Royal Australasian
College
of Surgeons

The Western Australian Audit of Surgical Mortality (WAASM)

2024 Report

5-year review
Jan 2019 - Dec 2023

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Clinical Director's report

All changing, utterly changing

This report is being written against a background of significant changes that will have profound implications for the Royal Australasian College of Surgeons (RACS), the Australian and New Zealand Audit of Surgical Mortality (ANZASM) and individual surgeons. Exactly when and where these changes land remains to be determined.

It is very possible that in future years, 2024 will be seen as an inflection point in the Australian surgical safety and quality environment.

Significant events in 2024 include the establishment of continuing professional development (CPD) homes including RACS, that shift the reporting of compliance from individual surgeons to RACS;[1,2] the revised version of the Australian Commission on Safety and Quality in Health Care (ACSQHC) Framework for Australian clinical quality registries (CQRs);[3] the Federal Department of Health National Strategy for CQRs 2020-2030;[4] and the funding of national CQRs by the Commonwealth.[5] General surgeons will in addition need to respond to the likely development of clinical care standards for emergency laparotomy, one of the 2 common surgical emergencies (with hip fracture) with a high mortality.

If there is a single, unifying theme in these developments, it is the requirement of the jurisdictions for more complete case ascertainment, associated with more timely collecting and reporting of safety and quality data. The expectation is that there will be near real-time data collection, with longitudinal analysis being returned within 3 months, and in high-risk settings perhaps more frequently. Annual reports will no longer be adequate or acceptable. This short timeframe is already the standard overseas, and with increasing electronic recording, automation and artificial intelligence (AI), is likely to progress very rapidly. RACS, ANZASM and individual surgeons will have to respond.

From ANZASM's perspective there are several parties to this process. The first is the efficiency of the Audit of Surgical Mortality offices. The data logs clearly show there is minimal internal delay.

The second are the hospitals, who need to notify their Audit of Surgical Mortality office of any deaths promptly. Western Australia (WA) is already well placed to meet these requirements as it receives notification of most deaths from the WA Department of Health each Monday. In addition, the hospitals need to promptly provide medical records when requested for a second-line assessment (SLA); this is done in WA. Accessing medical records will greatly improve with wider adoption of electronic medical records. In keeping with the jurisdictional demands, there has already been a measurable improvement in other states/territories.

The third party is the surgeons, who will need to complete and return their ANZASM surgical case forms (SCFs) promptly, certainly within 2 months. In addition, the first-line assessments (FLAs) will need to be completed with minimal delay. ANZASM needs to have a goal of completing all FLAs within 3 months.

In addition, it is surgeons who undertake the SLAs. These are often not returned for many months and that will not satisfy the requirement of timely review. The Western Australian Audit of Surgical Mortality (WAASM) is very aware of the impost on the second-line assessors who give their time freely and will work to minimise the number required.

The work for both the first and second-line assessors would be greatly reduced if surgeons provided more detail in the SCFs. This should be considered a professional responsibility in terms of safety and quality and a professional courtesy to consultant colleagues, the assessors. WAASM already returns poorly completed SCFs and in order to further reduce the burden on its assessors, may need to adopt a more robust position.

Having collected timely data, ANZASM will need to present it to surgeons, hospitals and health departments. There is a worldwide shift away from static reports, normally presented annually, towards near real-time longitudinal reports using statistical process control (SPC) charts.[6] Sam Riley, Director of the National Health Service (NHS), England, Making Data Count, spoke to their use at a WA Department of Health summit in February 2024. In Australia, the WA Department of Health is leading the way with its Safety and Quality Indicator Set (SQuiS) dashboards.[7] SPC charts are already being used in surgical CQRs in both the NHS and Australia.

The utility of SPC within WAASM has been explored in a 'proof of concept' analysis included in this report (Section 5). WAASM data has been plotted using the NHS SPC Excel templates. It is suggested that ANZASM would be able to present SPC data in a format that will be of value to hospitals and jurisdictions. However, a key requirement will be timely data collection.

The learnings from review of these cases will also need to be discussed. The obvious place would be the surgical Mortality and Morbidity meeting. RACS already has guidelines for these meetings.

An important part of the discussion with the jurisdictions has been the role of Qualified Privilege (QP). WAASM would never have commenced without QP but, 22 years later, its place needs to be reviewed. However, ANZASM needs to ensure that reports by surgeons and assessors remain protected. Without protection, surgeons will not have the confidence to provide the detailed reports that are essential to ANZASM. The jurisdictions do not want, and have not requested, access to the surgeons' and assessors' reports.

However, the jurisdictions, reasonably, would like to know which deaths were identified by ANZASM as having had a care issue and that they have been reviewed at surgeon and hospital level. The obvious place to discuss would be at the surgical Mortality and Morbidity meeting.

The aim of CQRs is to identify and manage variation and in particular unwarranted variation, often termed outliers.[8,9] For such variation to be detected, it is essential that the data is complete and accurate. It is recommended that CQRs capture at least 95% of all relevant data.[10,11] ANZASM meets this standard, albeit to date not always in a timely manner.

However, ANZASM is an exception as almost all other Australian surgical CQRs have low participation, piecemeal case ascertainment and poor completion of data fields. In many Australian surgical CQRs, less than half of all eligible cases are included.[12] This means there is a real risk of serious poor care not being detected and/or managed. It is important that poor care is identified as soon as possible so as to limit harm to future patients.

As a direct result of poor data quality and non-participation, Ian Paterson, a UK surgeon, was not stopped from working and so unnecessarily harmed many more women.[13,14] Paterson faced a criminal trial and was sentenced to 15 years imprisonment, that was increased to 20 years on appeal.

To specifically address the failures uncovered by the Paterson inquiries, the Heath Quality Improvement Partnership (HQIP) changed its guidelines in January 2024. 'Non-participation' is now treated as an outlier event at the alarm level (>99%), with referral to the Care Quality Commission, the UK independent and external health regulator.[15]

The revised ACSQHC CQR Framework has uplifted the HQIP outlier processes and includes referral of non-participants.[3] A critical difference is that the ACSQHC guidelines only refer the non-participant to the health service organisation or the local health district/network and not to an independent, external health regulator. Both a hospital and a board would know, or be expected to know, that an organisation they are responsible for is not participating in a CQR. It is unclear why the ACSQHC has made the HQIP guidelines less strong by limiting non-participation to what is essentially an internal referral. This was the very reason why Paterson escaped detection. It is not a level of external independent scrutiny that ANZASM promotes; and it would be unacceptable in other safety-critical industries. How this ACSQHC requirement will work in practice remains to be determined.

Turning to this report, the prominent observation is that the uptick in deaths first noted in 2021 continues. In the absence of any other explanation, this is likely to be secondary to COVID-19. Whether it is a direct effect of active COVID-19, or a legacy effect of previous infection, as suggested in last year's WAASM report, is unknown.[16]

This report has been generated by the WAASM staff – Franca Itotoh, Natalie Zorbas and Katie Morgan. It is a detailed and complex analysis, and they have again excelled. Additional thanks and credit are due to Franca, particularly, for the substantial extra work required to generate the SPC data, only some of which have been included in this report. On behalf of all WA surgeons, I offer my sincere thanks for all their excellent work throughout the year. They do not need to fear the arrival of AI!

RJ Aitken

WAASM Clinical Director

Abbreviations

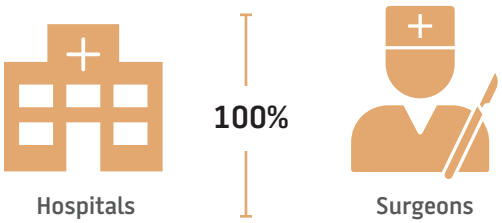
ACSQHC	Australian Commission on Safety and Quality in Health Care
AI	Artificial intelligence
ANZASM	Australian and New Zealand Audit of Surgical Mortality
ANZELA–QI	Australian and New Zealand Emergency Laparotomy Audit – Quality Improvement
ASA	American Society of Anesthesiologists
CCU	Critical care 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
HQIP	Health quality improvement partnership
MR	Moving range
NHS	National Health Service
PELA	Perth Emergency Laparotomy Audit
QI	Quality improvement
QP	Qualified privilege
RAAS	Research, Audit and Academic Surgery
RACS	Royal Australasian College of Surgeons
SCF	Surgical case form
SLA	Second-line assessment
SPC	Statistical process control
SQUiS	Safety and quality indicator set
TED	Thromboembolic deterrent
WA	Western Australia/n
WAASM	Western Australian Audit of Surgical Mortality

Snapshot

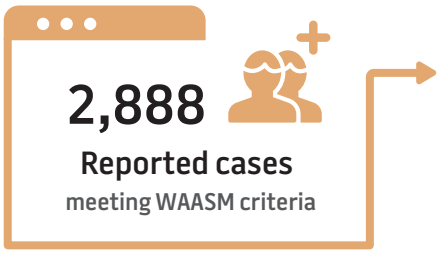
This snapshot covers cases reported to WAASM from **1 January 2019 to 31 December 2023**.

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

Participation



Analysis and audit numbers

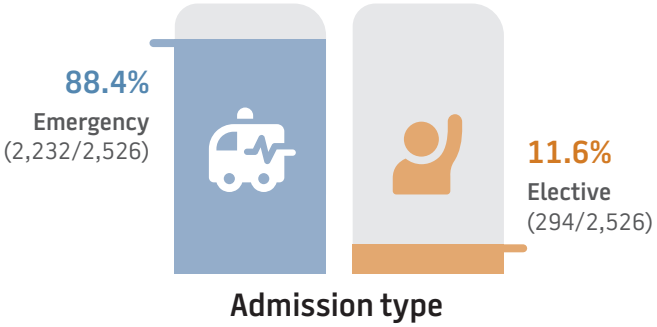


86.2%
Completed cases
(2,489/2,888)

2.6%
Cases in progress
(74/2,888)

11.1%
Excluded terminal care cases
(320/2,888)

0.2%
Cases lost to follow-up
(5/2,888)

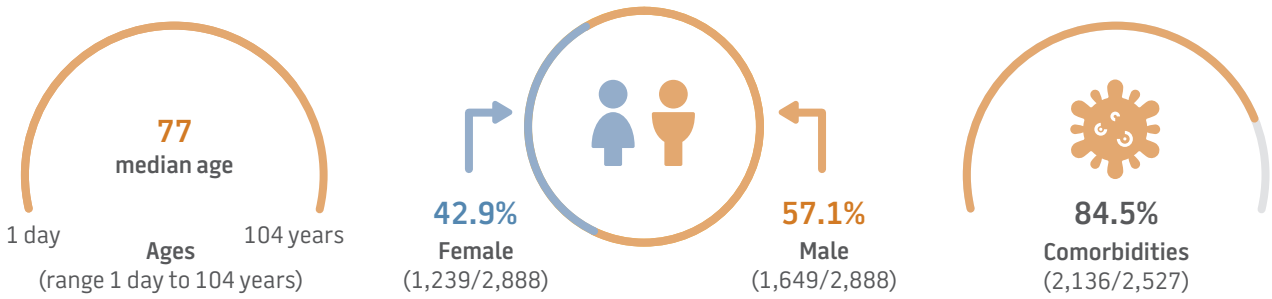


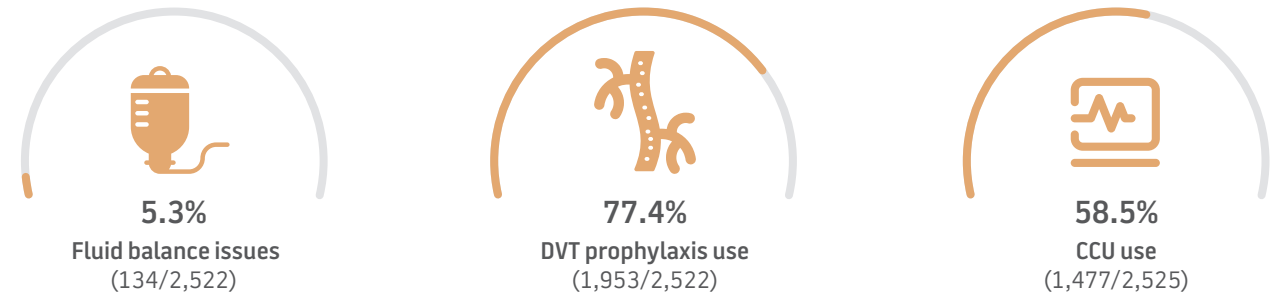
Public **83.7%**
(2,116/2,527)

Private **9.6%**
(242/2,527)

Co-location **6.7%**
(169/2,527)

Risk profile





Patient transfers

29.9%
Patients transferred (753/2,521)

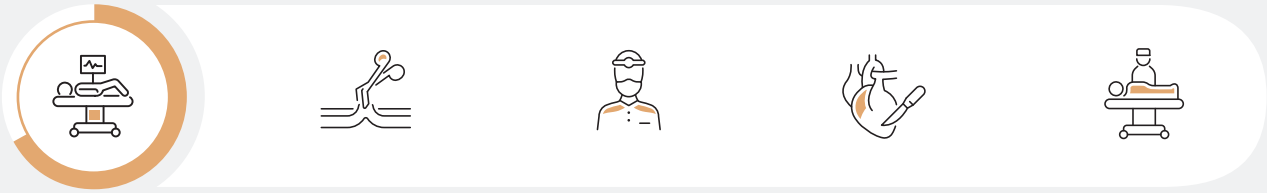
11.4%
Delay in transfer (85/746)

4.3%
Insufficient clinical information (32/743)

4.0%
Inappropriate transfer (30/745)

2.4%
Inappropriate level of care (18/742)

Operations



63.5%
Patients had surgery (1,605/2,527)

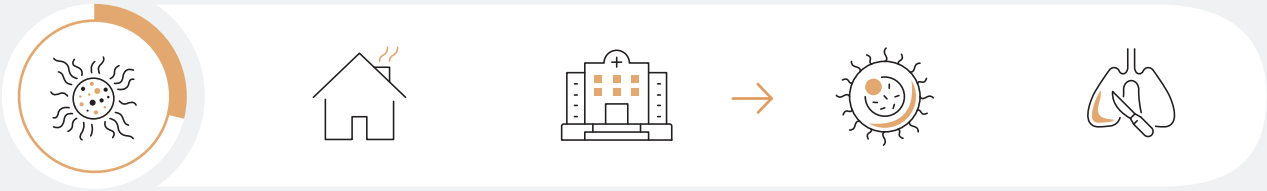
93.4%
Consultant surgeons who made the decision to operate (1,987/2,127)

67.7%
Consultant surgeons who performed the surgery (1,440/2,127)

14.3%
Unplanned returns to theatre (230/1,604)

4.3%
Operations abandoned on finding a terminal situation (90/2,115)

Infection



31.0%
Patients with clinically significant infection (783/2,524)

53.8%
Infection acquired prior to admission (421/782)

46.2%
Infection acquired during admission (361/782)

26.0%
Infection acquired preoperatively (94/361)

55.7%
Infection acquired postoperatively (201/361)

Peer-review outcomes

14.4%
Cases with one or more clinical management issues (358/2,489)

584
Number of clinical management issues

11.1%
Adverse events (65/584)

46.2%
Adverse events that caused death (30/65)

30.0%
Definitely preventable adverse events that caused death (9/30)

Review of 2023 recommendations

2023 Recommendations	Progress
Education	
Cross-promote ANZASM webinars across all regions to facilitate access to a range of educational opportunities for WA surgeons.	Over the past year, WAASM has continued to widely promote ANZASM webinars and thereby increase educational opportunities for WA surgeons. These included: • *Surgical challenges and the vulnerable patient* (Queensland Audit of Surgical Mortality) • *Putting evidence into practice* (South Australian Audit of Surgical Mortality) • *RACS: Making Data Count* (How to present data, UK NHS Director Sam Riley).
Clinical management	
For the 2024 WAASM Report, continue to monitor and report any trends observed in unplanned returns to theatre.	For the reporting period 2019–2023, an unplanned return to theatre was reported in 14.3% of operative cases (230/1,604). Figure A.1a in Appendix A.1 shows the breakdown by year. Males accounted for 53.9% (124/230) and females 46.1% (106/230) of these cases. Of the total unplanned returns to theatre, 15.2% of patients (35/230) were age ≤50 years, 30.4% (70/230) were age 51–70 years and 54.3% (125/230) were age > 70 years. Of those cases with an unplanned return to theatre, 83.5% (192/230) were in public hospitals, with 12.2% (28/230) and 4.3% (10/230) in private and co-location hospitals, respectively. Emergency admissions accounted for 69.1% of cases (159/230) and elective admissions 30.9% (71/230). As in the previous reporting period (2018–2022), 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 (16.9%; 272/1,605). Figure A.1b in Appendix A.1 shows groupings by surgical specialty, with General Surgery (33.5%; 77/230), Neurosurgery (20.0%; 46/230), and Cardiothoracic Surgery (18.3%; 42/230) making up the majority of cases.

Review of 2023 recommendations (continued)

Clinical management	
For the 2024 WAASM Report, continue to monitor and report any trends observed in unplanned readmissions within 30 days of surgery.	For the reporting period 2019–2023, an unplanned readmission within 30 days was reported in 3.5% of cases (89/2,521). Figure A.2a in Appendix A.2 shows the breakdown by year. Males accounted for 64.0% (57/89) and females 36.0% (32/89) of these cases. Of the total unplanned readmissions within 30 days, 10.1% of patients (9/89) were age ≤50 years, 28.1% (25/89) were age 51–70 years and 61.8% (55/89) were age > 70 years. Of those cases with an unplanned readmission within 30 days, 85.4% (76/89) were in public hospitals, with 11.2% (10/89) and 3.4% (3/89) in private and co-location hospitals, respectively. Emergency admissions accounted for 77.5% of cases (69/89) and elective admissions 22.5% (20/89). Figure A.2b in Appendix A.2 shows groupings by surgical specialty, with General Surgery (25.8%; 23/89), Orthopaedic Surgery (21.3%; 19/89), and Vascular Surgery (16.9%; 15/89) 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 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).	This analysis is still in progress. WAASM now intends to examine the data over an extended period and present the results using SPC charts. This will be shared in the 2025 report.

2024 recommendations

Education

- Ensure that surgeons are viewing WAASM feedback letters for each of their cases, so insights and suggestions made by assessors and subsequent lessons from the audit, are communicated to them.

Clinical management

- For the 2025 and 2026 reports, examine surgeon responses to the SCF question '*In retrospect, would you have done anything differently*', and identify and report on any emerging themes.
- For the 2025 and 2026 reports, examine the preoperative risk of death as recorded by surgeons in the SCF and by surgical assessors in the assessment form, and identify and report on any trends.

Research and reporting on audit data

- In conjunction with ensuring that WAASM feedback letters are viewed by audit participants (noted above), develop strategies to increase the number of peer-review feedback evaluation forms returned to WAASM following the receipt of feedback letters. This ongoing evaluation is important in closing the loop and indicating how care or processes have been improved.
- As described in the Clinical Director's report, the environment within which WAASM will operate will be influenced by jurisdiction-initiated discussions with ANZASM regarding improvements they feel will enhance its value. The 3 major issues the jurisdictions want addressed are:
    - more timely reporting
    - complete participation and case ascertainment
    - a nationally consistent approach to open and transparent reporting.

  This approach has to be viewed against the publication of the ACSQHC revised Framework for Australian CQRs and the Commonwealth providing up to $40 million to fund national CQRs. A major focus for WAASM will be how it can best respond to the jurisdictions' requests.

1. Background and methods

1.1 Introduction

The Western Australian Audit of Surgical Mortality (WAASM) is an external and 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.

As a patient safety and quality improvement initiative, WAASM is designed as an educational tool and feedback mechanism for surgeons, to encourage reflection on surgical care and practice following the death of a patient. Information submitted to WAASM by the surgeon provides the opportunity to identify areas in which care could be improved. Surgical peers review the medical record and assess the surgical management of every patient, including hospital processes and systems, and provide feedback to the surgeons responsible for each case.

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.

