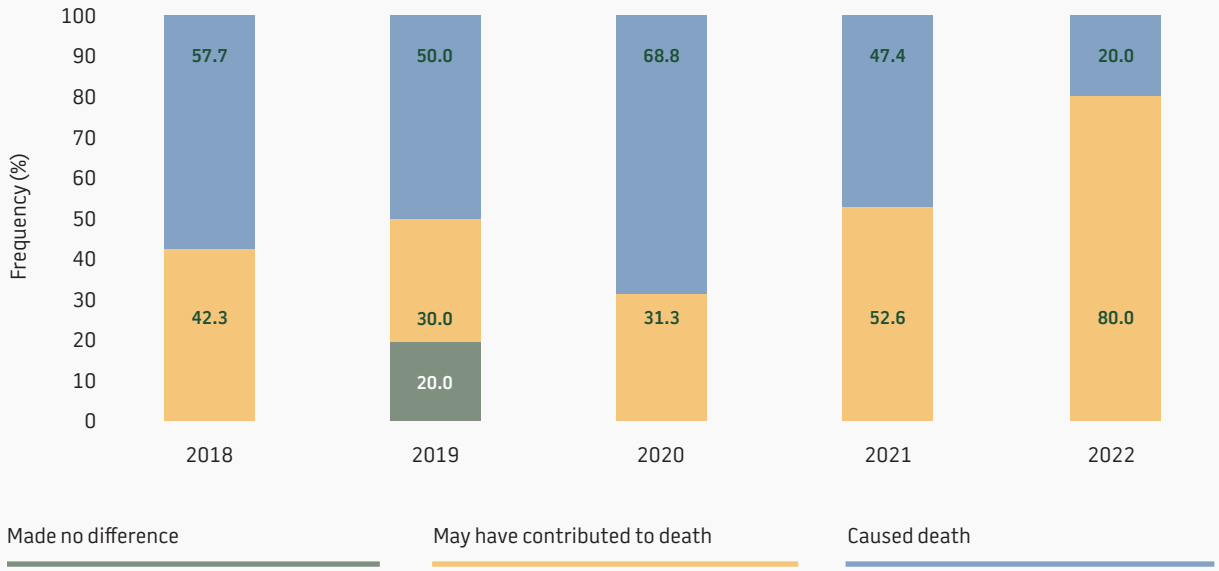
CMI: clinical management issue.
Refer to Appendix D.2 for further information on data.

When an adverse event is identified, assessors 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, are shown in Figure 32.

In the period 2018 to 2022, assessors perceived that 53.9% of the reported adverse events (41/76) caused the death of the patient and 43.4% of the reported adverse events (33/76) may have contributed to the death. For 2.6% of reported adverse events (2/76), assessors perceived that it made no difference to the outcome of the patient. There was considerable variability in assessors' perception of the impact of adverse events over the reporting period (2018–2022).

4.4 Clinical management issues (continued)

Figure 32: Assessor perception of impact of adverse event on clinical outcome, by year



Note: Some 2022 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

Assessors also report on the preventability of any adverse event that caused the death of a patient (Figure 33).

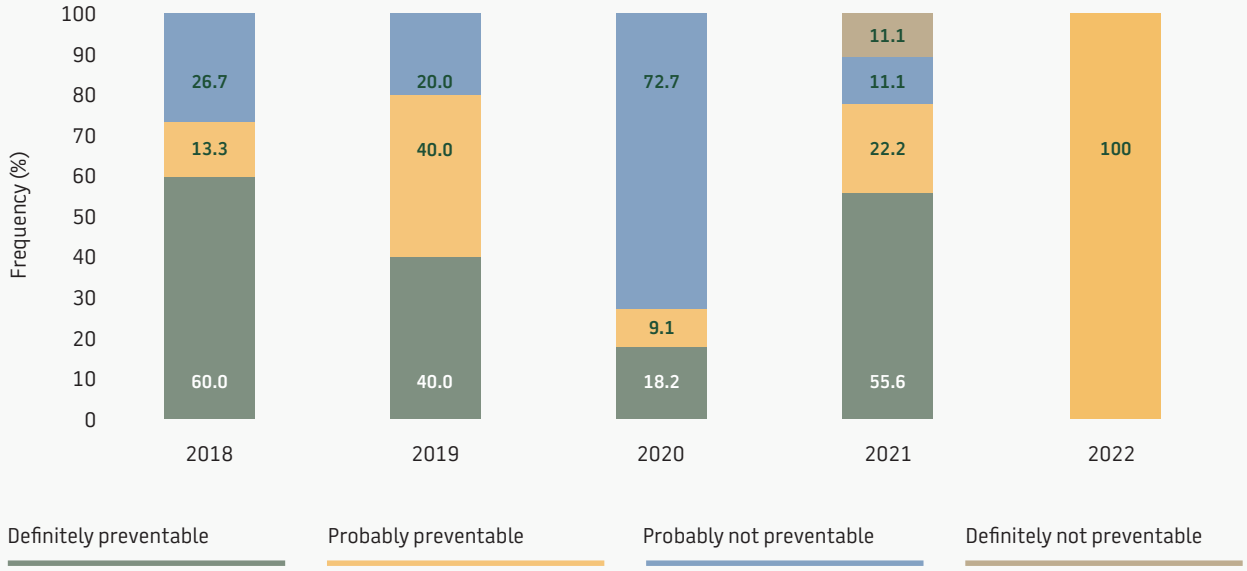
Assessors indicated that 2.4% of adverse events (1/41) that caused the death of a patient were definitely not preventable. In 34.1% of adverse events (14/41) that caused the death of a patient, assessors stated that the deaths were probably not preventable.

Assessors considered that 19.5% of adverse events (8/41) that resulted in the death of a patient were probably preventable. In 43.9% of adverse events (18/41) that caused the death of a patient, assessors indicated that the deaths were definitely preventable.

As of the census date (17 April 2023), only one adverse event causing the death of a patient has been identified by an assessor in 2022. This adverse event was deemed to be probably preventable.