1.3 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.

1.4 Audit process

The audit process combines surgeon self-reflection with the peer-review of all surgical deaths. The aim is to determine whether a death was the direct result of the disease process alone, or whether aspects of patient management or hospital systems and protocols may have contributed.

The audit process begins when a surgical death is reported to WAASM. Public hospital deaths are reported 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 surgeon responsible for 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 surgeon was responsible for 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 surgeon. This information is based on the patient's diagnosis during the last admission and incorporates test results, operations and postmortem reports when available.

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

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

1.5 Providing feedback

The core purpose of WAASM is to improve patient outcomes. This is accomplished by the provision of detailed feedback to 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**

  Surgeons are provided with assessor feedback on individual cases. The identities of assessors remain anonymous at all times. WAASM encourages 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 surgeons. All information in the case note reviews is de-identified so events cannot be linked to an individual patient, surgeon or hospital.

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

1.5 Providing feedback (continued)

- **Surgical News**

  This RACS publication is released every 2 months, and each issue contains an ANZASM case study.

- **Annual report**

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

1.6 Data analysis

WAASM audits all surgery-related deaths occurring in WA hospitals. This 2024 report covers deaths reported to WAASM from **1 January 2019** to **31 December 2023** (census date 15 April 2024).

The full audit process can take 3 months or longer from the initial notification of death, so some 2023 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.

Statistical analysis was performed using the Statistical Package for Social Sciences (IBM SPSS version 28.0). Graphs were produced with Microsoft Office Excel. All data are de-identified to preserve the confidentiality of the patient, surgeon and hospital.

2. Audit overview

Key results for the period 2019 to 2023:

- 2,888 deaths met WAASM criteria
- 98.6% of SCFs returned
- 83.7% of admissions were to a public hospital

2.1 Audit numbers

During the audit period 1 January 2019 to 31 December 2023, there were 3,006 deaths reported to WAASM. Of these, 118 deaths were excluded for not meeting WAASM inclusion criteria, resulting in a total of 2,888 deaths included for the current report (Table 1). The biggest increase was seen between 2020 and 2021 (11.2%; from 534 to 594).

Table 1: Deaths reported to WAASM, by year

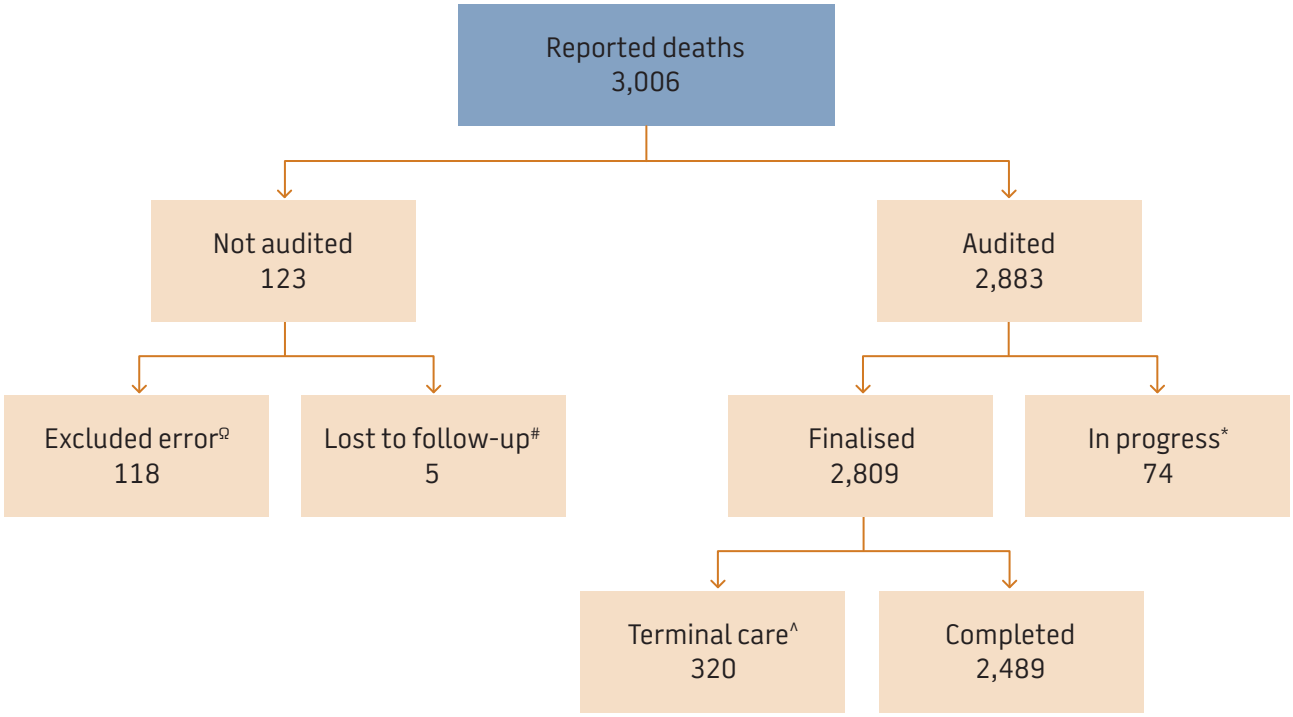
Year	Number of deaths reported	Deaths not meeting criteria*	Deaths meeting criteria#
2019	562	10	552
2020	556	22	534
2021	616	22	594
2022	632	38	594
2023	640	26	614
Total	**3,006**	**118**	**2,888**

WAASM: Western Australian Audit of Surgical Mortality.
* Reported deaths subsequently found to have no surgeon involvement.
# All deaths meeting WAASM criteria, including terminal care cases.
Refer to Appendix D.1 for further information on data.

2.1 Audit numbers (continued)

Figure 1 shows the number of reported deaths audited in the period 2019 to 2023.

Figure 1: Deaths audited by WAASM



[Ω] Reported deaths not meeting WAASM inclusion criteria.
[#] Cases remaining incomplete for a period of 2 years or more.
[*] Cases that have not completed the full audit process.
[^] Patients admitted specifically for terminal care are excluded from the full audit process.
Refer to Appendix D.2 for further information on data.

As of the census date (15 April 2024), 86.2% of cases (2,489/2,888) had completed the audit process. There were 2.6% (74/2,888) of cases in progress, with cases from 2023 constituting the largest proportion of those incomplete (2.5%; 73/2,888).

Patients admitted specifically for terminal care are excluded from the full audit process and surgeons do not have to complete the SCF. Over the reporting period (2019–2023), terminal care accounted for 11.1% of cases (320/2,888).

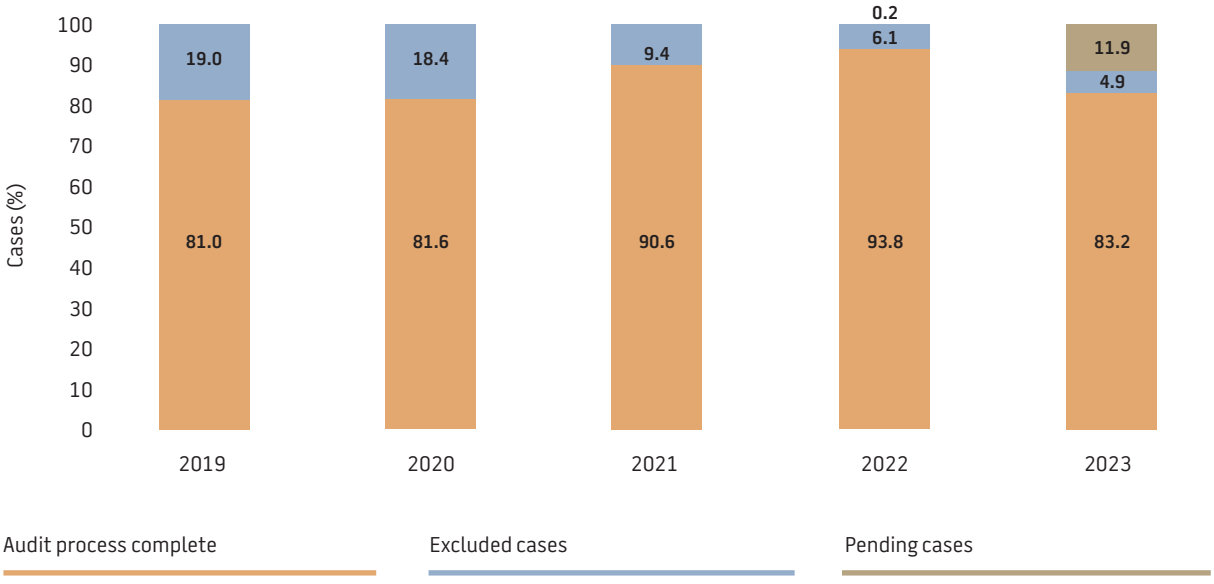
The proportion of terminal care cases has gradually decreased over the reporting period (18.1%, 2019; 18.4%, 2020; 9.4%, 2021; 6.1%, 2022 and 4.9%, 2023). This can be attributed to the detailed review of terminal care cases that WAASM has undertaken since 2021 to ensure that incorrect terminal care classifications are identified and SCFs are returned to surgeons for completion.

2.1 Audit numbers (continued)

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 year 2019, 'lost to follow-up' cases accounted for 0.9% (5/552) of cases.

Overall, a total of 11.3% of cases (325/2,888) were excluded from the audit for being terminal care admissions or 'lost to follow-up' (Figure 2). There has been a consistent reduction each year in the proportion of excluded cases over the reporting period.

Figure 2: Case status, by year

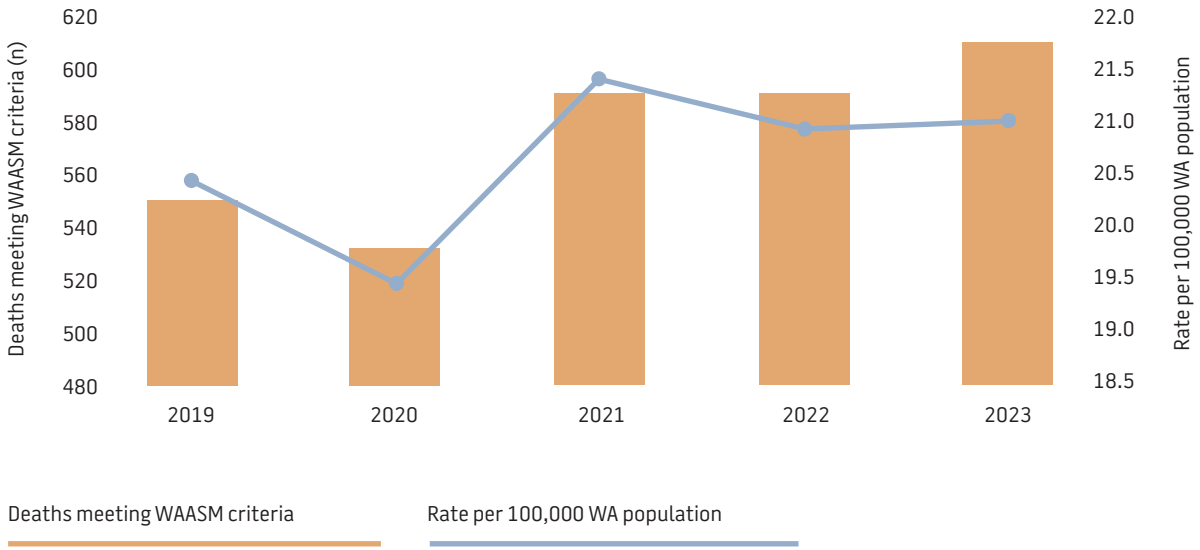


Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

2.1 Audit numbers (continued)

The rate of deaths under the care of a surgeon per 100,000 WA population decreased between 2019 and 2020, followed by an increase in 2021 and a slight drop in 2022 (Figure 3).[17]

Figure 3: WAASM deaths and mortality rate per 100,000 WA population, by year



WAASM: Western Australian Audit of Surgical Mortality, WA: Western Australia.
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

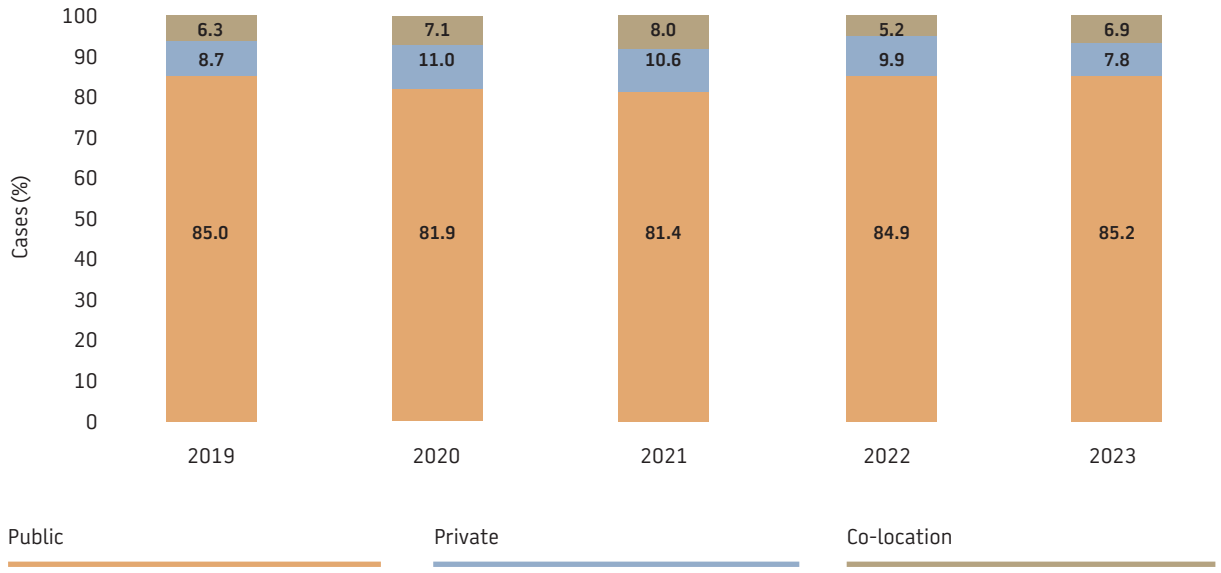
2.2 Hospitals

All hospitals certified to provide surgical services in WA participate in the audit. Between 2019 and 2023, 24 hospitals (of 48) were associated with the 2,888 deaths meeting the WAASM criteria.

Between 2019 and 2023, public hospitals accounted for 83.7% of admissions (2,116/2,527), with private and co-location hospitals accounting for 9.6% (242/2,527) and 6.7% (169/2,527) of admissions, respectively (Figure 4). (Co-location hospitals are those that provide both privately and publicly funded surgical services. Data for co-location hospitals include public and private patients.)

2.2 Hospitals (continued)

Figure 4: Deaths by hospital status, by year



Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

2.3 Surgeon participation

Surgeons participate in WAASM both as the treating surgeons responsible for the cases being audited, and also as assessors undertaking peer-reviews.

The return rate for SCFs, including terminal care cases, was 98.6% (2,848/2,888).

Table 2 shows WAASM deaths for each surgical specialty in the period 2019 to 2023. General Surgery reported the most deaths at 43.0% (1,242/2,888), followed by Orthopaedic Surgery at 17.9% (518/2,888) and Neurosurgery at 16.3% (471/2,888).

2.3 Surgeon participation (continued)

Table 2: WAASM deaths by surgical specialty

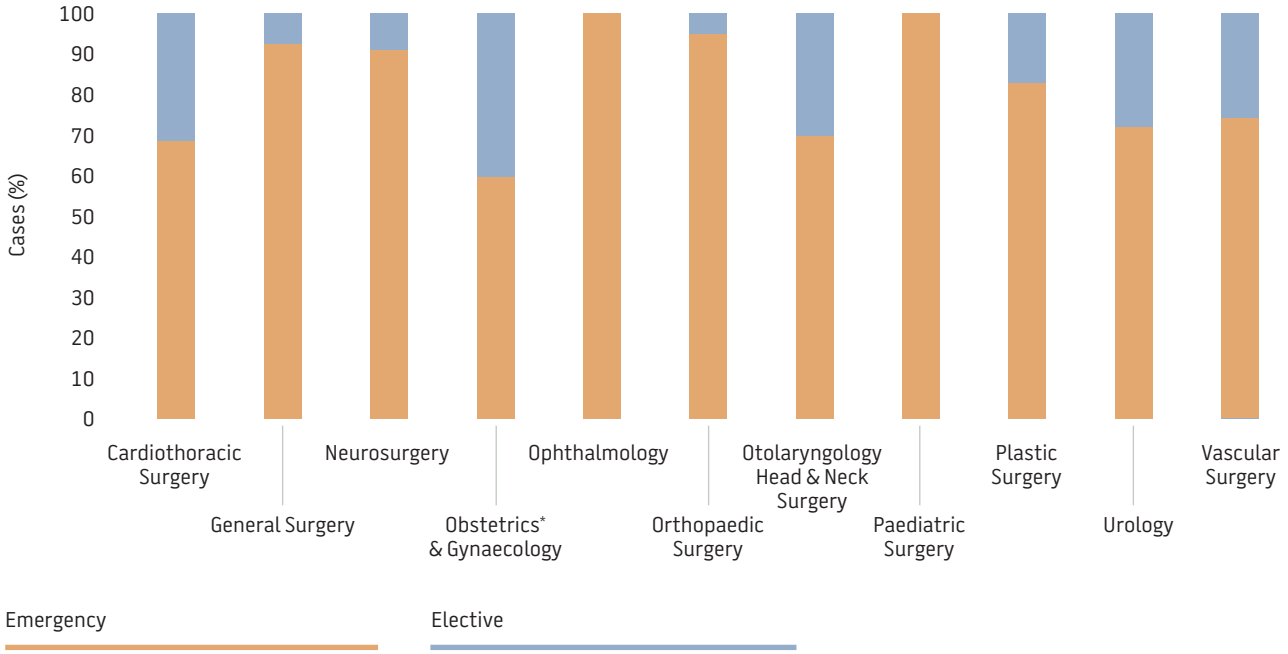
Surgical specialty	Number of deaths	Percentage (%)
General Surgery	1,242	43.0
Orthopaedic Surgery	518	17.9
Neurosurgery	471	16.3
Vascular Surgery	226	7.8
Cardiothoracic Surgery	185	6.4
Urology	122	4.2
Plastic Surgery	51	1.8
Otolaryngology Head & Neck Surgery	47	1.6
Paediatric Surgery	14	0.5
Obstetrics* & Gynaecology	10	0.3
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.

2.3 Surgeon participation (continued)

Emergency admissions accounted for 88.4% (2,232/2,526) and elective admissions for 11.6% (294/2,526) of hospital admissions in the period 2019 to 2023. All specialties had more emergency admissions compared to elective admissions (Figure 5).

Figure 5: Deaths by surgical specialty and hospital admission



* Obstetric cases are not included in the audit process; only gynaecological cases are audited.
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3. Results

Key results for the period 2019 to 2023:

- 57.1% of cases were males
- 63.5% of patients had one or more operations
- 29.9% of patients had a preoperative transfer
- 84.5% of cases had one or more comorbidities present
- 31.0% of cases had a clinically significant infection

3.1 Patient demographics

In the period 2019 to 2023, the median age at death for all patients and the age breakdown by sex are presented in Table 3. Males accounted for 57.1% (1,649/2,888) and females 42.9% (1,239/2,888) of all deaths.

Table 3: Median age, by sex

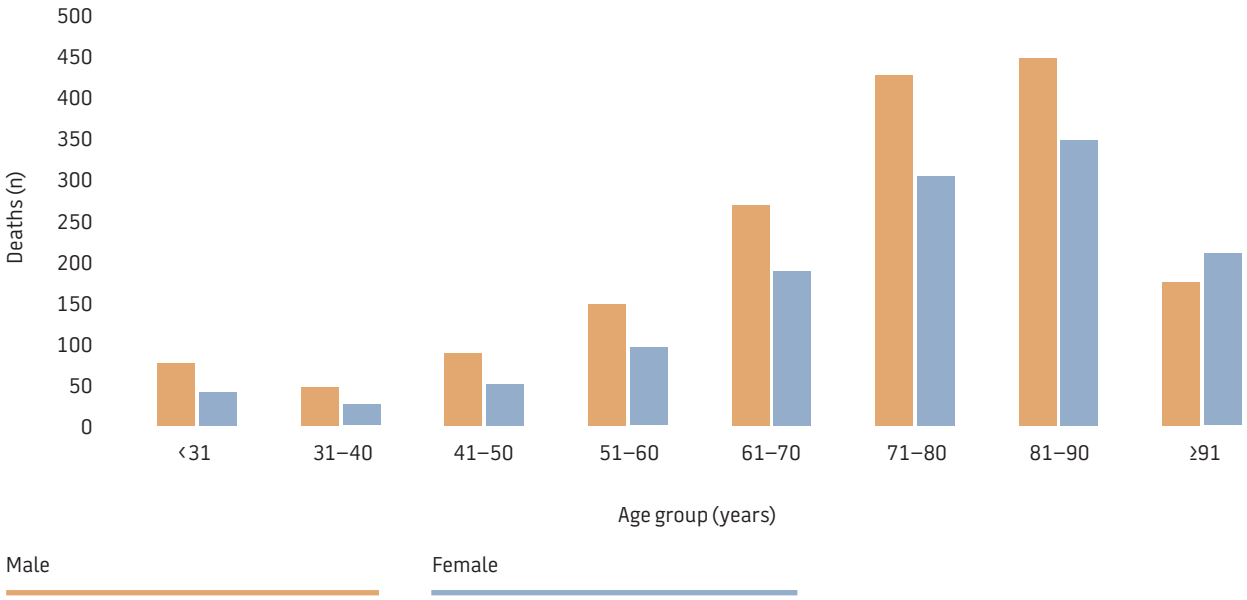
Sex	Number of cases	Median age (years)	Interquartile range (years)
All patients	2,888	77	65–86
Males	1,649	76	64–84
Females	1,239	78	66–88

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

The distribution of deaths by age group and sex between 2019 and 2023 is displayed in Figure 6. The trend of male deaths outnumbering female deaths continued in all patients up to age 90. This reversed in the 91 years and older age group, where females represent the larger proportion of deaths. This corresponds with the greater number of females in the total WA population older than 90 years.[18] After age 50, an overall rise in the number of deaths is noted, with the majority of all deaths (51.8%; 1,496/2,888) occurring in patients age 71–90 years. The decrease in deaths after age 90 (13.1%; 378/2,888) potentially reflects the diminished population size in this age group.

3.1 Patient demographics (continued)

Figure 6: Deaths by age group and sex



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

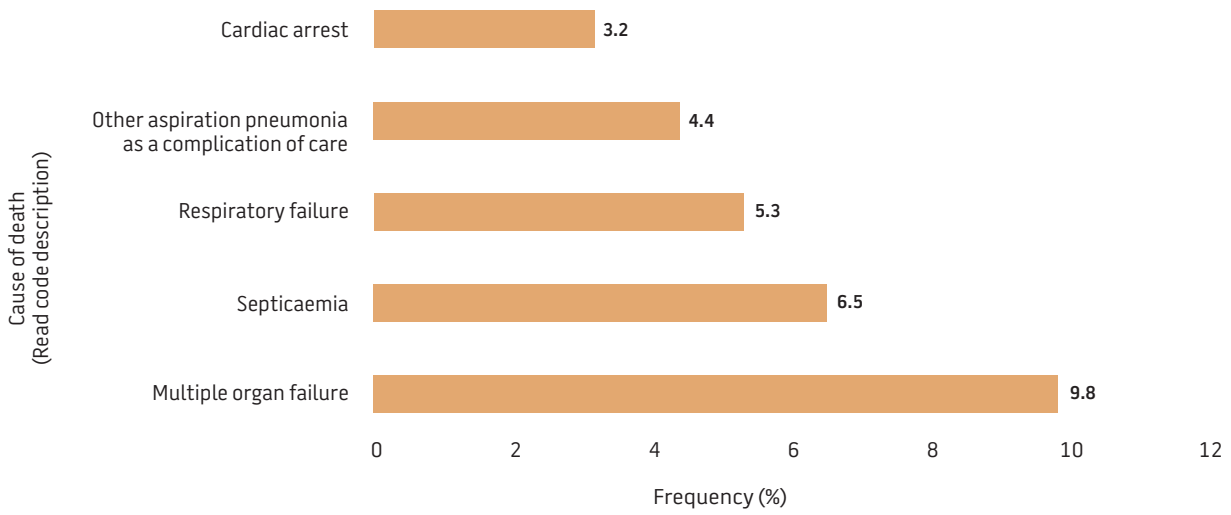
3.2 Causes of death

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

More than one cause of death can be listed for some cases. Overall, the most frequently reported causes of death were multiple organ failure (9.8%; 385/3,935) and septicaemia (6.5%; 257/3,935). Figure 7 shows the most common causes of death by Read codes, which form a clinical decision tree containing terms, synonyms and abbreviations covering all aspects of patient care.

3.2 Causes of death (continued)

Figure 7: Most common causes of death, by Read code*



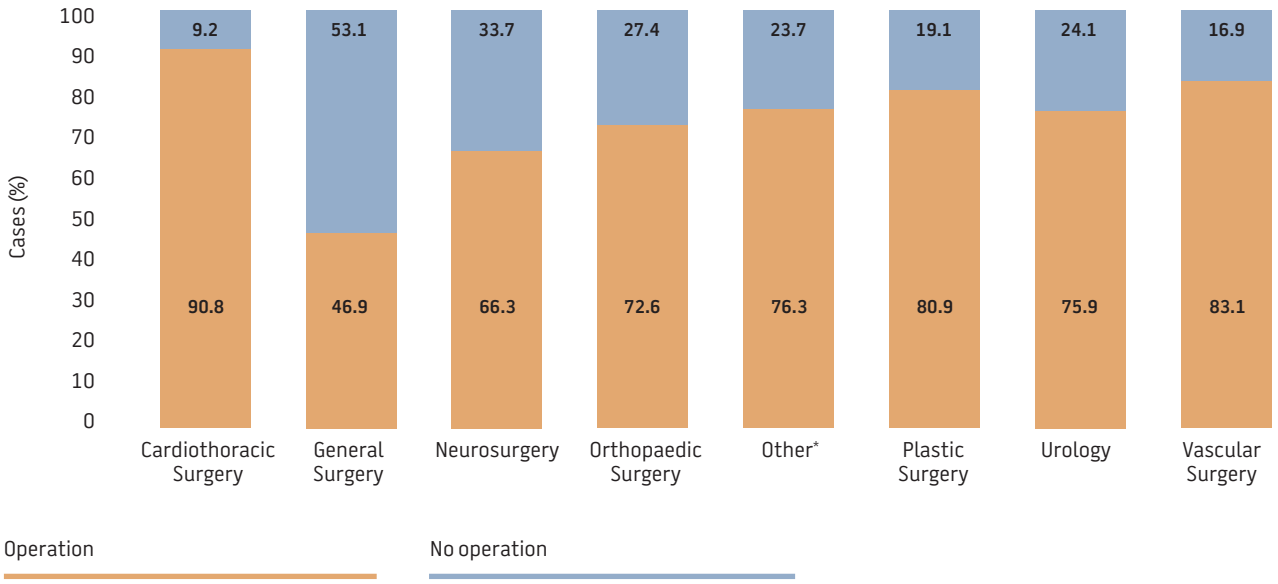
* Surgical diagnoses categorised using a coded thesaurus of clinical terms.
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.3 Operative and nonoperative cases

In the period 2019 to 2023, 63.5% (1,605/2,527) of patients underwent one or more operation. Figure 8 shows that Cardiothoracic Surgery reported the highest operation rate (90.8%; 157/173), while General Surgery had the lowest operation rate (46.9%; 486/1,036).

3.3 Operative and nonoperative cases (continued)

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).

Note: Some 2023 cases still undergoing review, so case data unavailable for this report.

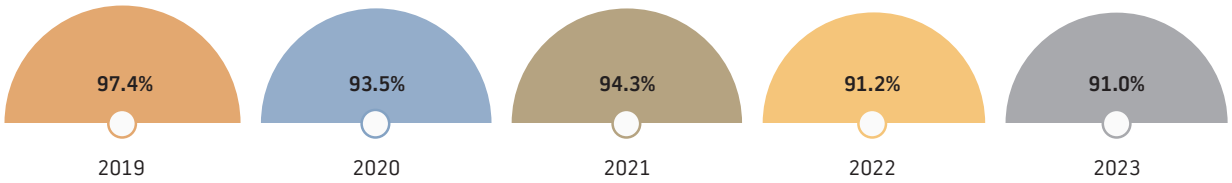
Refer to Appendix D.2 for further information on data.

The proportion of emergency and elective admissions involving an operation remained relatively steady in the period 2019 to 2023, with 83.1% of patients (1,333/1,605) admitted as an emergency.

Consultant surgeons may be in theatre to perform, assist with or supervise an operation. A total of 2,127 operations were performed on 1,605 patients between 2019 and 2023. For 93.4% of reported operations (1,987/2,127), a consultant surgeon made the decision to proceed to surgery (Figure 9). A consultant surgeon performed the surgery in 67.7% of operations (1,440/2,127) (Figure 10).

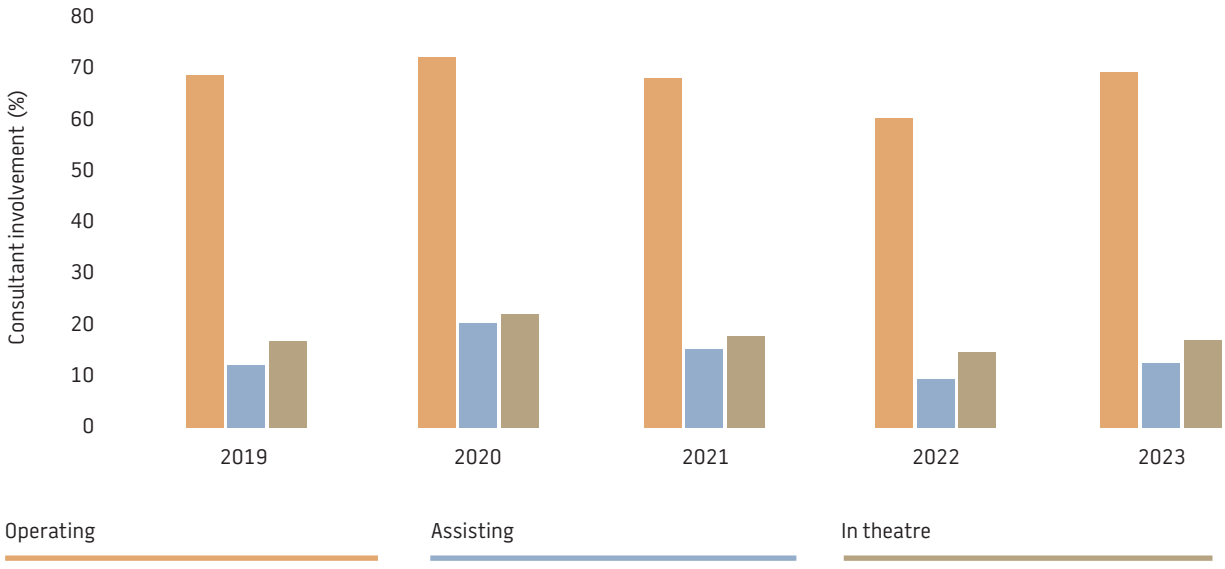
3.3 Operative and nonoperative cases (continued)

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



Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

Figure 10: Consultant surgeon involvement in operations, by year



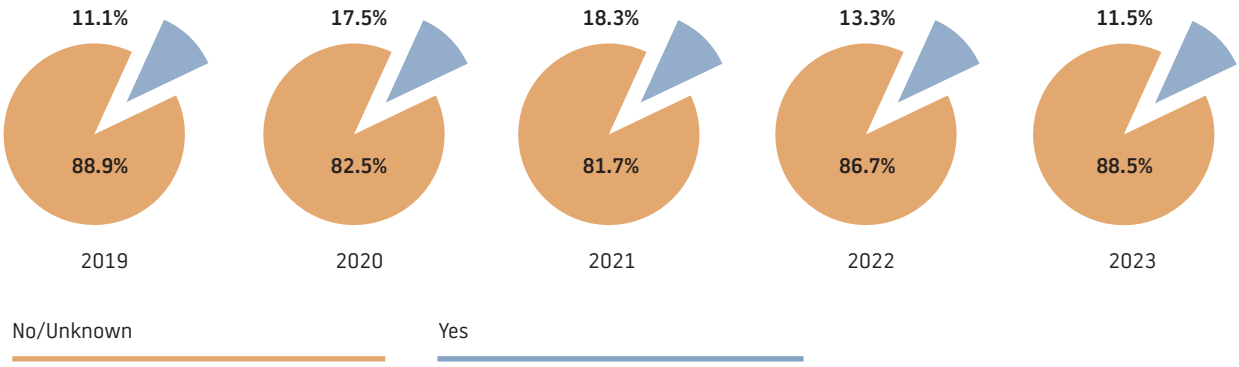
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

Overall, an operation was abandoned upon finding a terminal situation in 4.3% of operations (90/2,115).

In the period 2019 to 2023, 14.3% of operative cases (230/1,604) had an unplanned return to the operating theatre (Figure 11). The percentage of patients who had an unplanned return to theatre decreased in 2022 (13.3%; 45/339) and 2023 (11.5%; 39/338).

3.3 Operative and nonoperative cases (continued)

Figure 11: Unplanned return to operating theatre, by year

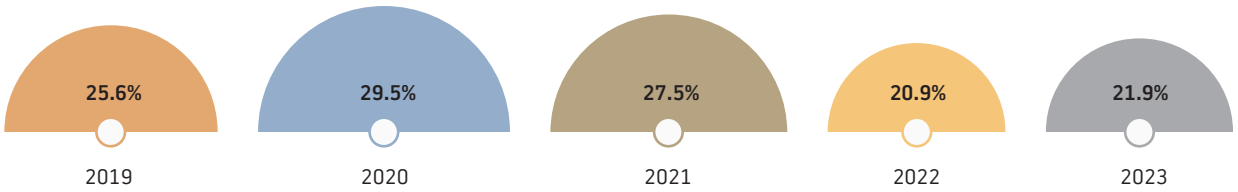


Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

Postoperative complications occurred in 24.9% of operative patients (400/1,604) between 2019 and 2023.

There was a total of 544 postoperative complications among 400 operative patients. (Patients may have more than one postoperative complication listed.) The most frequently reported postoperative complications were postoperative bleeding (17.5%; 70/400), tissue ischaemia (11.5%; 46/400) and sepsis (10.3%; 41/400). These data make a strong case for a consultant surgeon to be present when a patient is returned to theatre. Figure 12 shows the distribution of postoperative complications by year.

Figure 12: Postoperative complications, by year

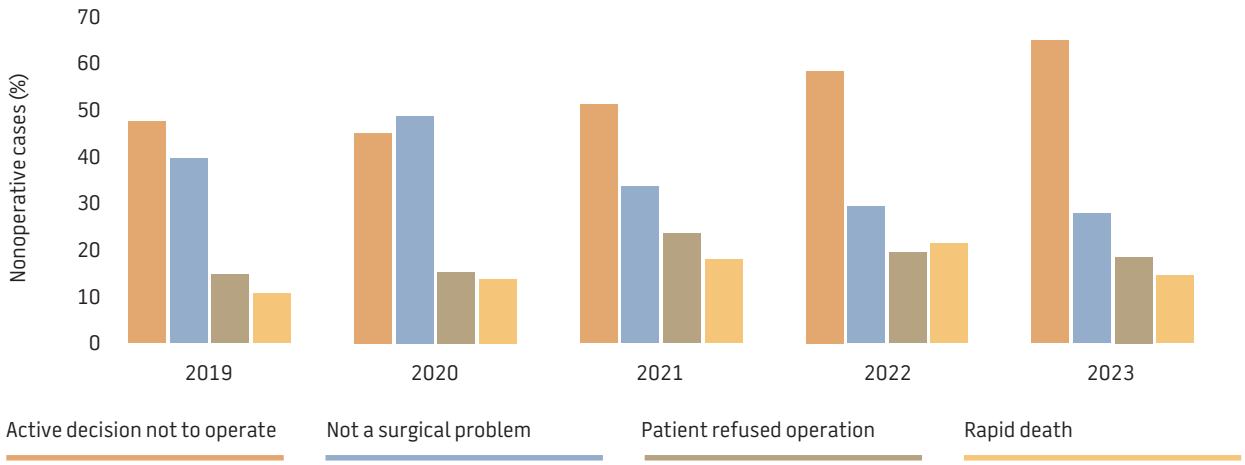


Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.3 Operative and nonoperative cases (continued)

Not all patients underwent surgery (36.5%; 922/2,527). Figure 13 shows that some patients did not undergo an operation for reasons such as an active decision by the consultant 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 (97.6%; 899/921).

Figure 13: Reasons for not operating, by year

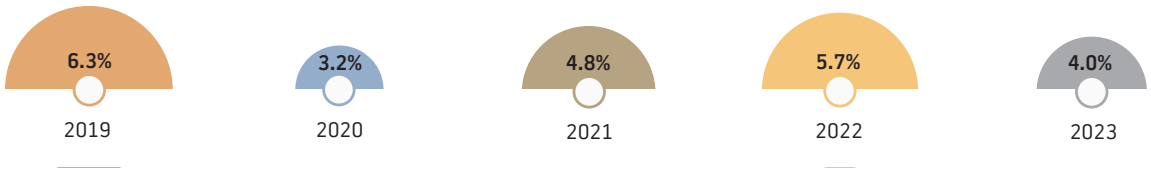


Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.4 Preoperative diagnostic delays

In the period 2019 to 2023, a preoperative diagnostic delay was recorded by the surgeon in 4.8% of cases (122/2,526). The percentage of patients with preoperative diagnostic delays over the reporting period varied across the years but displayed a downward trend in 2023 for the first time since 2020 (Figure 14).

Figure 14: Cases with preoperative diagnostic delays, by year



Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.4 Preoperative diagnostic delays (continued)

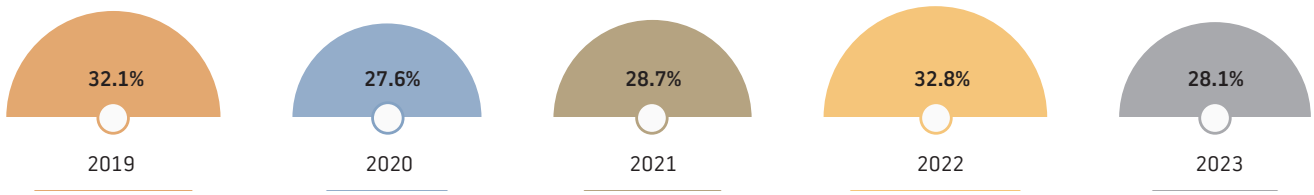
Over the reporting period, the majority of surgeons who reported a preoperative diagnostic delay for a patient provided no details regarding the cause of the delay or who it was associated with. The cause of a preoperative diagnostic delay can be related to more than one unit. Most of the reported delays were associated with medical units (44.3%; 54/122), surgical units (21.3%; 26/122) and general practitioners (4.1%; 5/122).

Of the delays associated with a surgical unit, common reasons stated (potentially more than one for each patient) were 'misinterpretation of results' (9 cases), 'unavoidable factors' (8 cases), 'inexperience of staff' (7 cases), 'failure to do correct test' (3 cases) and 'results not seen' (3 cases).

3.5 Hospital transfers

Between 2019 and 2023, preoperative hospital transfers occurred for 29.9% of patients (753/2,521) (Figure 15). Emergency admissions accounted for 96.5% (727/753) of this group.