4.4 Clinical management issues (continued)

Figure 33: Assessor perception of preventability of adverse event causing death, by year



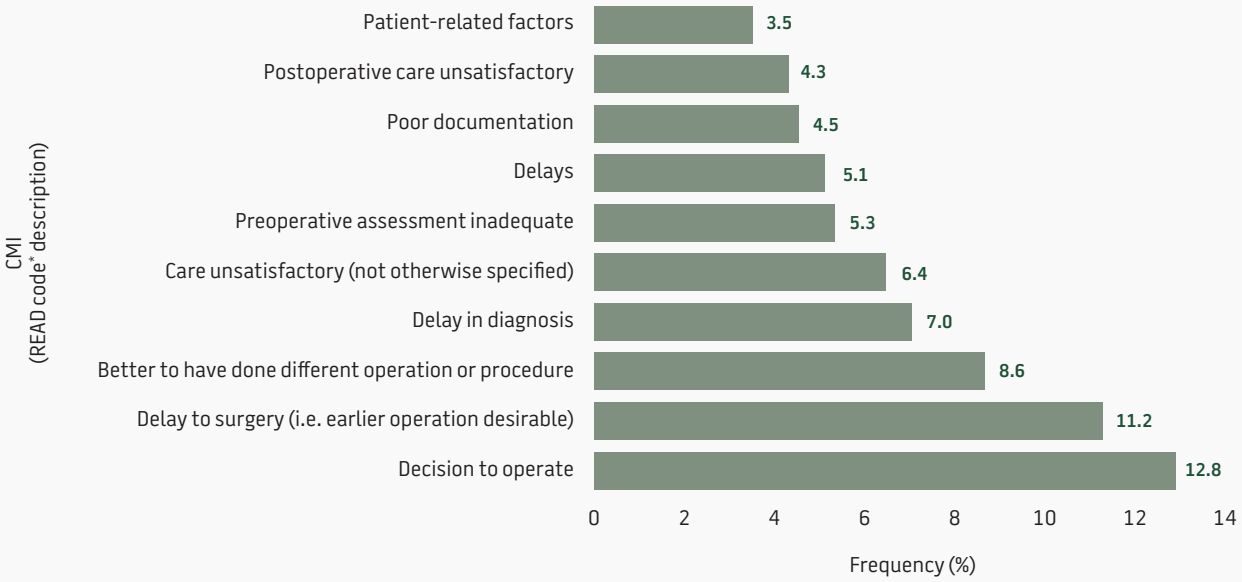
Note: Some 2022 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

The 10 most common CMIs are shown in Figure 34.

Assessors identified several CMIs in some patients. The decision to operate (12.8%; 48/374) and delay to surgery (11.2%; 42/374) were the 2 most frequently reported CMIs.

4.4 Clinical management issues (continued)

Figure 34: Most frequently reported CMI



CMI: clinical management issue.

*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, 21.4% of the CMIs related to the assessor questioning whether an operation should have occurred at all, or the assessor believing there was a different, better option. Another 23.3% of CMIs related to some sort of delay. Therefore, 44.7% of all CMIs related to the decision to operate, the choice of operation or delay.

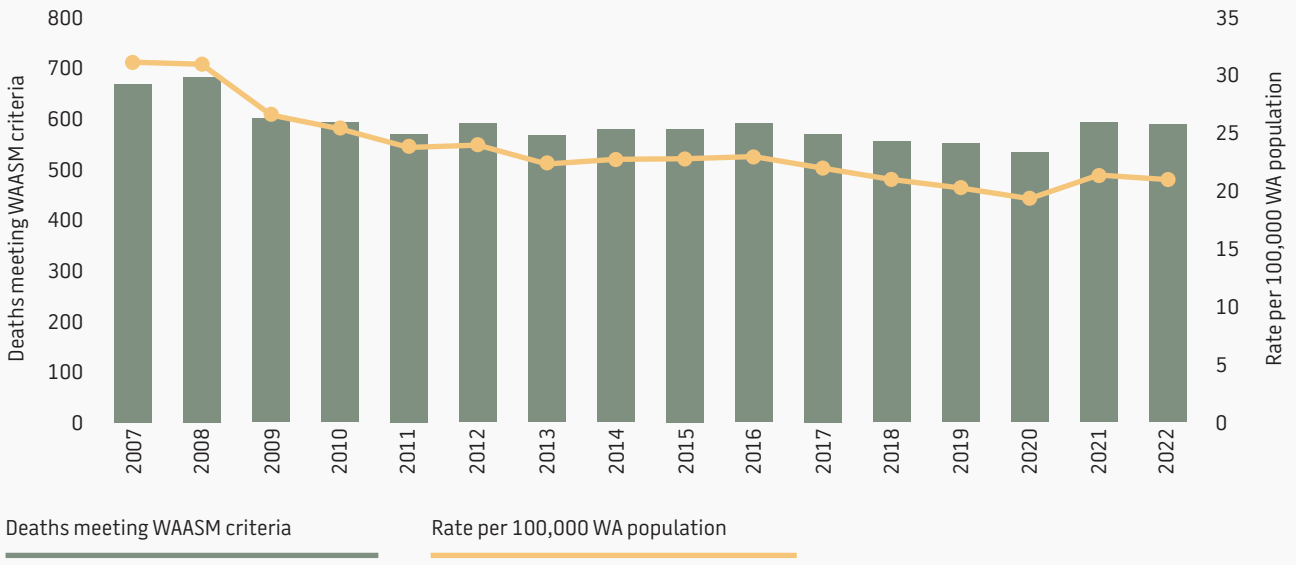
5. A closer look

5.1 Impact of COVID-19 on deaths under the care of a surgeon

Is there a legacy effect from COVID-19 that has a long-term adverse effect on surgical mortality?

A standout observation in this year's report is the increase in the number of deaths in 2021 and 2022 compared to the previous 4 years (2017–2020). The increase of approximately 40–50 patients (approximately 7%) in each year is an abrupt reversal of the progressive and almost uninterrupted decline in surgical deaths since WAASM commenced over 20 years ago. The number of deaths has reverted to that last seen in 2016 (Figure 35).