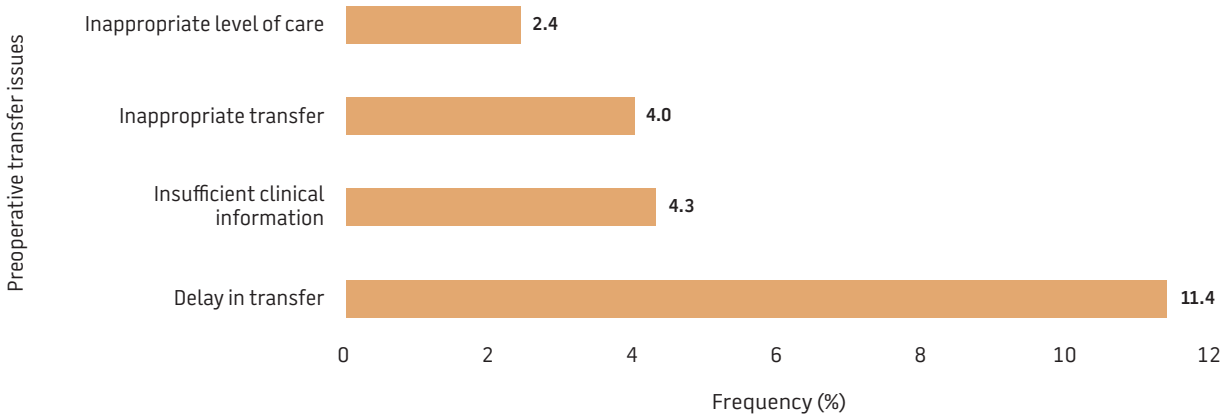
Figure 15: Preoperative hospital transfers, by year



Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

In the period 2019 to 2023, there was a range of concerns related to preoperative transfers (Figure 16). The most frequently reported preoperative transfer issue was 'delay in transfer' (11.4%; 85/746).

Figure 16: Preoperative transfer issues

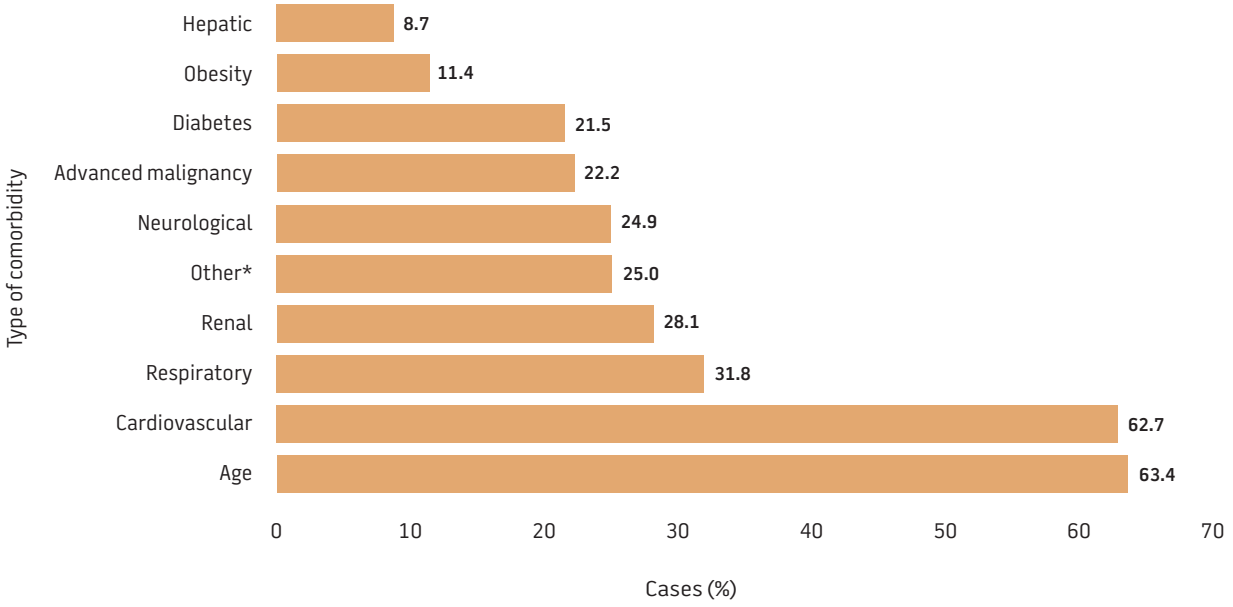


Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.6 Comorbidities

Most patients (84.5%; 2,136/2,527) had at least one comorbidity, with 83.9% (1,792/2,136) of patients having more than one comorbidity. As shown in Figure 17, the 2 most commonly reported comorbidities were age (63.4%; 1,354/2,136) and cardiovascular disease (62.7%; 1,340/2,136).

Figure 17: Cases with specific comorbidities



* 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.

Note: Some 2023 cases still undergoing review, so case data unavailable for this report.

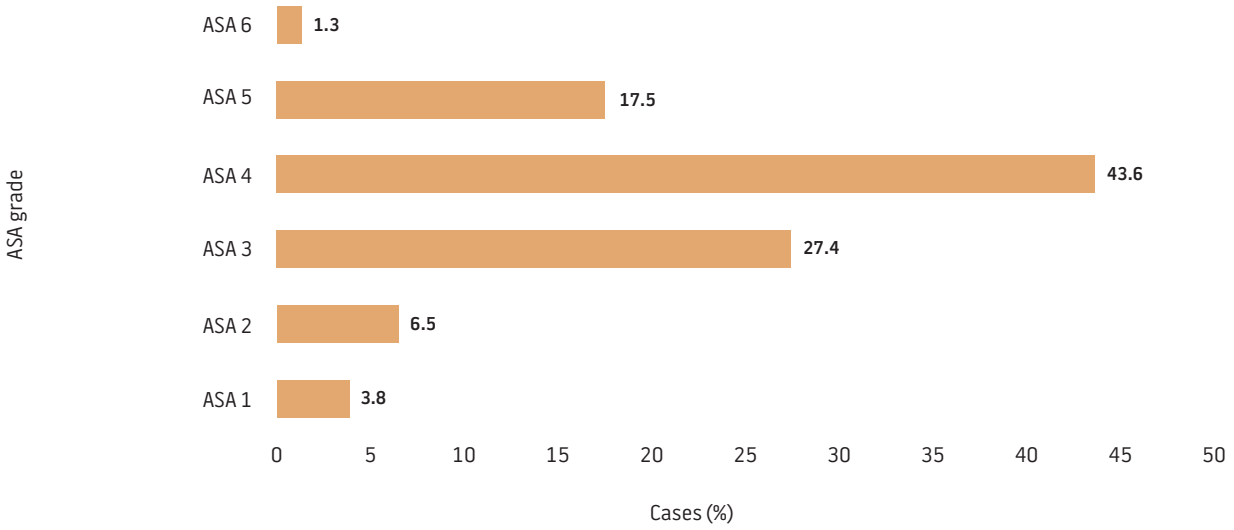
Refer to Appendix D.2 for further information on data.

The American Society of Anesthesiologists (ASA) classification system is an internationally recognised measure of a patient's physical status (Appendix D.3).[19]

As Figure 18 demonstrates, most patients (43.6%; 1,059/2,431) were assigned ASA grade 4, defined as a patient with severe systemic disease that is a constant threat to life. ASA grade 3, defined as a patient with severe systemic disease, was the second most frequently assigned (27.4%; 666/2,431).

3.6 Comorbidities (continued)

Figure 18: Frequency of ASA grades

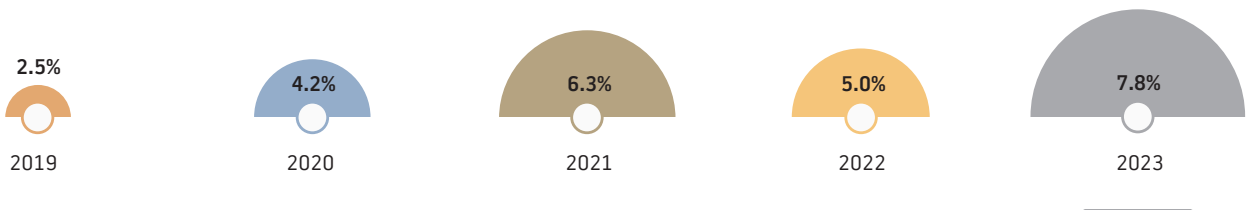


ASA: American Society of Anesthesiologists.
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.
Refer to Appendix D.3 for definitions of ASA grades.

3.7 Fluid balance

Surgeons indicated that there were fluid balance issues in 5.3% of cases (134/2,522) between 2019 and 2023. Figure 19 shows the frequency of these cases by year. The highest proportion of cases with fluid balance issues was reported in 2023, and this could potentially increase further when all data for this year is available.

Figure 19: Cases with fluid balance issues, by year



Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.7 Fluid balance (continued)

Emergency and elective admissions accounted for 86.6% (116/134) and 13.4% (18/134) of cases with fluid balance issues, respectively.

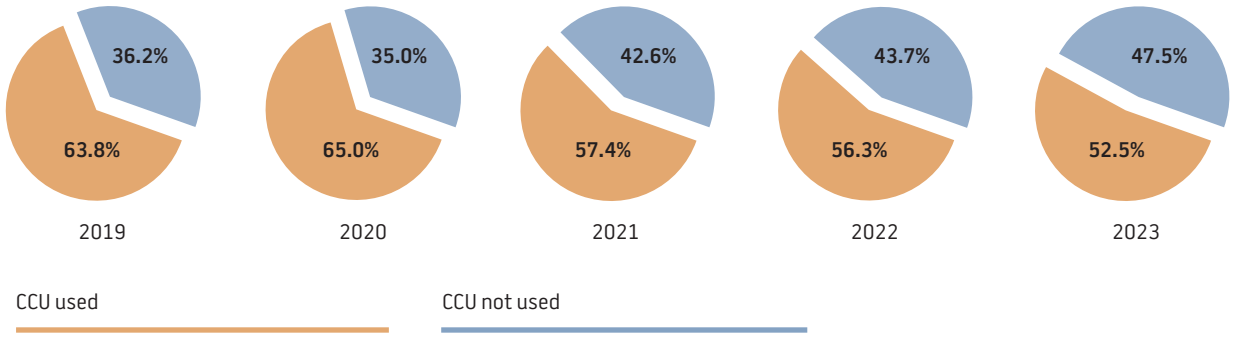
An operation was performed in 79.9% of cases (107/134) with fluid balance issues, whilst 20.1% of cases (27/134) with fluid balance issues had no surgery.

3.8 Critical care units

Between 2019 and 2023, critical care units (CCUs) were utilised in 58.5% of cases (1,477/2,525) (Figure 20). For each year of the reporting period, the proportion of CCU use was greater than non- use.

Emergency and elective admissions accounted for 86.2% (1,273/1,477) and 13.8% (204/1,477) of CCU use, respectively.

Figure 20: CCU use, by year

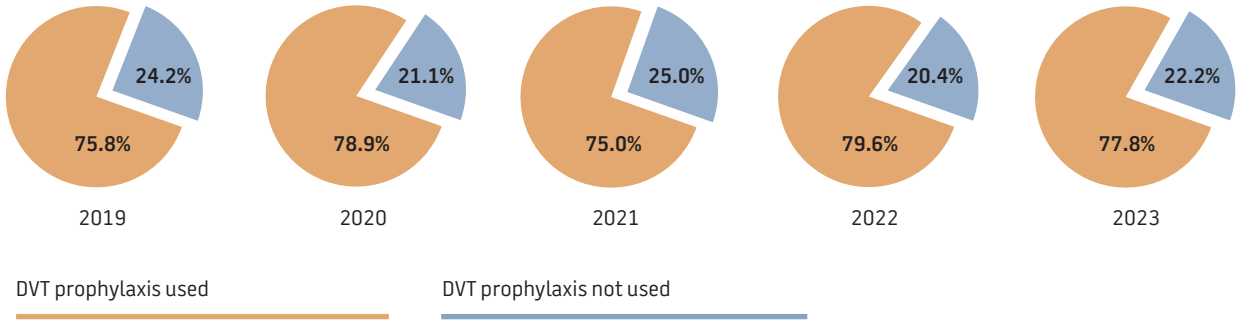


CCU: critical care unit.
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.9 Deep vein thrombosis prophylaxis

Surgeons reported the use of deep vein thrombosis (DVT) prophylaxis in 77.4% of cases (1,953/2,522) between 2019 and 2023. The use and non-use of DVT prophylaxis by year is presented in Figure 21.

Figure 21: DVT prophylaxis use, by year



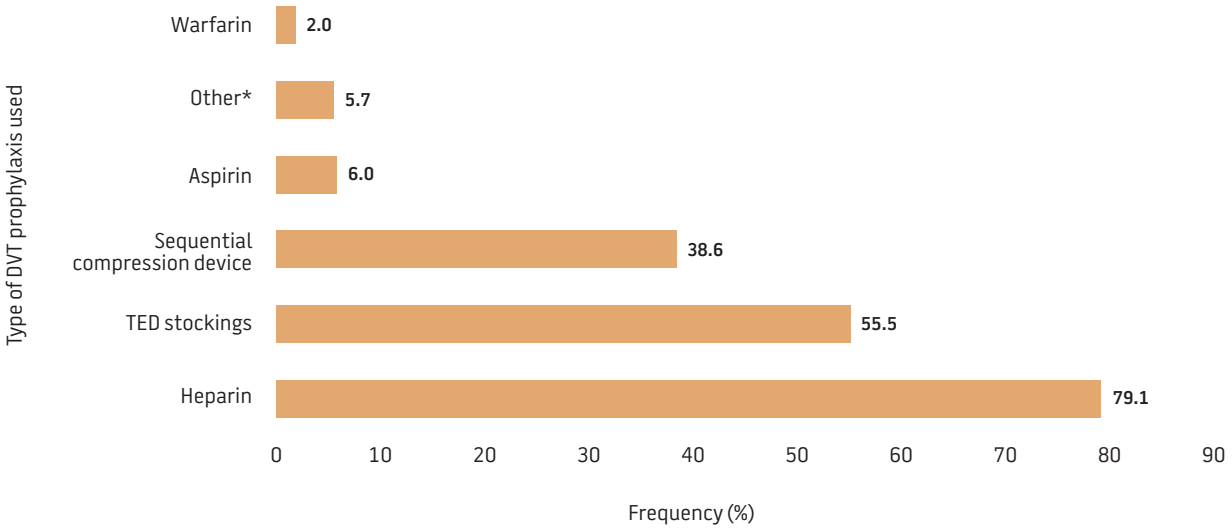
DVT: deep vein thrombosis.
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

DVT prophylaxis was not used in 22.6% of cases (569/2,522) because it was inappropriate (65.0%; 369/568), there was an active decision to withhold it (32.9%; 187/568), or it was not considered (2.1%; 12/568).

In many cases, more than one type of DVT prophylaxis was used. Heparin (79.1%; 1,545/1,953) and TED (thromboembolic deterrent) stockings (55.5%; 1,084/1,953) were the most frequently used DVT prophylaxis agents (Figure 22).

3.9 Deep vein thrombosis prophylaxis (continued)

Figure 22: Type of DVT prophylaxis used



DVT: deep vein thrombosis, TED: thromboembolic deterrent.
* Other could include enoxaparin sodium, clopidogrel bisulfate, danaparoid sodium and enoxaparin sodium combined with early mobilisation.
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

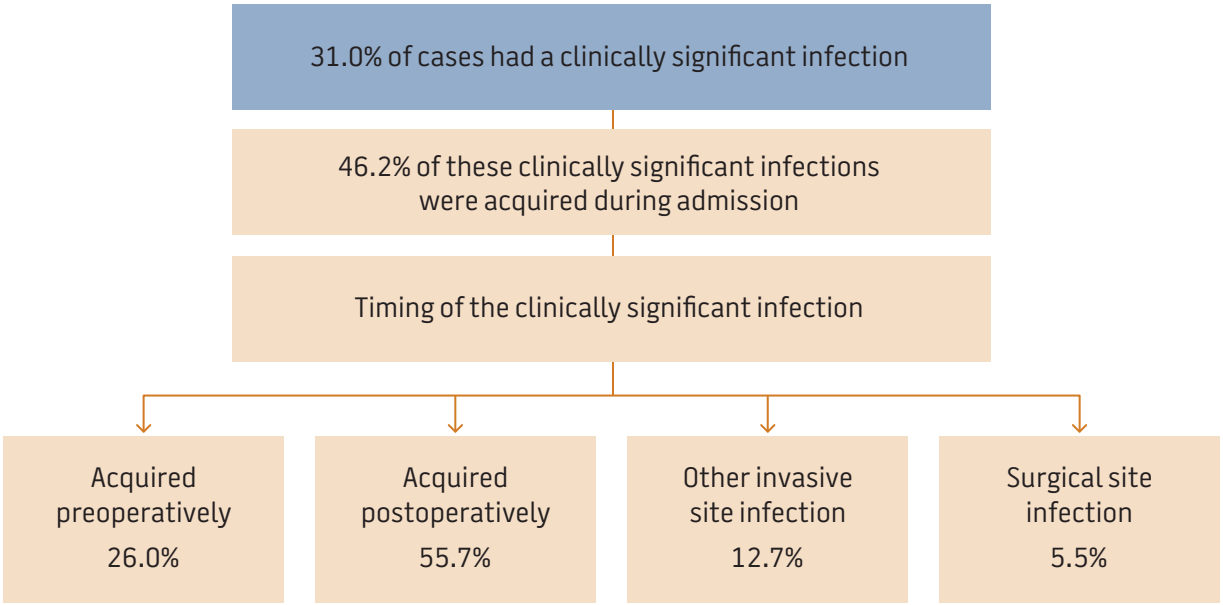
3.10 Infections

Surgeons are asked to record whether patients died with a clinically significant infection and, if so, whether the infection was present before admission or if it developed during the hospital admission. Between 2019 and 2023, almost a third of patients (31.0%; 783/2,524) died with a clinically significant infection.

More patients acquired the clinically significant infection before their admission to hospital (53.8%; 421/782) than during their admission (46.2%; 361/782). Of the patients who acquired the infection during admission, 55.7% (201/361) acquired the infection postoperatively (Figure 23).

3.10 Infections (continued)

Figure 23: Clinically significant infections during admission

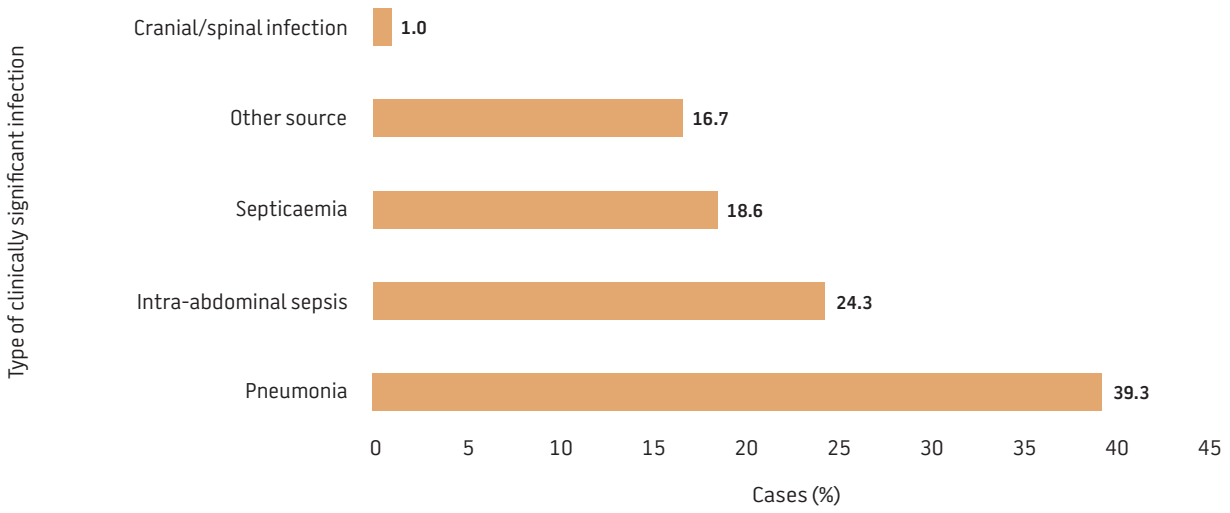


Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

Figure 24 shows the types of clinically significant infections reported by surgeons before or during admission. Pneumonia was the most common clinically significant infection reported, accounting for 39.3% of cases (308/783). Intra-abdominal sepsis represented 24.3% of cases (190/783), followed by septicaemia (18.6%; 146/783). 'Other source' and cranial/spinal infection accounted for 16.7% (131/783) and 1.0% (8/783) of cases, respectively.