Figure 35: WAASM deaths and mortality rate per 100,000 WA population, 2007–2022



Note: Some 2022 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.

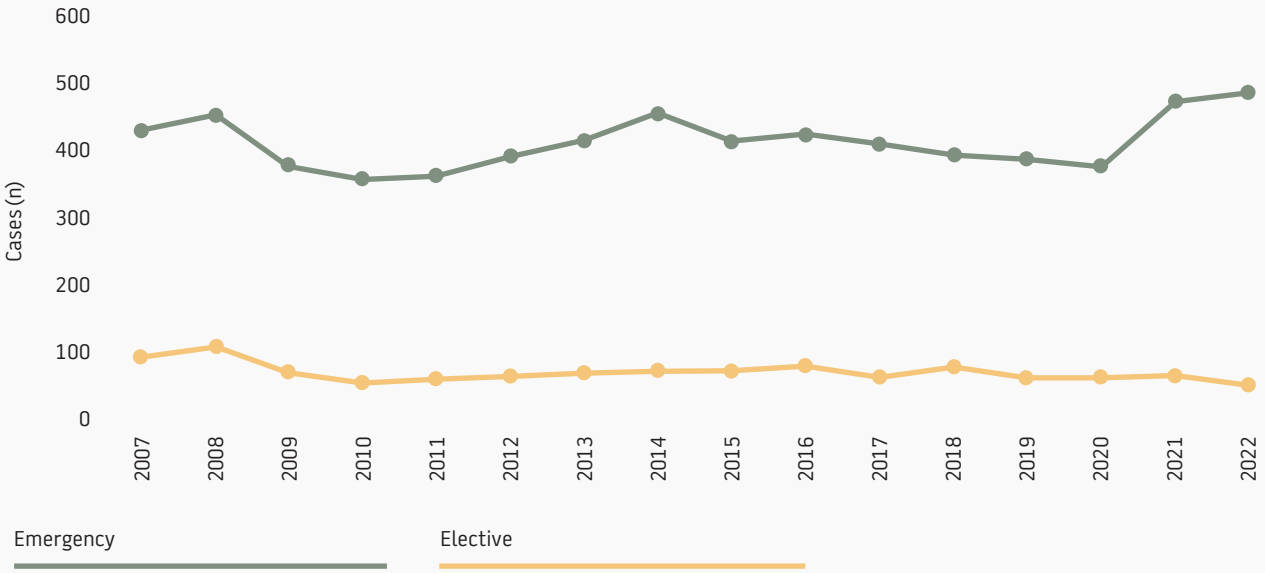
It is possible that this increase represents annual variation. However, it would seem a large variation, inconsistent with the long-term trend and by extending over 2 years it is atypical of previous experience.

An alternative explanation is that the increased mortality is a consequence of COVID-19. However, this should be considered with the knowledge that the spread of COVID-19 in WA was different to elsewhere. In WA, the number of reported COVID-19 infections and hospitalisations throughout 2020 and 2021 was very small, only starting to rise in March 2022. The first death of a surgical patient with COVID-19 was reported to WAASM in March 2022. Thus, it is unlikely that the increase in mortality in 2021 was directly related to patients having an active COVID-19 infection.

The increased mortality seems to be entirely confined to emergency admissions (Figure 36) and impacted both those who did and did not have an operation (Figure 37).

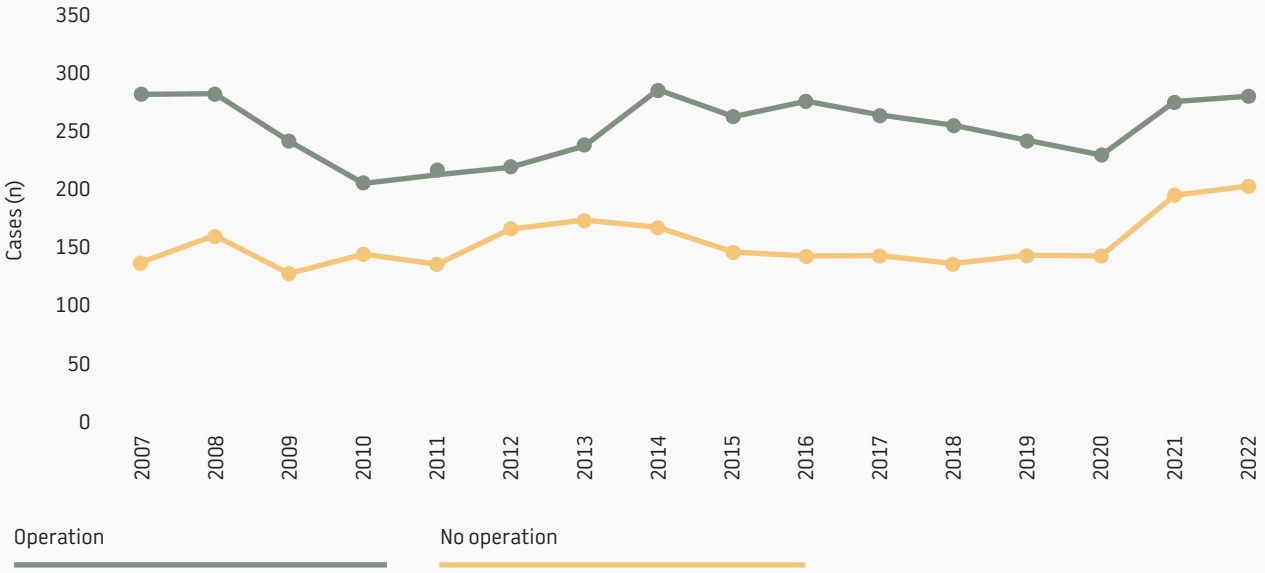
5.1 Impact of COVID-19 on deaths under the care of a surgeon (continued)

Figure 36: Elective and emergency admissions, 2007–2022



Note: Some 2022 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

Figure 37: Emergency admissions operative and nonoperative cases, 2007–2022



Note: Some 2022 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

5.1 Impact of COVID-19 on deaths under the care of a surgeon (continued)

The observed increase in surgical deaths in 2021 could be a secondary consequence of the following possibilities:

- Access to routine community medical services was reduced or delayed, leading to the following possible scenarios:
  - patients presented as emergency admissions with medical comorbidities poorly managed (regardless of past or present COVID-19 status).
  - patients underwent surgical interventions for underlying pathologies that had progressed to the extent that non-surgical intervention was impossible, adversely impacting high-risk patients.
  - patients were reluctant to attend hospital in a timely manner even when developing acute surgical symptoms.
- Patients who had contracted COVID-19 outside of WA were asymptomatic after quarantine within WA but had an unknown legacy effect from COVID-19.

Likewise, there are several possible explanations for the increase in surgical deaths among emergency admissions in 2022, in addition to those listed above.

- Unlike elective surgery, deferring emergency surgery is not possible. Thus, emergency surgery proceeded despite the documented increased risk associated with surgery in patients who are COVID-19 positive (or within 7 weeks of infection).[13]
- Emergency surgery occurred in patients who had recovered from acute COVID-19 infection but had known symptoms of long COVID (post-COVID condition). There are minimal data on the potential surgical risks for patients with long COVID, but it is likely that elective surgery would have been postponed while emergency surgery proceeded.

In 2022, WAASM documented 31 deaths in COVID-19 positive patients – slightly more than half the observed overall increase in deaths. Whilst it is possible that WAASM did not capture all COVID-19 positive surgical patients who died, there may be another COVID-19-related explanation for why the increase in the number of deaths was greater than the number infected. The 2022 WAASM Report noted that COVID-19 infection impacts microvascular circulation. Other conditions that have a similar impact (e.g. smoking, diabetes) are well known to be associated with greater surgical risk and poorer outcomes. The same is true if a patient's immune system has been disturbed.

It is possible that some deaths were a consequence of previous COVID-19 infection in asymptomatic patients who appeared to be fully recovered and were managed under this assumption. If, however, such patients had a hidden legacy of microvascular circulation or immune system impairment, their surgical risk may have increased. At the time, there were no data regarding surgical risk in asymptomatic post COVID-19 patients with or without symptoms of long COVID. In mid-2023, the Australian Safety and Efficacy Register of New Interventional Procedures – Surgical (ASERNIP–S) published a review of the surgical risk for asymptomatic post COVID-19 patients.[14] The review acknowledged a dearth of objective evidence on this subject; however, WAASM recommends that surgeons should ascertain if patients have had COVID-19 and consider the guidelines in the ASERNIP–S review.

5.2 Days to death—a marker of non-beneficial surgery?

Since WAASM commenced over 20 years ago, it has had a long-term interest in the avoidance of non-beneficial surgery, now often termed futile surgery. However, it is only recently that this parameter has attracted wider interest and its importance recognised. For many patients, poor postoperative quality of life, especially if it is associated with a loss of independent living, is 'a fate worse than death.'[15]

The 2022 WAASM Report presented long-term data over the first 20 years. One of the notable findings from this data review was the increase in nonoperative deaths over this time. It is legitimate to ask the question if the increase in nonoperative deaths under a surgeon is related to education from WAASM.

The usual way to present comparative mortality data is via a standardised mortality ratio (SMR). Surgical mortalities across Australian states and territories were compared using SMR methods, which showed that the progressive annual decrease in mortality observed in WAASM was replicated in all states and for all specialties.[16] There is no obvious clinical change to surgical care over the last 10 to 15 years that could have produced this universal decrease.

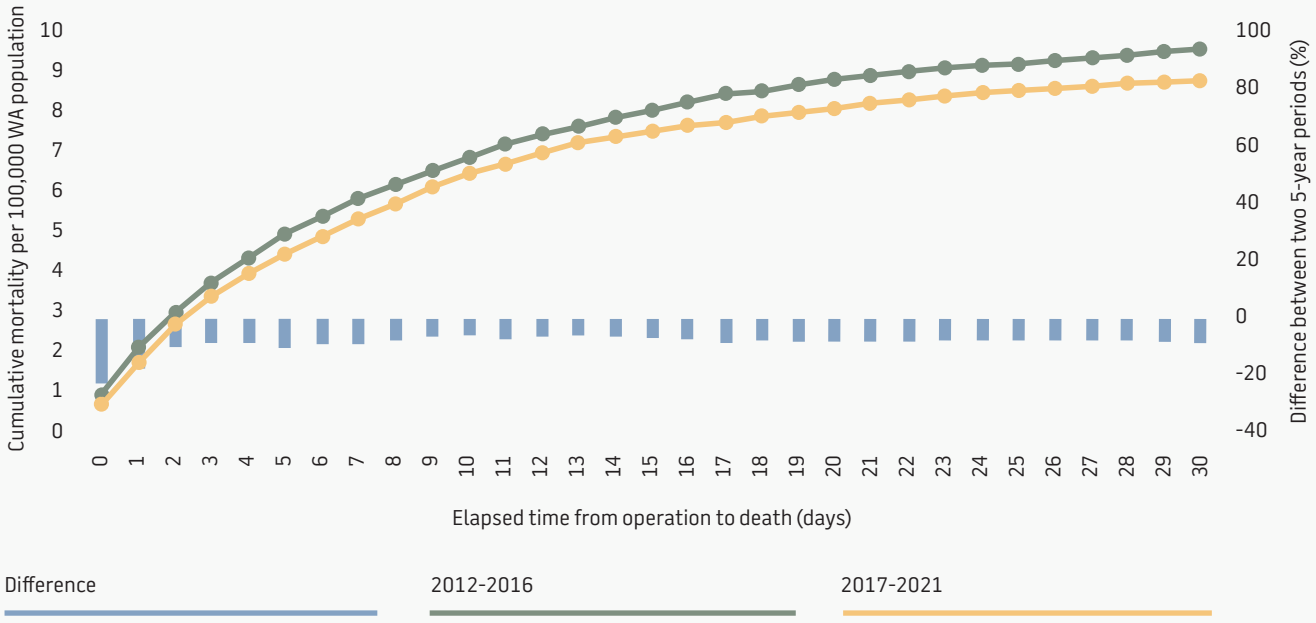
There is no agreed definition as to what constitutes futile surgery. Recently, 3 publications have considered the elapsed time from operation to death following an emergency laparotomy—a high-risk operation often undertaken in elderly, comorbid patients.[16,17,18] The studies found that 40% of deaths after an emergency laparotomy occurred within 4 days. These were considered to be early deaths. The authors of these studies hypothesise that a patient dying earlier than expected after an emergency laparotomy, may be considered to have had a non-beneficial, or futile, emergency laparotomy. A similar analysis of the Australian and New Zealand Emergency Laparotomy Audit found that the proportion of patients in Australia and Aotearoa New Zealand who had an early death was half of that reported for patients in the UK, USA and elsewhere.[9] Perhaps the ANZASM/WAASM focus on avoidance of futile surgery has contributed to this disparity. It would be interesting to explore if this is also the case for other operations and specialties.