3.10 Infections (continued)

Figure 24: Type of clinically significant infection reported



Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

Where information was provided, surgeons reported that the antibiotic regime was appropriate in 90.8% of cases of clinically significant infections (709/781). In 8.3% of cases (65/781) the appropriateness of the antibiotic regime was unknown, and in 0.9% (7/781) it was considered inappropriate.

4. Outcomes of peer-review assessment

Key results for the period 2019 to 2023:

- 13.3% of cases were referred for second-line assessment
- 584 CMIs were identified in 358 cases
- 11.1% (65/584) of CMIs were classified as adverse events
- 46.2% (30/65) of adverse events were deemed to have caused the death of the patient
- 30.0% (9/30) of adverse events that caused the death of a patient were considered definitely preventable.

4.1 Second-line assessment

All cases undergo a peer-review assessment (except for those confirmed as terminal care). Following the initial first-line assessment (FLA), many cases are finalised. This process is assisted by SCFs that have been completed in full and provide detailed information about each case. A small proportion of cases are identified as requiring a more in-depth review and these are recommended for a second-line assessment (SLA).

Between 2019 and 2023, the rate of FLA returns was 99.3% (2,511/2,528). Of the 2,511 FLAs returned, 13.3% (333/2,511) were referred for SLA (Table 4).

Table 4: Peer-review assessments, by year

Year	FLAs returned	Cases referred for SLA	
		Number	Percentage (%)
2019	447	62	13.9
2020	436	71	16.3
2021	538	64	11.9
2022	558	73	13.1
2023	532	63	11.8
Total	**2,511**	**333**	**13.3**

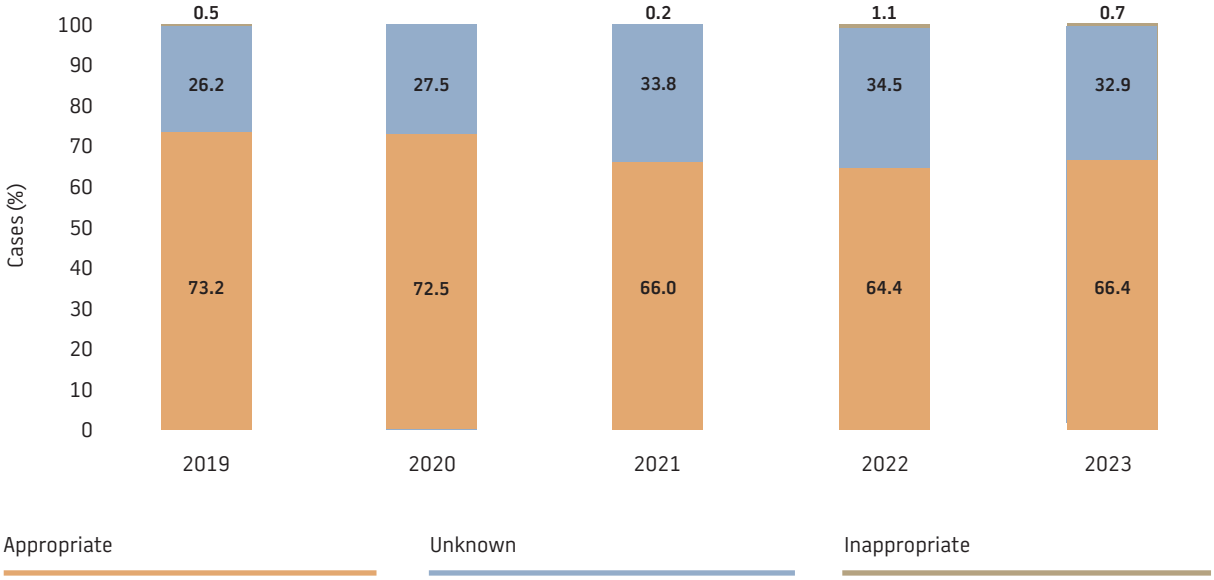
FLA: first-line assessment, SLA: second-line assessment.
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.1 for further information on data.

4.2 Areas where management could be improved – grade/experience of surgeon deciding on patient care

Assessors are asked to consider if the management of a patient could have been improved in areas such as the grade/experience of the surgeon deciding on the care of the patient. Figure 25 shows assessors' opinions on the grade/experience of the surgeon deciding during the 5-year audit period.

Between 2019 and 2023, assessors indicated that the grade/experience of the surgeon deciding on patient care was appropriate in 68.1% of cases (1,393/2,045). In 0.5% of cases (11/2,045), assessors reported that the grade/experience of the surgeon deciding on patient care was inappropriate. Assessors could not comment or were unsure of the grade/experience of the surgeon deciding on patient care in 31.3% of cases (641/2,045).

Figure 25: Assessor opinion on appropriateness of grade/experience of surgeon deciding on patient care, by year



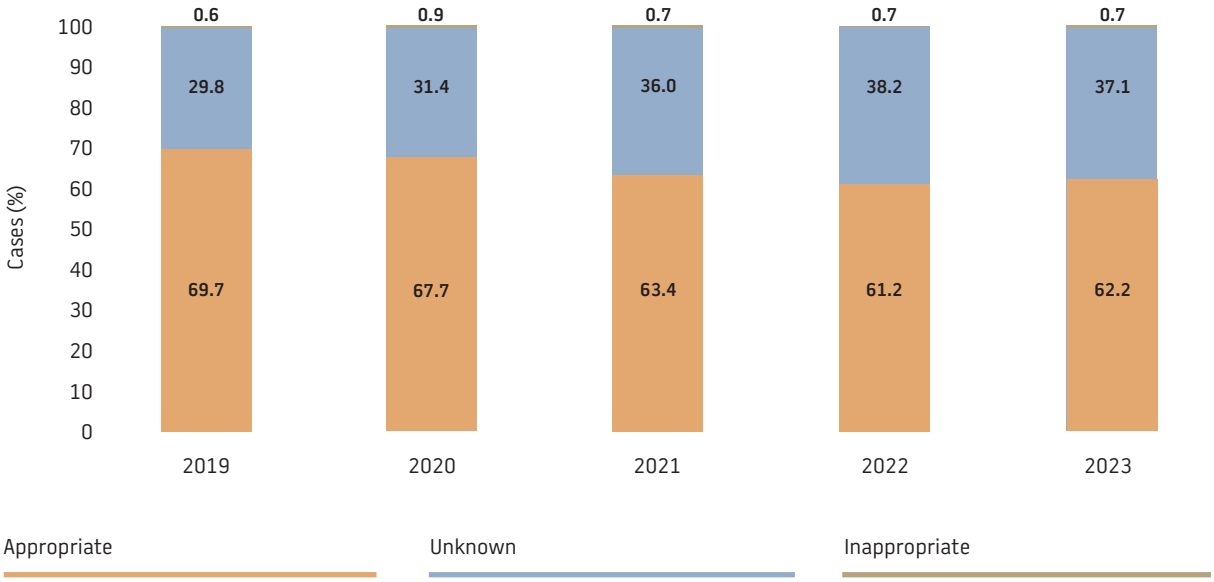
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

4.3 Areas where management could be improved – grade/experience of surgeon operating

Assessors are asked to consider the grade/experience of the surgeon operating on a patient. Figure 26 shows assessors' opinions on the grade/experience of the surgeon operating during the 5-year audit period.

Between 2019 and 2023, assessors indicated that the grade/experience of the surgeon operating was appropriate in 64.5% of cases (1,312/2,034). In 0.7% of cases (14/2,034), assessors reported that the grade/experience of the surgeon operating was inappropriate. Assessors could not comment or were unsure of the grade/experience of the surgeon operating in 34.8% of cases (708/2,034).

Figure 26: Assessor opinion on appropriateness of grade/experience of surgeon operating, by year



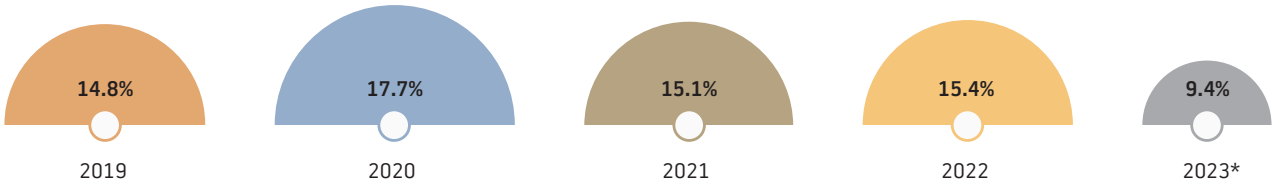
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

4.4 Clinical management issues

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 27, with the highest proportion noted in 2020. (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 2023 cases are still undergoing the peer-review process, meaning these data are incomplete.)

Figure 27: Cases with CMIs, by year



CMI: clinical management issue.
* Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

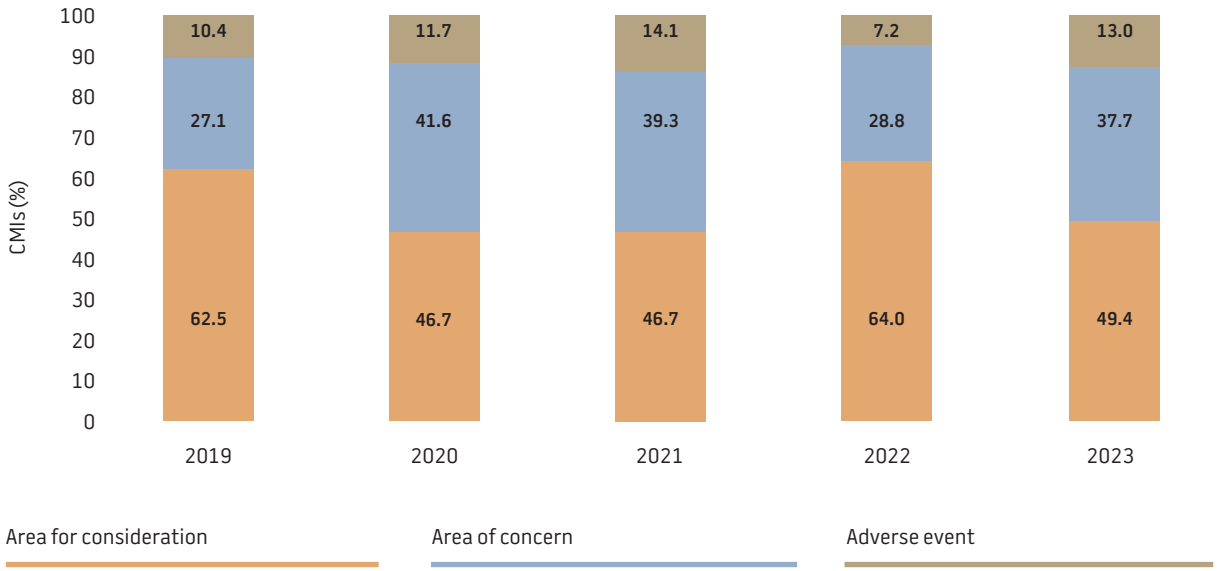
One or more CMIs were identified in 14.4% of cases (358/2,489) during the period 2019 to 2023. No CMIs were identified in 85.6% of cases (2,131/2,489).

Assessors may identify several CMIs for each patient. Figures 28 to 30 show data based on the number of CMIs, not the number of patients.

Assessors reported 584 CMIs in 358 cases (Figure 28). Between 2019 and 2023, more than half (53.8%; 314/584) of the CMIs identified were areas for consideration. Areas of concern and adverse events comprised 35.1% (205/584) and 11.1% (65/584) of CMIs, respectively.

4.4 Clinical management issues (continued)

Figure 28: Categories of CMIs, by year



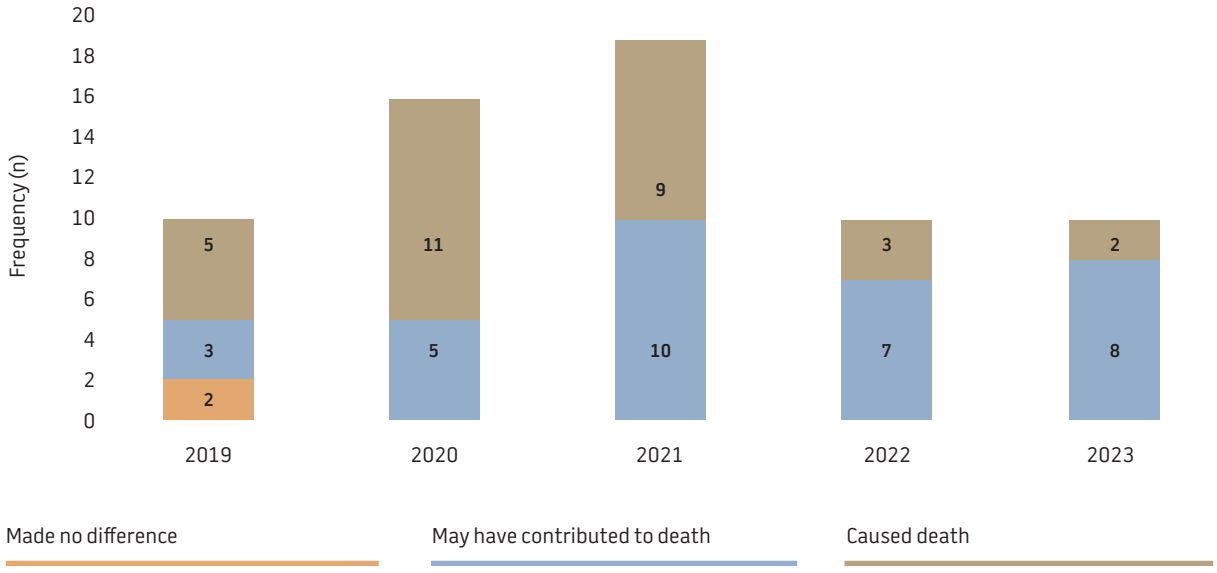
CMI: clinical management issue.
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

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 29.

In the period 2019 to 2023, assessors perceived that 46.2% of the reported adverse events (30/65) caused the death of the patient. Assessors perceived that 50.8% of the reported adverse events (33/65) may have contributed to the death. For 3.1% of reported adverse events (2/65), assessors perceived that it made no difference to the outcome of the patient. There was considerable variability in assessors' perceptions of the impact of adverse events over the reporting period (2019–2023).

4.4 Clinical management issues (continued)

Figure 29: Assessor perception of impact of adverse event on clinical outcome, by year



Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

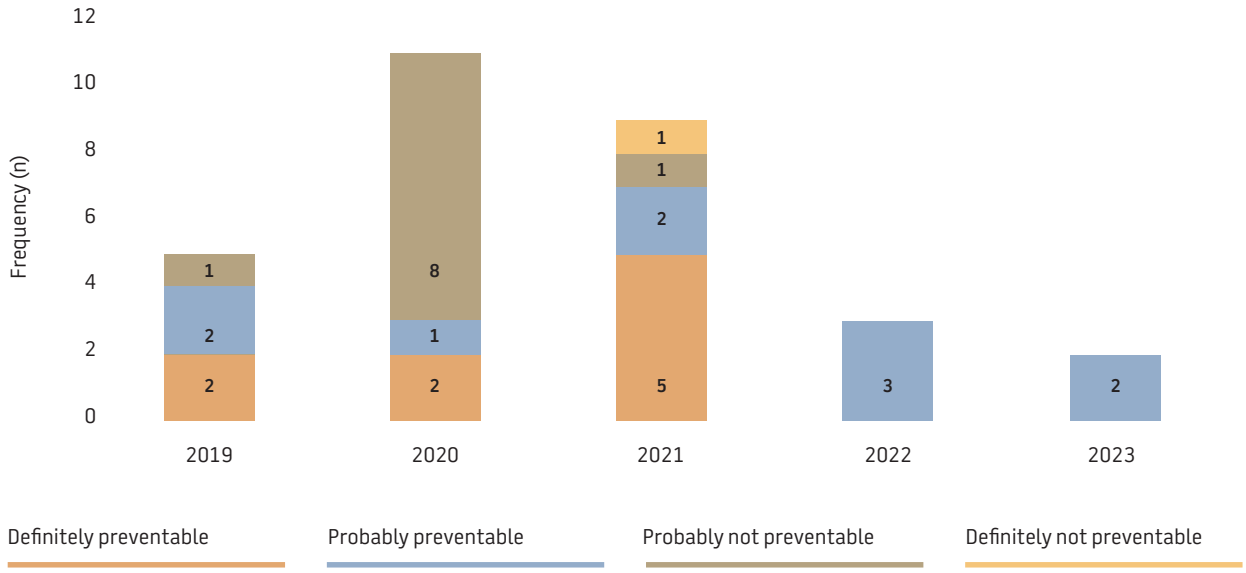
Assessors also report on the preventability of any adverse event that caused the death of a patient (Figure 30).

In the period 2019 to 2023, assessors indicated that 3.3% of adverse events (1/30) that caused the death of a patient were definitely not preventable. For 33.3% of adverse events (10/30) that caused the death of a patient, assessors stated that the deaths were probably not preventable. Assessors considered that 33.3% of adverse events (10/30) that resulted in the death of a patient were probably preventable. For 30.0% of adverse events (9/30) that caused the death of a patient, assessors indicated that the deaths were definitely preventable.

In 2022 and 2023, there were no adverse events that were deemed to be definitely preventable (noting all 2023 data is not yet available). The 5 adverse events causing the death of the 5 patients over these 2 years were all identified by assessors as being probably preventable.

4.4 Clinical management issues (continued)

Figure 30: Assessor perception of preventability of adverse event causing death, by year

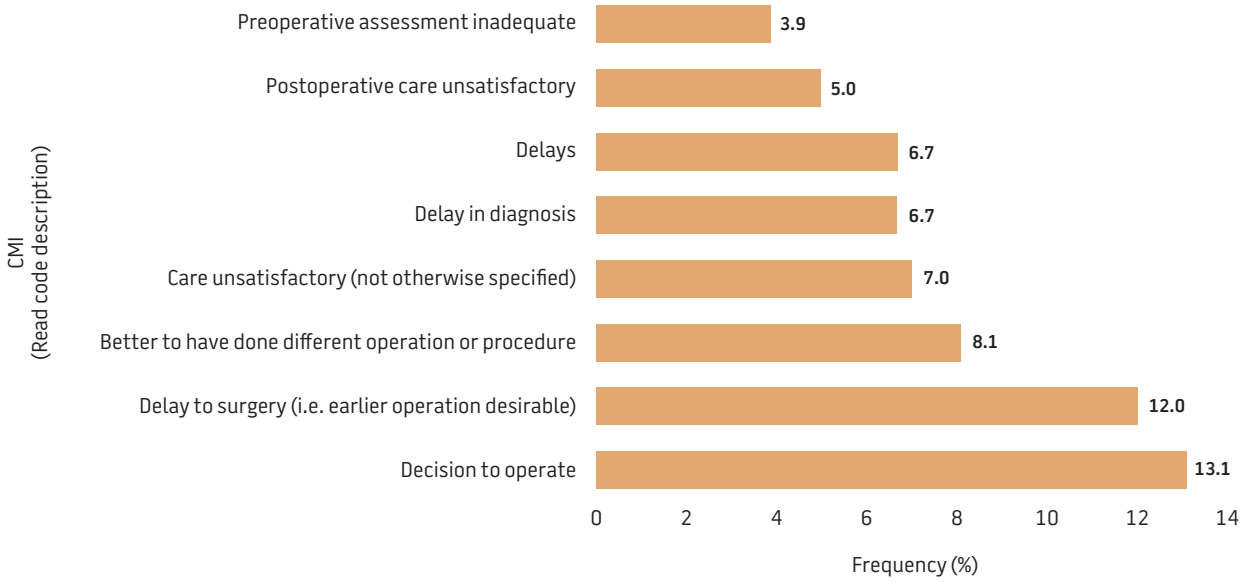


Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

Assessors identified several CMIs in some patients. The decision to operate (13.1%; 47/358) and delay to surgery (12.0%; 43/358) were the 2 most frequently reported CMIs. The 8 most common CMIs are shown in Figure 31.