WAASM has examined days to death in a wider context using data extracted from the WAASM database. The number of deaths each day from postoperative day one to the day of death was calculated, leading to the cumulative number of deaths per day for each year. To avoid the wide annual variation characteristic of mortality audits, the average of two 5-year periods was compared (2012–2016 compared to 2017–2021). Serendipitously, the ACSQHC published its national consensus statement on end-of-life care in 2016. These data were corrected to determine the WA population on 30 June each year.

Figure 38 shows that cumulative 30-day mortality was lower in the second period (2017–2021). A large part of the lower mortality at 30 days in the second period (2017–2021) was determined by the lower cumulative mortality over the first 3 days (22.1%, 16.9%, and 9.7% respectively). This lower early mortality established by day 3 then persists to day 30.

5.2 Days to death—a marker of non-beneficial surgery? (continued)

Figure 38: Cumulative daily mortality per 100,000 WA population



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

A limitation of this WAASM data is that there is insufficient data to examine 'early death' by specialty or admission status. Further, it is not known if WAASM data is reflective of other states. It does suggest that this analysis should be repeated by the other state mortality audits.

Acknowledgements

WAASM would like to acknowledge the support and assistance of the following individuals and institutions that have helped in the development and continuation of this project:

- participating surgeons
- first-line assessors
- second-line assessors
- hospital medical records departments
- Western Australian Department of Health, for funding the project
- Patient Safety Surveillance Unit, Clinical Excellence Division, Western Australian Department of Health, for continual commitment to, and support of, WAASM
- RACS, for infrastructure and oversight of this project
- 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:**

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

Professor Guy Maddern	Chair, ANZASM Steering Committee
Professor Wendy Babidge	General Manager, RAAS
Dr Helena Kopunic	Manager, Surgical Audit
Dr Nathan Procter	Project Manager, Victorian Audit of Surgical Mortality
Dr Kristin Weidenbach	Academic Editorial Manager

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Appendices

Appendix A: Review of 2022 recommendations (data)

Appendix A.1 Unplanned returns to theatre

Figure A.1a: Unplanned returns to theatre, 2018–2022

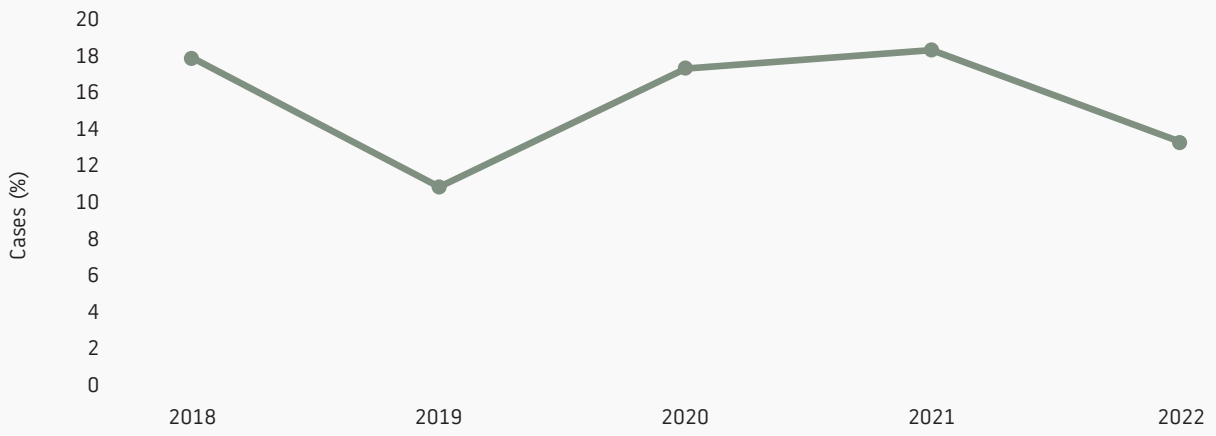
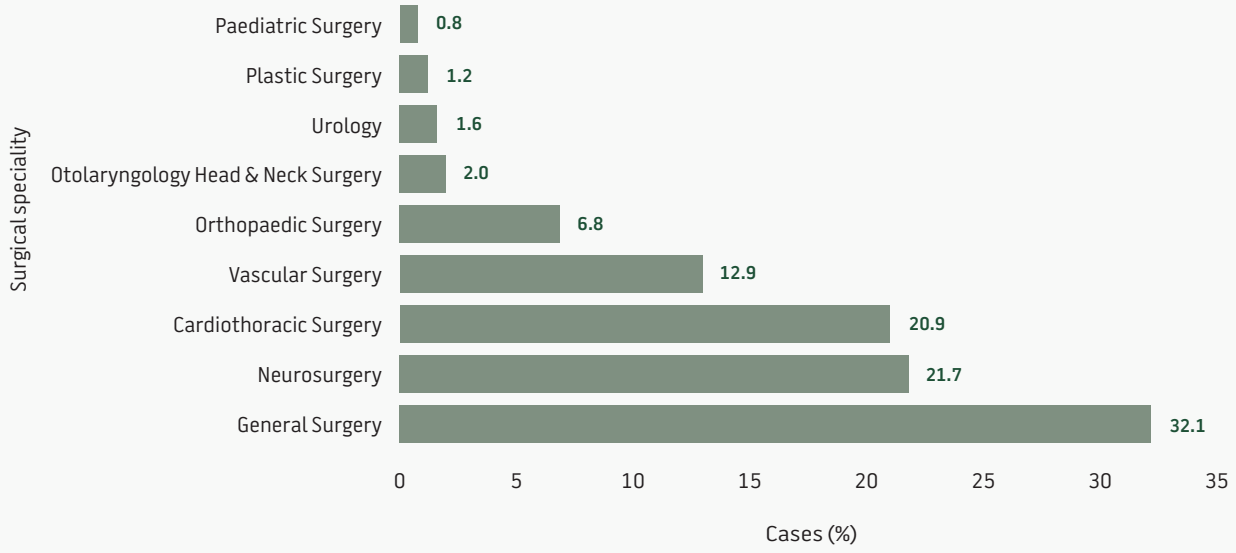