4.4 Clinical management issues (continued)

Figure 31: Most frequently reported CMIs, by Read code*



CMI: clinical management issue.
* Surgical diagnoses categorised using a coded thesaurus of clinical terms.
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

Among the top 8 CMIs listed in Figure 31, 21.2% of them relate to the assessor questioning whether an operation should have occurred at all (13.1%; 47/358) or believing there was a different, better option (8.1%; 29/358). Another 25.4% of CMIs relate to some sort of delay (delay to surgery 12.0%, 43/358; delay in diagnosis 6.7%, 24/358; delays 6.7%, 24/358). Therefore, 46.6% (167/358) of the listed CMIs relate to the decision to operate, the choice of operation or a delay of some kind.

5. A closer look: Statistical process control – a WAASM 'proof of concept' study

Health systems are awash with data, but how these data are used and interpretated can be inconsistent and poor. Traditionally, clinical feedback has been based on quality assurance, which typically relies on data collected over a specified period—usually a year—that is then analysed and returned 6 or more months later. By then, it often has little relevance to those who receive it. Over the last 5 to 10 years, there has been a rapid move to quality improvement (QI), whereby data are collected and returned near real-time. Electronic records and artificial intelligence (AI) will make QI increasingly more feasible and dynamic.

Statistical process control (SPC) is an analytic technique that plots data over time. It can identify unusual patterns of data (special cause variation) that are unlikely to have arisen by chance and thus merit inquiry.[20] Originally described in the 1930s, SPC has been widely used within industry. A major advantage of near real-time SPC charts is that they detect changes as they evolve and thereby encourage earlier intervention. For example, a manufacturer wants to know in a timely manner if a machine generates a disproportionate number of poor-quality products, not when customers start to return them in 6 months time.

A medical analogy is that it would be better to identify increasingly poor care sooner, not after multiple adverse incidents have occurred. Despite the obvious symmetry, the application of SPC in medicine has been minimal and mainly confined to short-term experimental studies. This is rapidly changing, with SPC charts now widely used by clinical quality registries (CQRs) overseas,[21] and being increasingly employed in Australia.[22,23] Notable examples include the states of New South Wales, Queensland,[24,25] and WA, where it forms the basis of the WA Department of Health's Safety and Quality Indicator Set (SQuiS) dashboards.[7]

ANZASM has not previously used SPC charts. Recently, the jurisdictions approached ANZASM seeking more timely reporting presented in a manner that will provide hospitals with greater insights on the safety and quality of their healthcare provision. One option would be for ANZASM to present its data using SPC charts.

The aim of the analysis in this section is to determine the utility or otherwise of using SPC charts to display WAASM data. It should be viewed as an initial analysis undertaken as a 'proof of concept'.

The data in this section were plotted using the FutureNHS Making Data Count SPC charts Excel template. A full technical description of SPC charts can be found on the FutureNHS Making Data Count website.[26] The lower graph in each figure is the moving range (MR), which measures the absolute difference between consecutive observations and whether it shows any abnormalities. It is useful for detecting important changes even though individual data points may remain within the control limits.

Data are plotted over consecutive periods of time. There is no set minimum period or number of data points that forms the basis of significance in an SPC chart. If monthly data are used, a duration of 3–6 years would be reasonable. This analysis used monthly data for the 6-year period January 2018 to December 2023, so 2 years of data prior to COVID-19 were captured.

The most pronounced reduction in surgical deaths occurred in the earlier years of WAASM, with the number plateauing until the advent of COVID-19 (as previously noted in the WAASM 2023 report).[16] Therefore, quarterly data from January 2009 to December 2023 were also extracted. Although WAASM data exist prior to 2009, it was the first year for which all deaths under a surgeon were reliably reported to WAASM.

WAASM has always recorded the number of deaths under surgeons in WA. In earlier years, however, not all SCFs were returned to WAASM, and some were incomplete. Since the submission of WAASM SCFs became a mandatory part of RACS CPD in 2013, the increased number of returned SCFs has corresponded with higher question completion rates.

The number of data points used to set the mean is normally between 12 and 20. In these charts, 15 points have been used in all cases. Special cause variation occurs when there is a consecutive trend (5 points), or a shift above or below the mean (normally 6 or 7 points). The greater the number of data points used, means a more prolonged change is required to achieve a significant shift or run. Special cause variation also occurs if 2 of 3 points are outside 2 sigma deviation or there is an astronomical reading beyond 3 sigma (99.7%). When special cause variation occurs, the FutureNHS SPC chart colours the relevant points blue (good) or orange (poor).

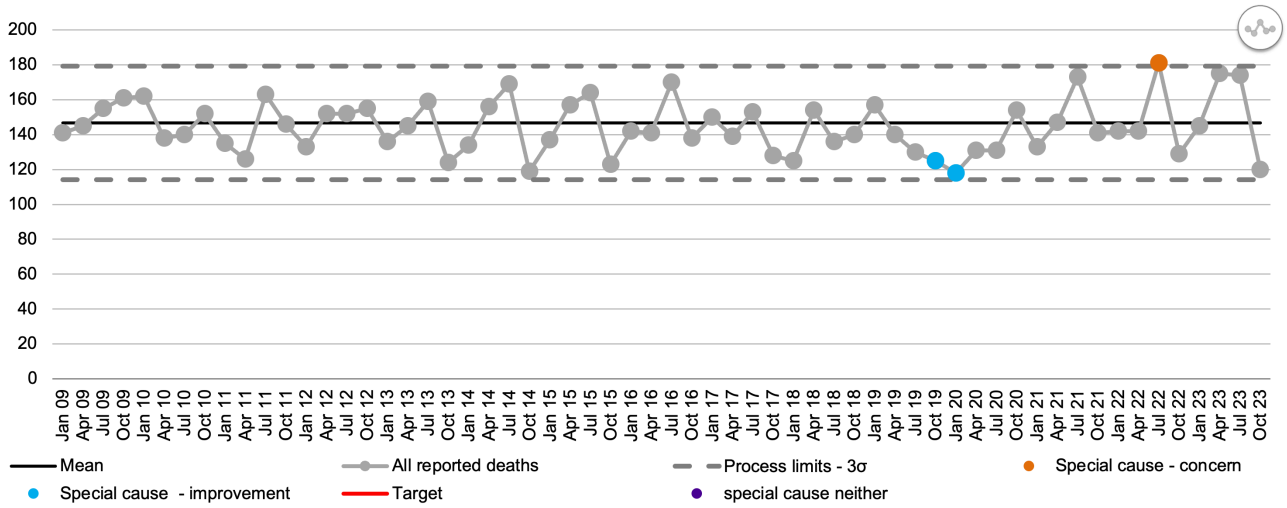
One potential issue with monthly data is that the numbers can be small and there can be wide month-to-month variation. As shown below, there are examples of many consecutive points below the mean, but the shift does not appear significant (coloured) because a single reading has interrupted the run of consecutive points.

5.1 Deaths reported to WAASM

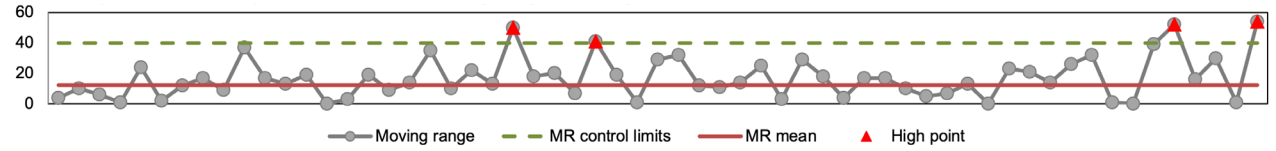
The number of deaths reported to WAASM since January 2009 has remained within the control limits (Figure 32). Ideally, these data would be corrected for the number of admissions under a surgeon but there are no reliable comparative data.[27] Between 2009 and 2023, the population in WA increased by 31.6%, so population has been used as a surrogate marker.[17] When corrected for population growth, there has been a persistent significant shift in the number of deaths under surgeons in WA (Figure 33). This is consistent with a recent ANZASM publication that used the standardised mortality ratio.[28]

5.1 Deaths reported to WAASM (continued)

Figure 32: WAASM deaths 2009–2023, by quarter



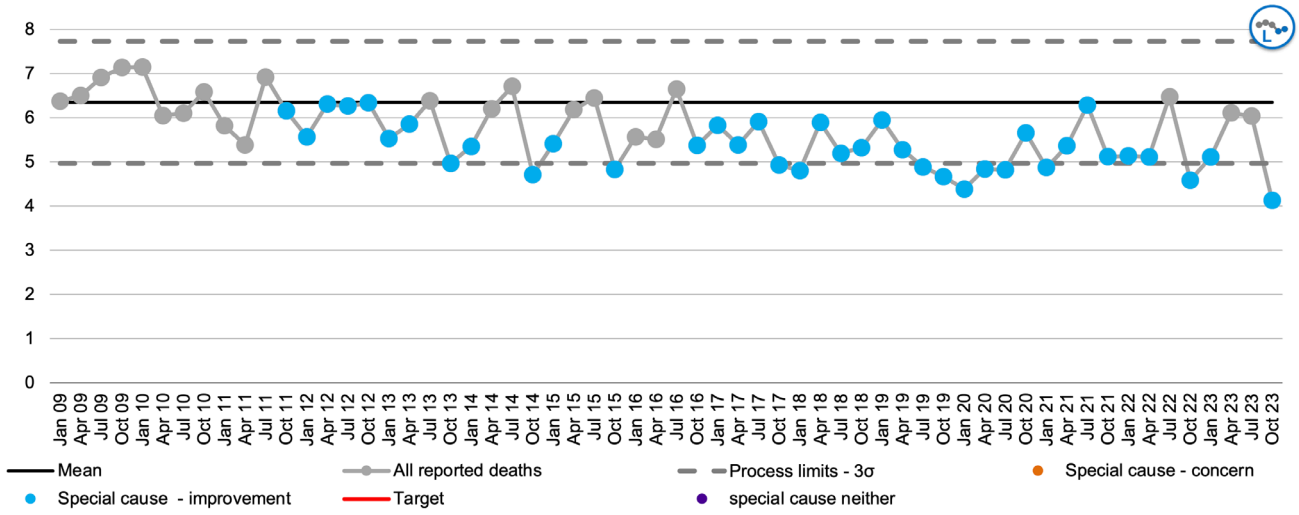
Moving range



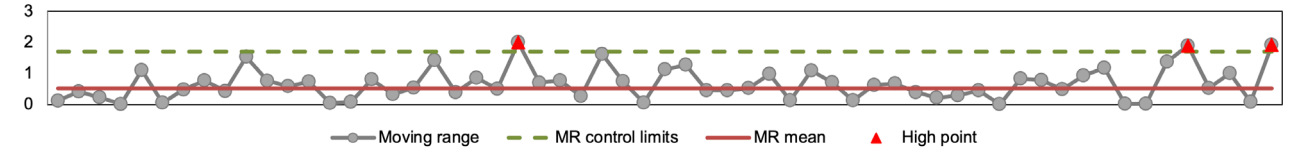
WAASM: Western Australian Audit of Surgical Mortality.
Refer to Appendix D.2 for further information on data.

5.1 Deaths reported to WAASM (continued)

Figure 33: WAASM deaths and mortality rate per 100,000 WA population 2009–2023, by quarter



Moving range



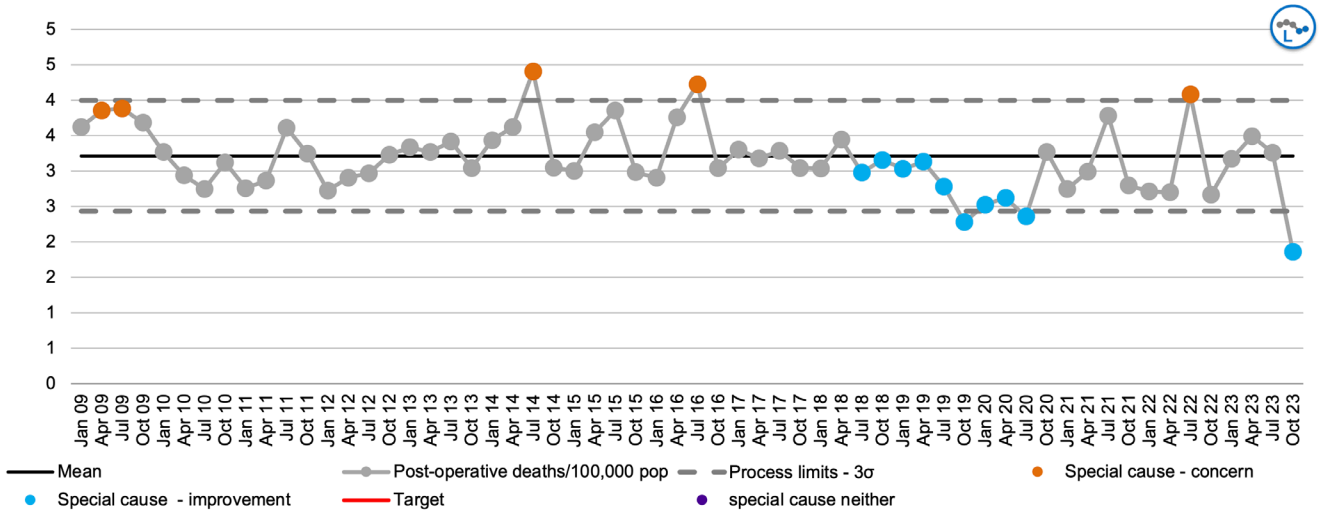
WAASM: Western Australian Audit of Surgical Mortality, WA: Western Australia.
Refer to Appendix D.2 for further information on data.

5.2 Postoperative deaths

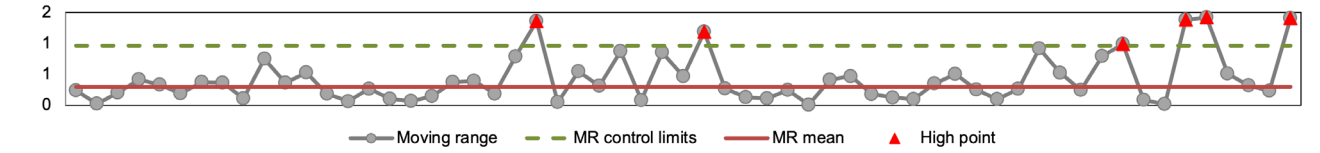
Between January 2009 and July 2018, the number of postoperative deaths remained within control limits except in 3 of 4 July quarters (Figure 34). From early 2017, the number of deaths appears to decrease. From early-mid 2018, this reduction was significant, as it was a year later in the 6-year chart (Figure 35). However, there was an increase from mid-late 2020. In the absence of any other explanation, this is likely to be a COVID-19 effect. The number of cases with COVID-19 in the early years of the pandemic was small, so it seems this was probably an indirect rather than a direct effect. This was noted in the 2023 WAASM report.[16]

5.2 Postoperative deaths (continued)

Figure 34: Postoperative deaths and mortality rate per 100,000 WA population 2009–2023, by quarter



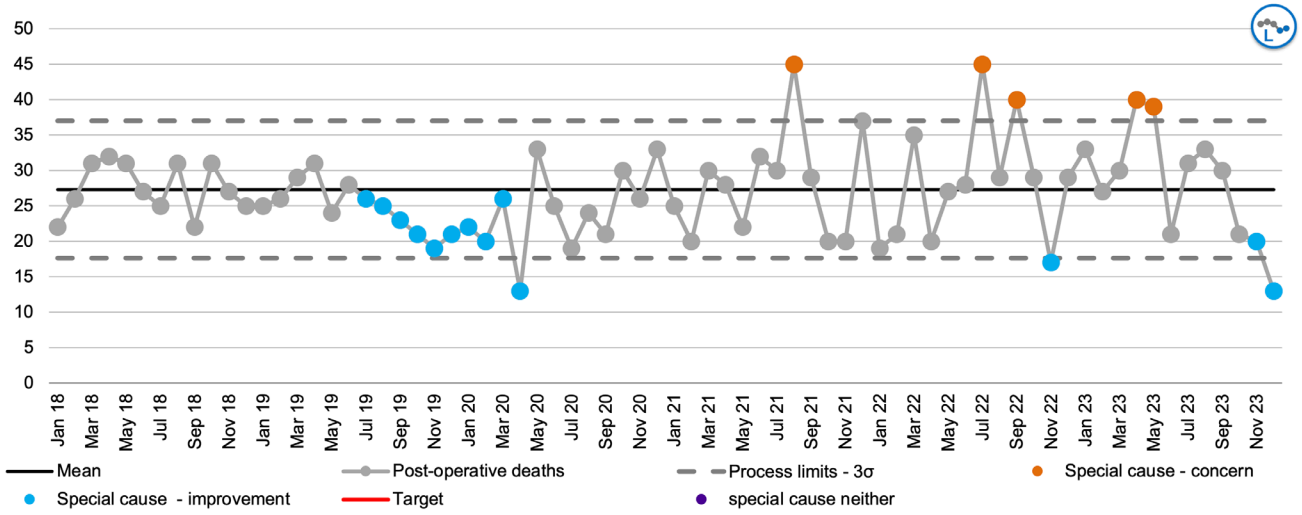
Moving range



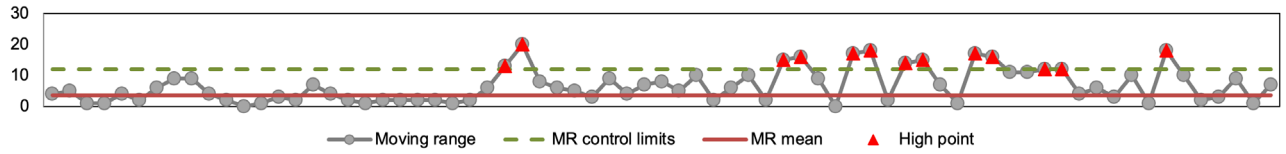
WA: Western Australia.
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

5.2 Postoperative deaths (continued)

Figure 35: Postoperative deaths 2018–2023, by month



Moving range



Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

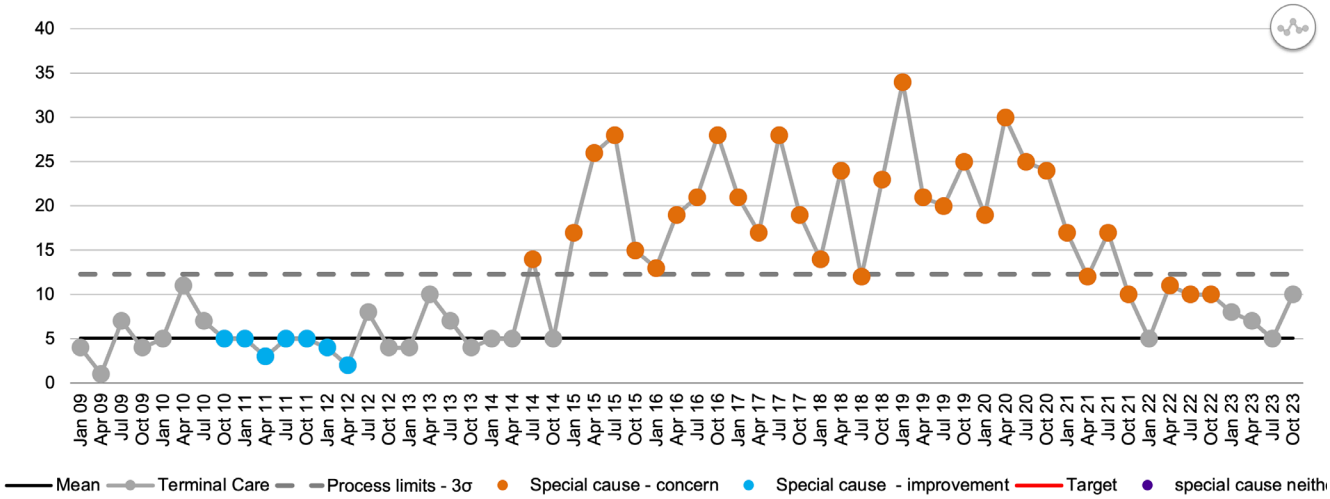
5.3 Terminal care and nonoperative cases

For many years, the number of cases admitted for terminal care was minimal—typically fewer than 10 per year. In 2014, the number of terminal care cases started to rise (Figure 36). Although WAASM was aware of this increase, it did not appreciate either the magnitude or duration until 2021, when it undertook a 20-year longitudinal analysis.

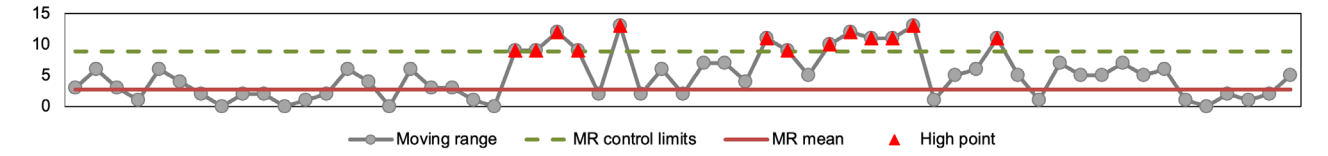
All cases classified as terminal care in 2021 were reviewed by WAASM. Many were found not to be admitted for terminal care; rather, a decision was made early after admission not to offer surgery. An early decision not to offer surgery is not the same as being admitted for terminal care. Since 2021, WAASM has obtained the discharge summaries for all cases submitted as terminal care. If WAASM deems that the classification is incorrect, the SCF is returned to the surgeon to be completed in full. Had WAASM been using SPC charts in 2014, this issue would have been noted earlier.

5.3 Terminal care and nonoperative cases (continued)

Figure 36: Terminal care cases 2009–2023, by quarter



Moving range



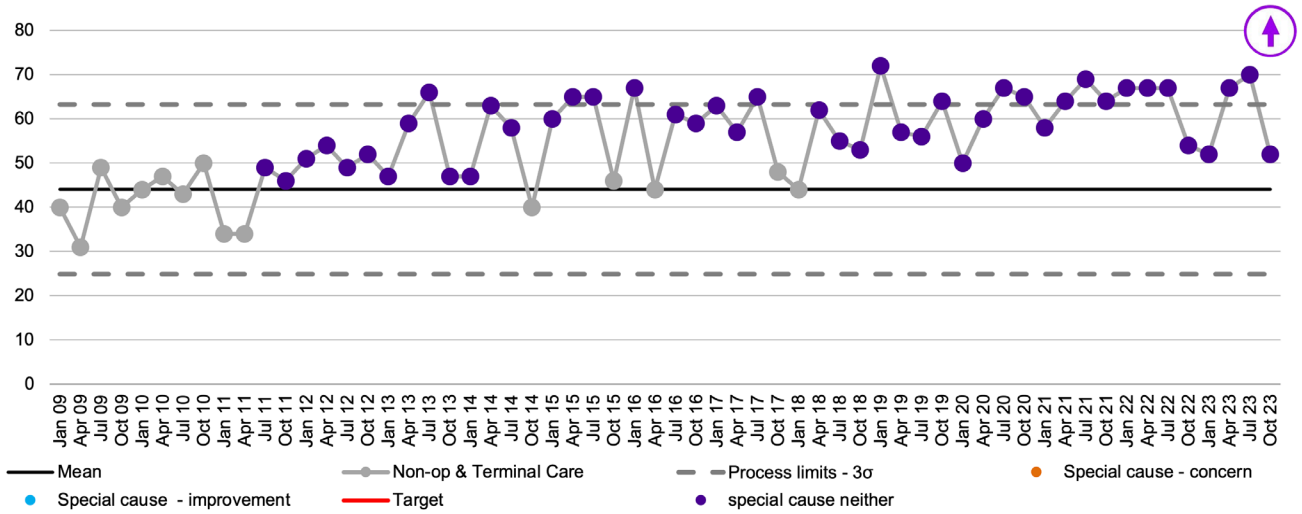
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

In some cases, the difference between being admitted for terminal care and not being offered surgery is semantic. A patient in the emergency department may be determined to decline an operation, but is admitted for logistical reasons (e.g. to allow travel time for family). The overall effect is the same: the patient did not have an operation.

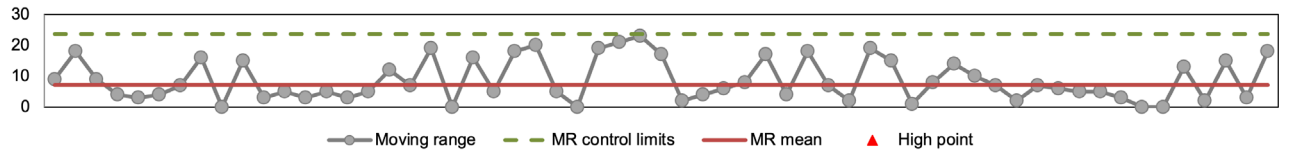
When terminal care and nonoperative cases are summed together, the upward shift over many years is obvious (Figure 37). Nonoperative deaths have increased since mid-2020 (Figure 38). As there is no right or wrong nonoperation rate, the points are coloured purple.

5.3 Terminal care and nonoperative cases (continued)

Figure 37: Nonoperative and terminal care cases 2009–2023, by quarter



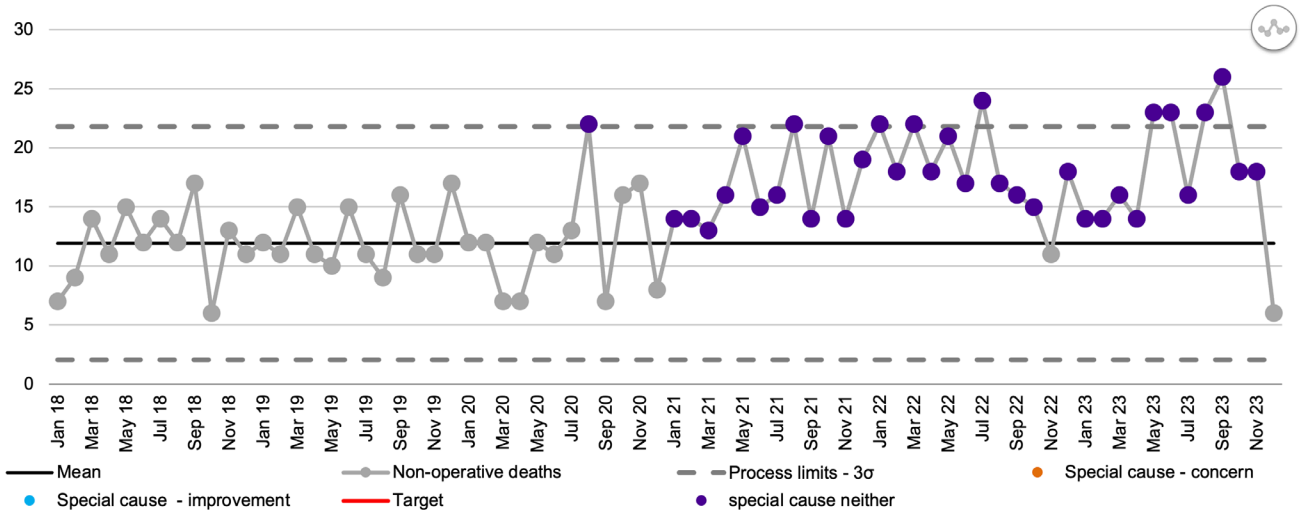
Moving range



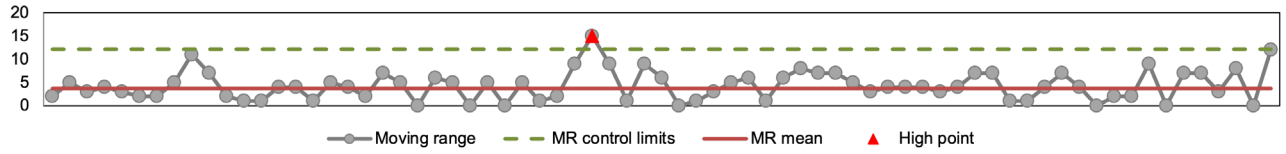
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

5.3 Terminal care and nonoperative cases (continued)

Figure 38: Nonoperative deaths 2018–2023, by month



Moving range

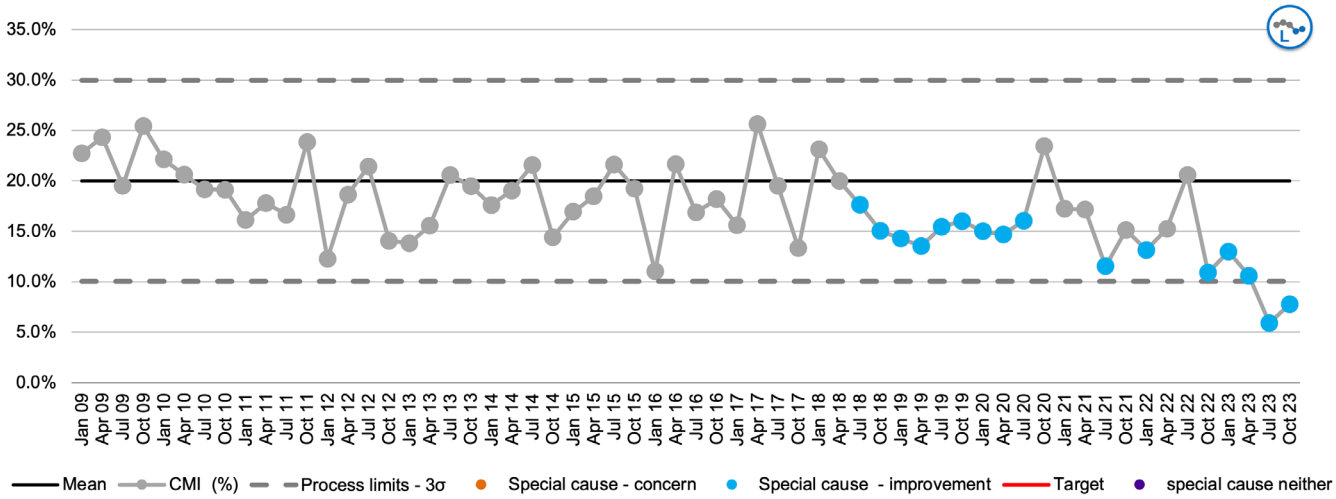


Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

5.4 Proportion of deaths with clinical management issues

The proportion of deaths with a CMI has progressively fallen (Figure 39). However, the proportion of preventable CMIs has remained steady (Figure 40).

Figure 39: Proportion of cases with CMIs 2009–2023, by quarter



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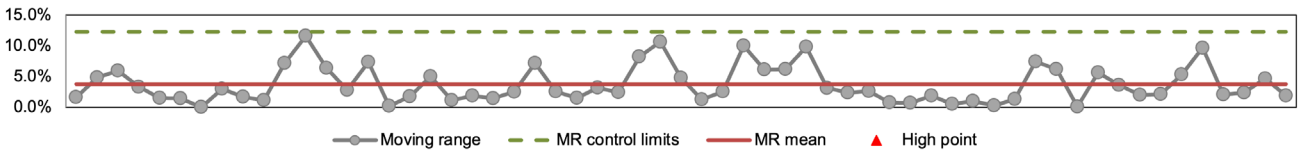
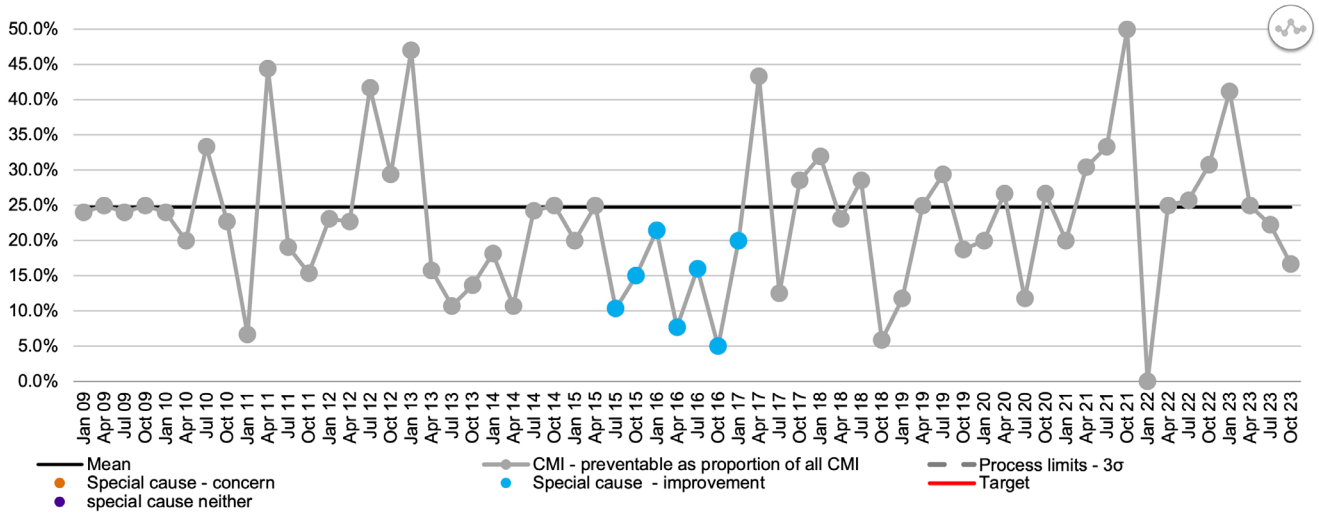


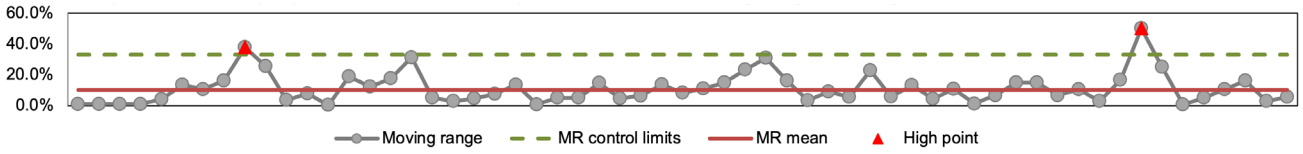
CMI: Clinical management issue.
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

5.4 Proportion of deaths with clinical management issues (continued)

Figure 40: Proportion of cases with preventable CMIs 2009–2023, by quarter



Moving range



CMI: Clinical management issue
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

5.5 General Surgery cases

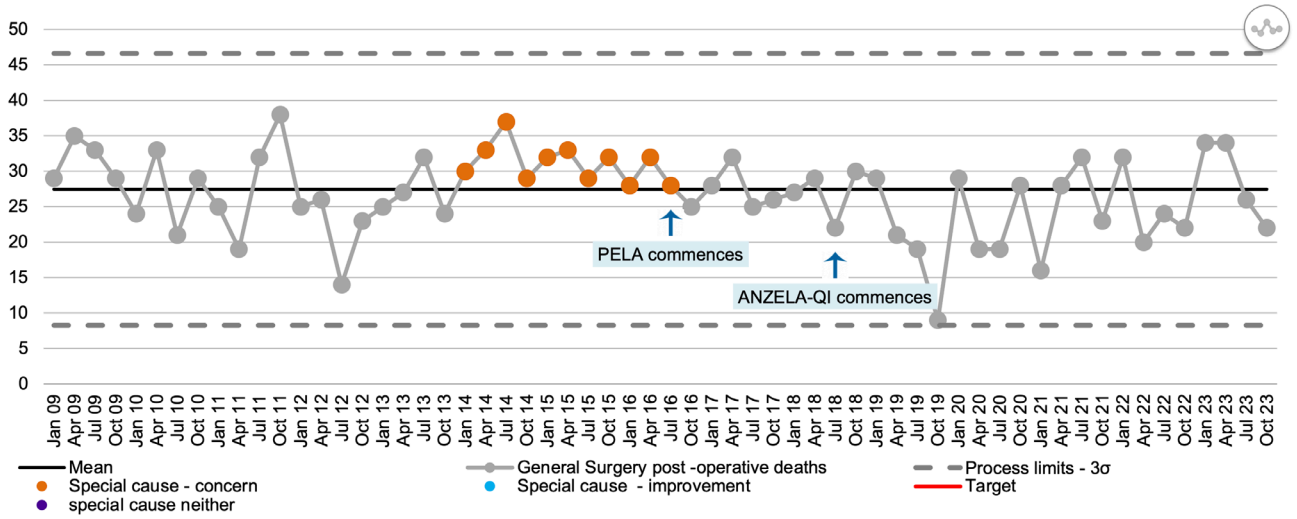
Between 2009 and 2023, General Surgery cases represented 42.3% (3,677/8,683) of all deaths reported to WAASM. Within General Surgery, the common operation with the greatest risk of death is emergency laparotomy. The management of emergency laparotomy has been a focus of attention in WA since the original Perth Emergency Laparotomy Audit (PELA) in late 2016 and, more recently, the Australian and New Zealand Emergency Laparotomy Audit – Quality Improvement (ANZELA–QI).[29]

The cause for the increase in General Surgery postoperative deaths between 2014 and mid-2016 is not obvious (Figure 41). However, since mid-2016, the number of postoperative deaths under a general surgeon has fallen (Figure 42). It is likely that this has been driven by the interest in emergency laparotomy. WAASM is unable to determine if the decrease is only due to emergency laparotomy or if there has been a halo effect that has reduced postoperative deaths in non-emergency laparotomy patients.

5.5 General Surgery cases (continued)

The question then arises as to whether the overall fall in postoperative deaths is a reflection of General Surgery rates, or if it has occurred in all specialties. Figure 43 shows postoperative deaths for all specialties except General Surgery, adjusted for population growth. The fall in postoperative deaths after 2016–2017 seen in General Surgery (Figure 42), is not obvious in other specialties (Figure 43). This suggests that the overall fall in postoperative deaths observed since 2016–2017 (Figure 34) may have been influenced by a disproportionate number of General Surgery deaths.