Figure A.1b: Unplanned returns to theatre by surgical specialty, 2018–2022



Appendix A.2 Unplanned readmissions within 30 days

Figure A.2a: Unplanned readmissions within 30 days, 2018–2022

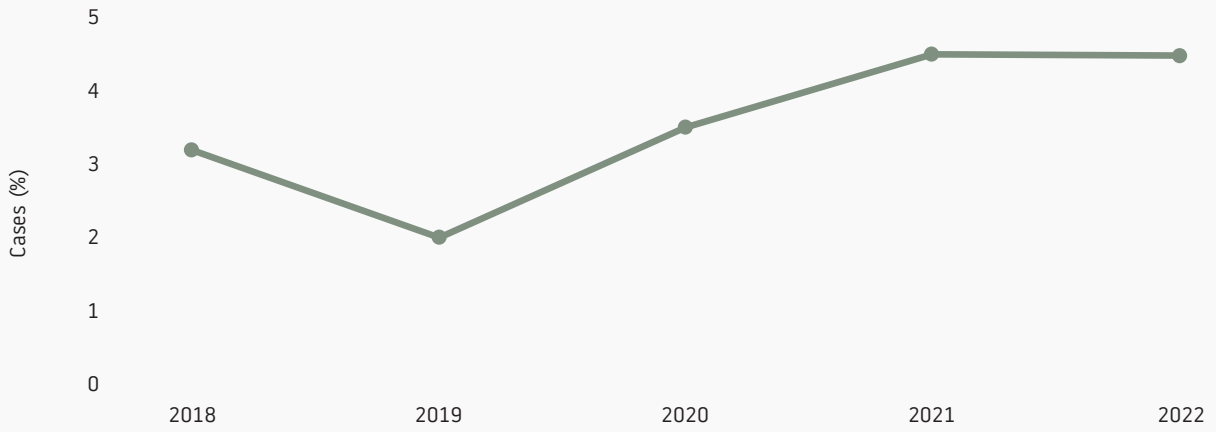
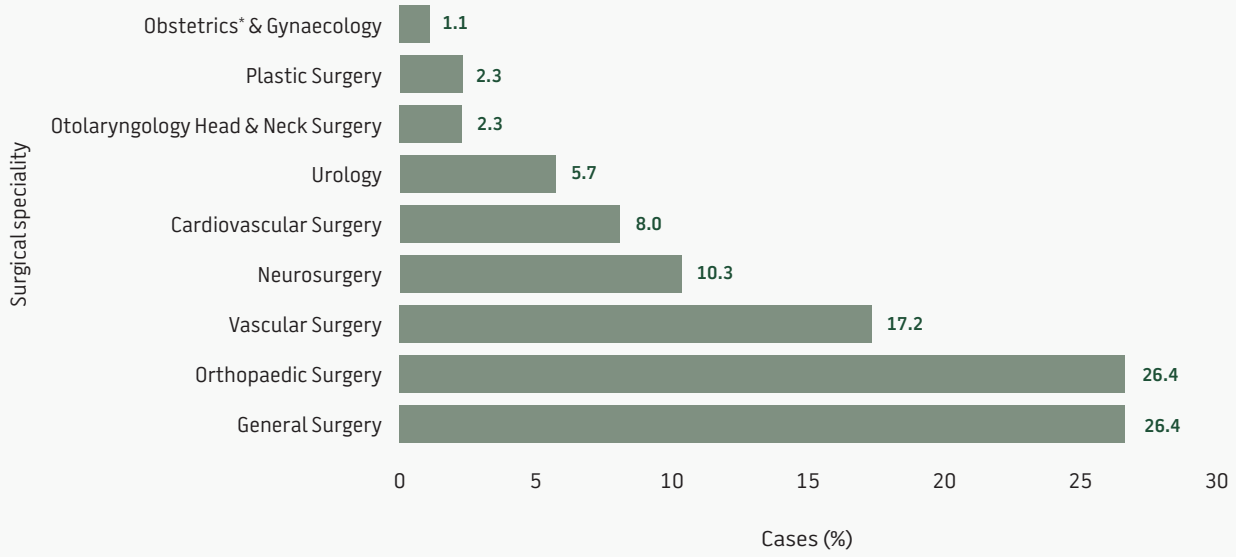
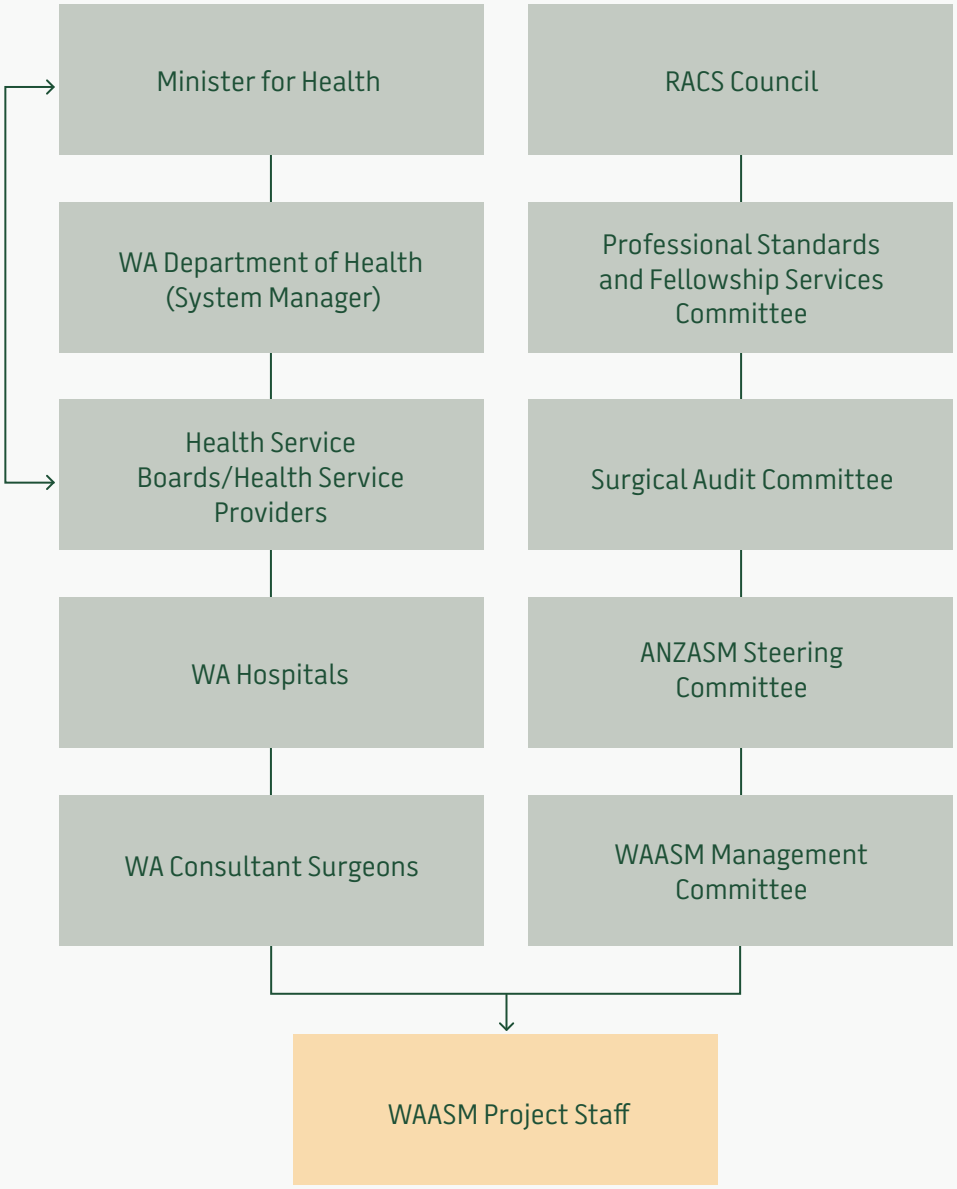


Figure A.2b: Unplanned readmissions within 30 days by surgical specialty, 2018–2022



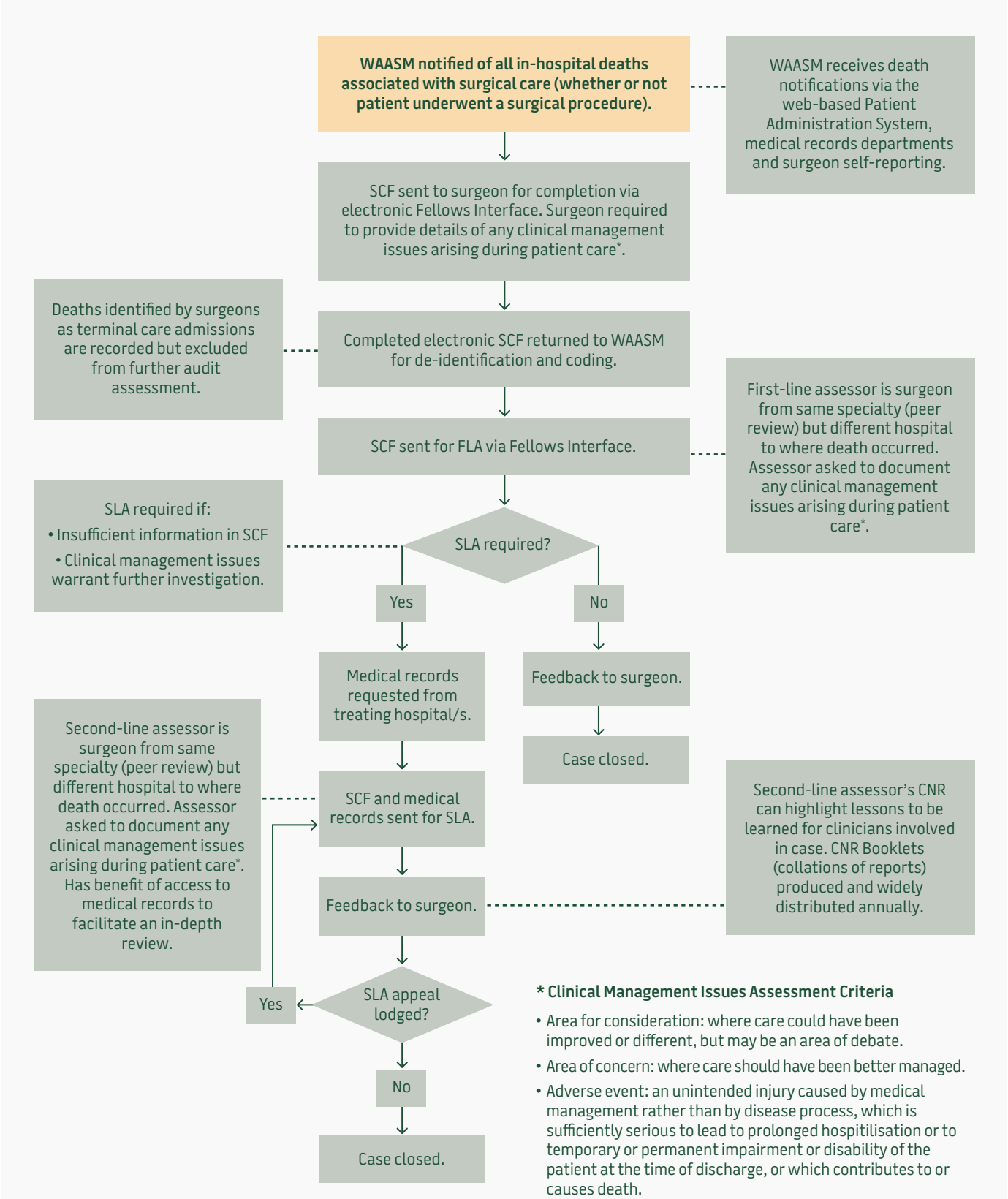
*Obstetric cases are not included in the audit process; only gynaecological cases are audited.

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 2018 and 2022. Total numbers of deaths reported to WAASM, including 'excluded error' cases (n=2,944).
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=2,825).
Data excluded	All 'excluded error' cases (n=119).
Table 3: Median age by sex	
Definition	Median age by sex for all cases.
Data included	All deaths falling within WAASM criteria (n=2,825).
Data excluded	All 'excluded error' cases (n=119).
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 2018 and 2022 (n=2,944).
Data excluded	No exclusions.
Figure 2: Most common causes of death (READ codes*), by year	
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=3,716).
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=2,825).
Data excluded	All 'excluded error' cases (n=119).
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=2,825).
Data excluded	All 'excluded error' cases (n=119).
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=2,424).
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=2,422).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. Data missing=3.
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=2,825).
Data excluded	All 'excluded error' cases (n=119).
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=187), General Surgery (n=979), Neurosurgery (n=429), Obstetrics & Gynaecology (n=3), Ophthalmology (n=2), Otolaryngology Head & Neck Surgery (n=34), Orthopaedic Surgery (n=442), Paediatric Surgery (n=14), Plastic Surgery (n=48), Urology (n=94), Vascular Surgery (n=192).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. Data missing=1.
Figure 9: Emergency operative and nonoperative cases, by year	
Definition	Percentages of emergency operative and nonoperative cases per year.
Data included	All deaths falling within WAASM criteria where an emergency admission was reported (n=2,110).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases.
Figure 10: Elective operative and nonoperative cases, by year	
Definition	Percentages of elective operative and nonoperative cases per year.
Data included	All deaths falling within WAASM criteria where an elective admission was reported (n=312).
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: 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=2,141).
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 12: 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=2,141).
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 13: 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=2,108).
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=33.
Figure 14: 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=1,579).
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 15: 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=427).
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.

Appendix D.2 Figures (continued)

Figure 16: 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=843) 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 17: 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=2,423).
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.
Figure 18: Hospital transfers, by year	
Definition	Percentages of hospital transfers per year.
Data included	All deaths falling within WAASM criteria where transfers were reported (n=2,408).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. Data missing=17.
Figure 19: 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=730).
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'=17; 'insufficient clinical information'=15; 'inappropriate transfer'=13; 'delay in transfer'=14.
Figure 20: 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.

Appendix D.2 Figures (continued)

Figure 21: 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=2,240).
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=185.
Figure 22: 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=2,417).
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=8.
Figure 23: 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=1,472) and non-use (n=948) of CCU was reported.
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. Data missing=5.
Figure 24: 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=1,870) and non-use (n=539) 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=16.
Figure 25: 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=1,870).
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.

Appendix D.2 Figures (continued)

Figure 26: 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=2,420).
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=5.
Figure 27: 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=723).
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.
Figure 28: 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=1,932).
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=28.
Figure 29: 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=847; HDU, n=843).
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=23, HDU=27.

Appendix D.2 Figures (continued)

Figure 30: 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=2,388).
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 31: Categories of CMI, by year	
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=601).
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 32: 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=76).
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 33: 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=41).
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.

Appendix D.2 Figures (continued)

Figure 34: Most frequently reported CMI	
Definition	Percentages and descriptions (in READ code) of the 10 most common CMI, as reported by assessors.
Data included	All deaths falling within WAASM criteria where CMI were reported (n=374).
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 35: WAASM deaths and mortality rate per 100,000 WA population, 2007—2022	
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 from 2007 - 2022 (n=9,185).
Data excluded	All 'excluded error' cases (n=231).
Figure 36: Elective and emergency admissions, 2007—2022	
Definition	Number of elective and emergency admissions per year.
Data included	All deaths falling within WAASM criteria where an elective and emergency admission was reported.
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care', 'lost to follow up', and 'closed non-participant' cases.
Figure 37: Emergency admissions operative and nonoperative cases, 2007—2022	
Definition	Number of emergency operative and nonoperative cases per year.
Data included	All deaths falling within WAASM criteria where an emergency admission was reported.
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care', 'lost to follow up', and 'closed non-participant' cases.
Figure 38: Cumulative daily mortality per 100,000 WA population	
Definition	Number of operative deaths falling within WAASM criteria and mortality rate difference between 2 5-year periods per 100,000 WA population.
Data included	All operative deaths falling within WAASM criteria from 2012 - 2021.
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care', 'lost to follow up', and nonoperative cases.

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

Royal Australasian College of Surgeons

Western Australian Audit of Surgical Mortality

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ACN 004 167 766 | NZCN 6235298
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