Figure 41: General Surgery postoperative deaths 2009–2023, by quarter



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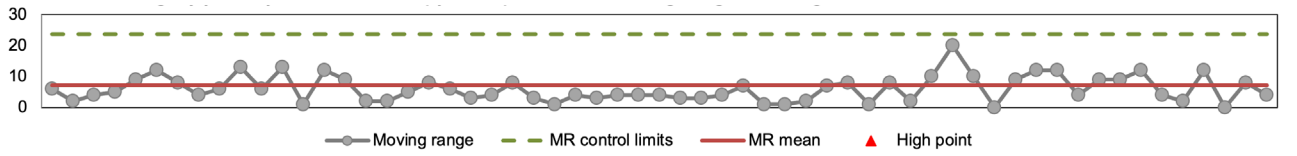
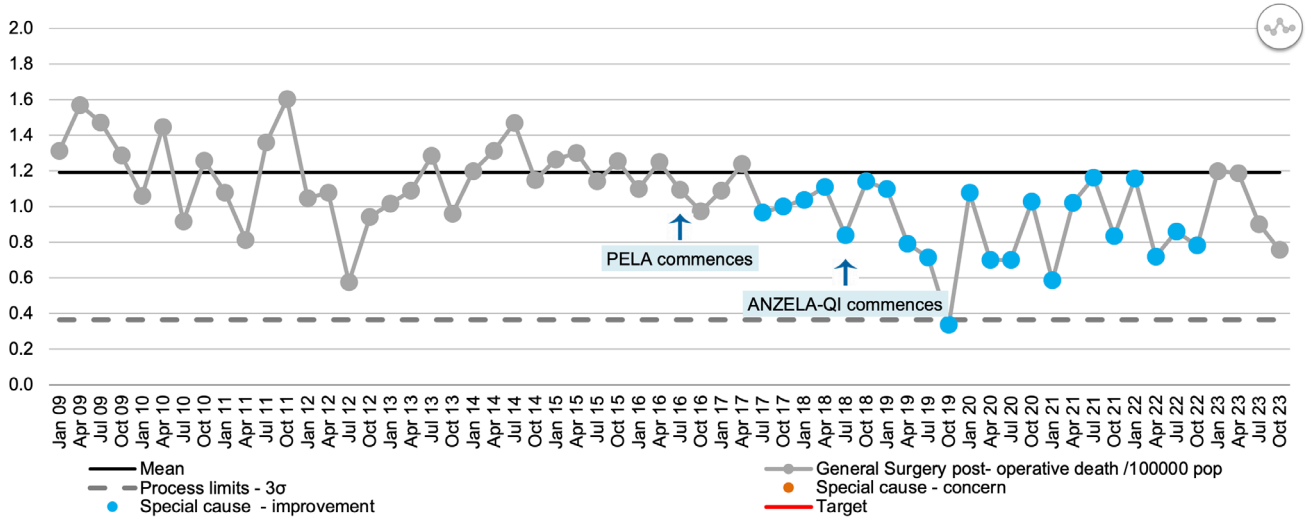


ANZELA-QI: Australian and New Zealand Emergency Laparotomy Audit – Quality Improvement, PELA: Perth Emergency Laparotomy Audit.
Note: Some 2023 cases still undergoing review, so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

5.5 General Surgery cases (continued)

Figure 42: General Surgery postoperative deaths and mortality rate per 100,000 WA population 2009–2023, by quarter



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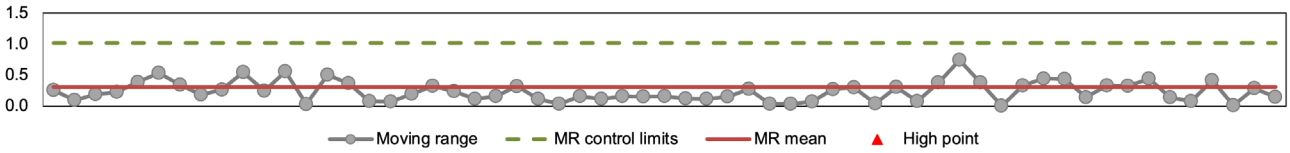


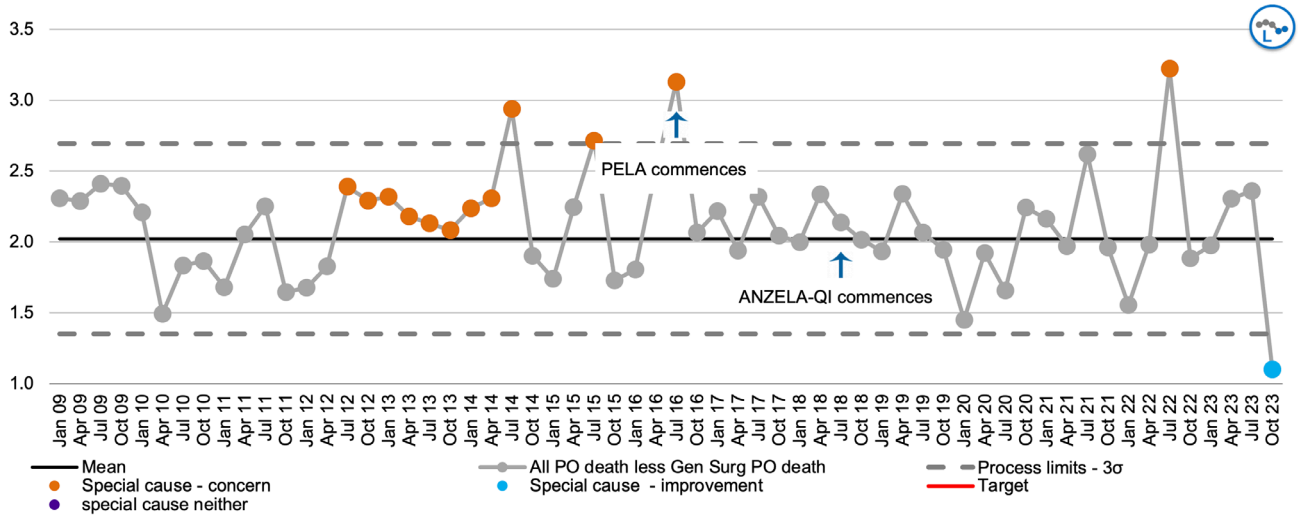
ANZELA-QI: Australian and New Zealand Emergency Laparotomy Audit – Quality Improvement, PELA: Perth Emergency Laparotomy Audit, WA: Western Australia.

Note: Some 2023 cases still undergoing review, so case data unavailable for this report.

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

5.5 General Surgery cases (continued)

Figure 43: Non-General Surgery postoperative deaths and mortality rate per 100,000 WA population 2009–2023, by quarter



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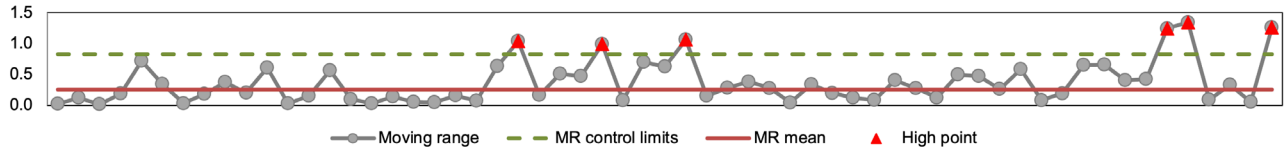

ANZELA-QI: Australian and New Zealand Emergency Laparotomy Audit – Quality Improvement, PELA: Perth Emergency Laparotomy Audit, WA: Western Australia.

Note: Some 2023 cases still undergoing review, so case data unavailable for this report.

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

5.6 Hospital-level data

Hospitals will reasonably argue that while the presented data are valuable at a statewide level, they would like to know what is happening at their individual sites. WAASM has examined representative data at hospital level, but the constraints of qualified privilege (QP) mean that, at this time, it would be inappropriate to show the data, even if de-identified, as it might be possible to reasonably infer the identity of the hospital.

In large hospitals and specialties, it appears that the use of SPC charts may be appropriate. Discussions between ANZASM and the jurisdictions are ongoing and this is a matter that is likely to be revised in future.

Acknowledgements

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- second-line assessors
- hospital medical records departments
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- RACS, for infrastructure and oversight of this project
- ANZASM Steering Committee.

- **WAASM Management Committee:**

Dr James Aitken	WAASM Clinical Director, general surgical representative
Dr Jonathan Spencer	Orthopaedic surgeon, orthopaedic surgical representative
Prof Francis Lannigan	Otolaryngology head and neck surgeon, otolaryngology head and neck surgical representative
Dr Senarath Werapitiya	General surgeon, rural surgical representative
Dr Mike Soares	Anaesthetist, anaesthetic representative
Dr Richard Murphy	Obstetrician and gynaecologist, obstetrics and gynaecology representative
Mr Rasa Subramaniam	Consumer representative

- **WAASM staff:**

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

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

Prof Guy Maddern	ANZASM Committee Chair
Prof Wendy Babidge	RAAS General Manager
Dr Helena Kopunic	Manager, Surgical Audit
Dr Kristin Weidenbach	Academic Editorial Manager

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Appendices

Appendix A: Review of 2023 recommendations (data)

Appendix A.1 Unplanned returns to theatre

Figure A.1a: Unplanned returns to theatre, 2019–2023

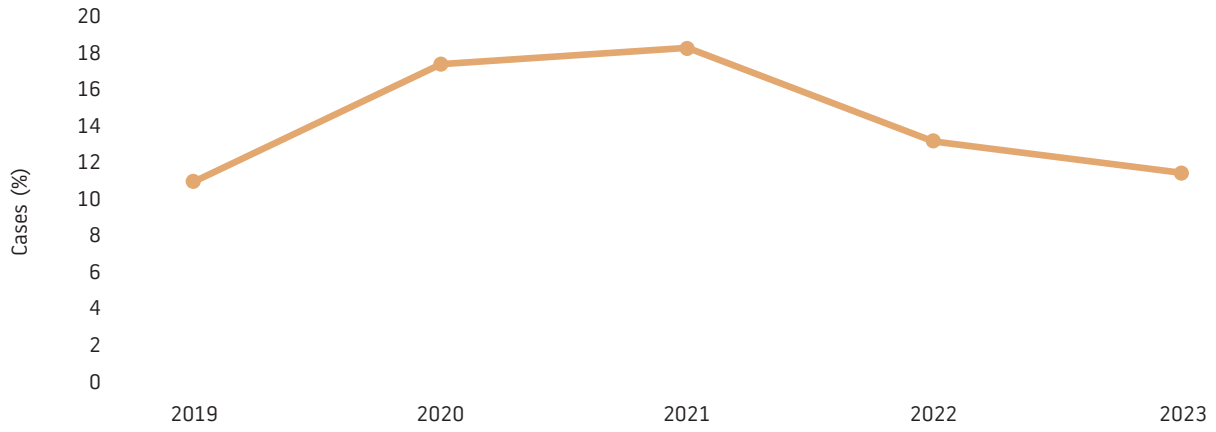
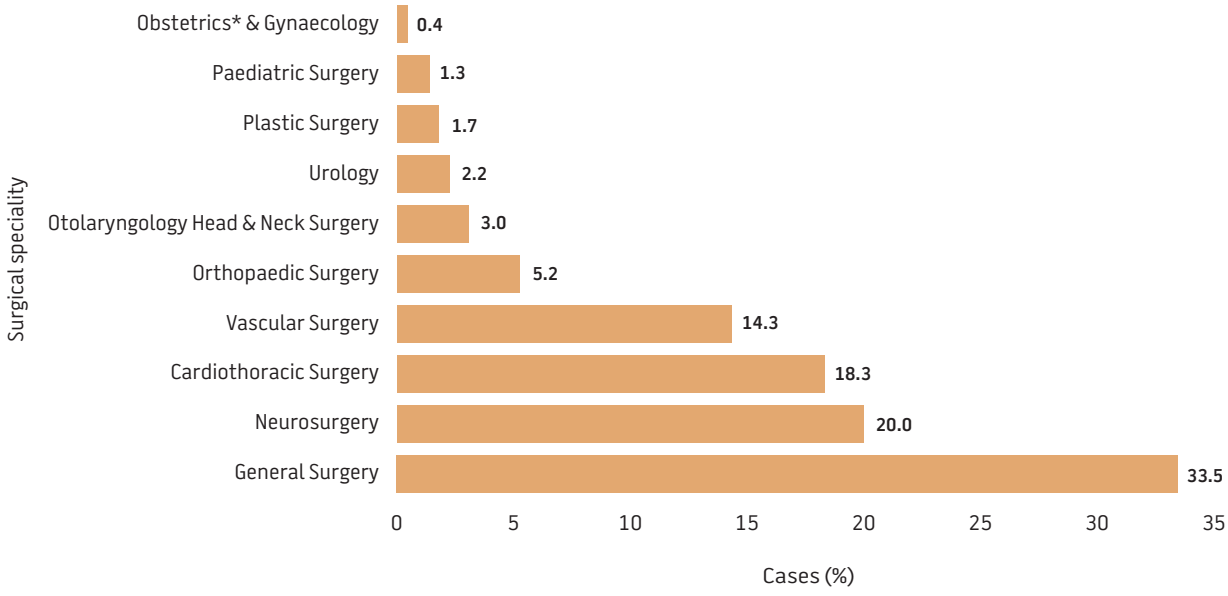


Figure A.1b: Unplanned returns to theatre by surgical specialty, 2019–2023



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

Appendix A.2 Unplanned readmissions within 30 days

Figure A.2a: Unplanned readmissions within 30 days, 2019–2023

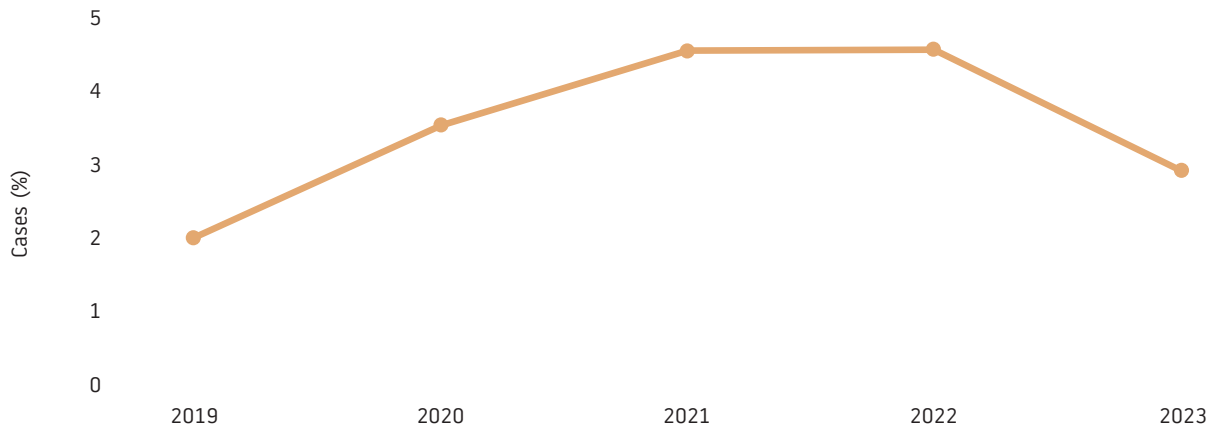
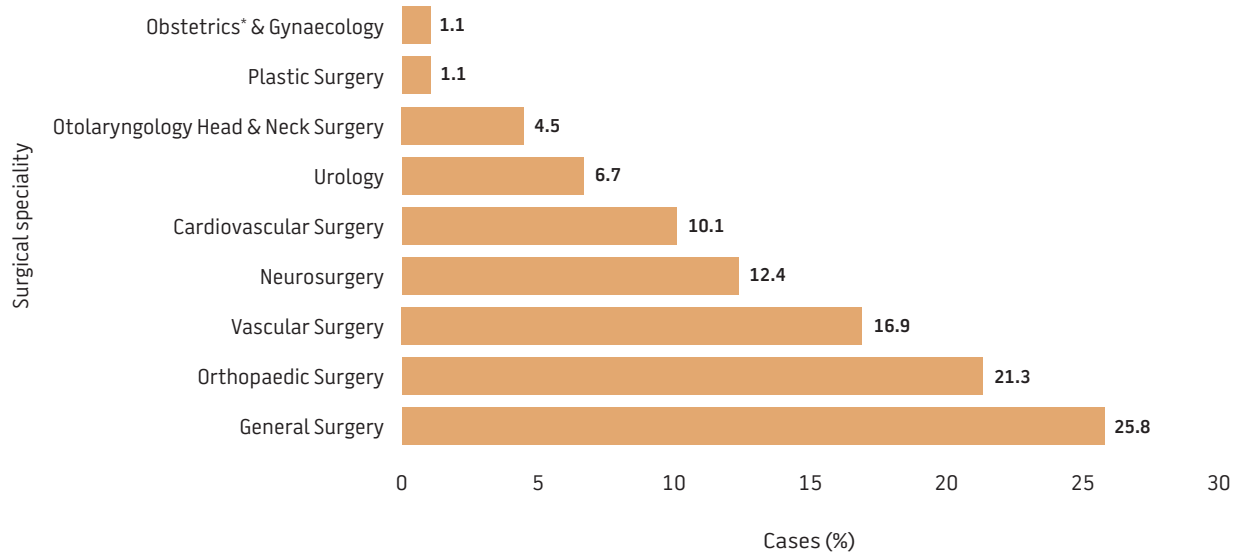
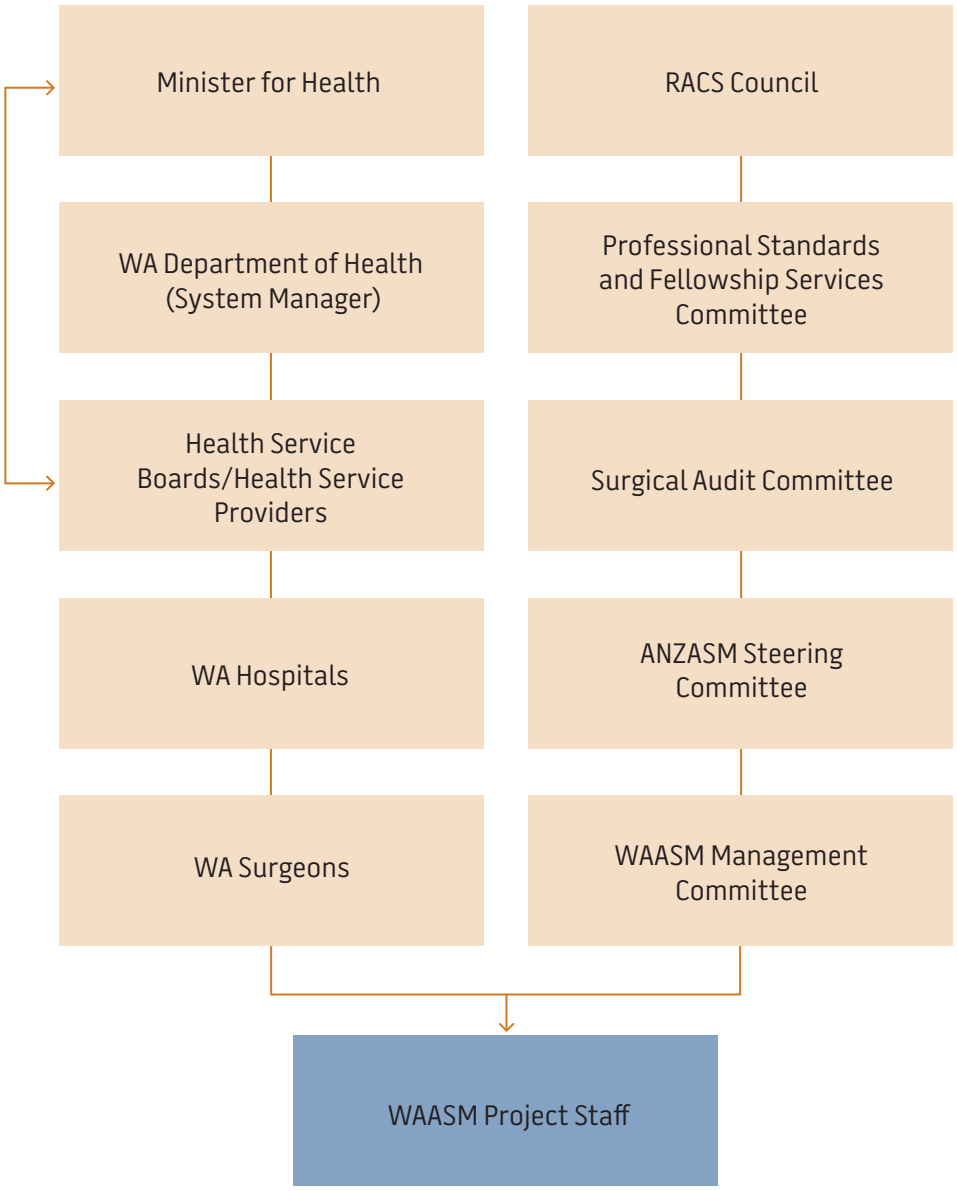


Figure A.2b: Unplanned readmissions within 30 days by surgical specialty, 2019–2023



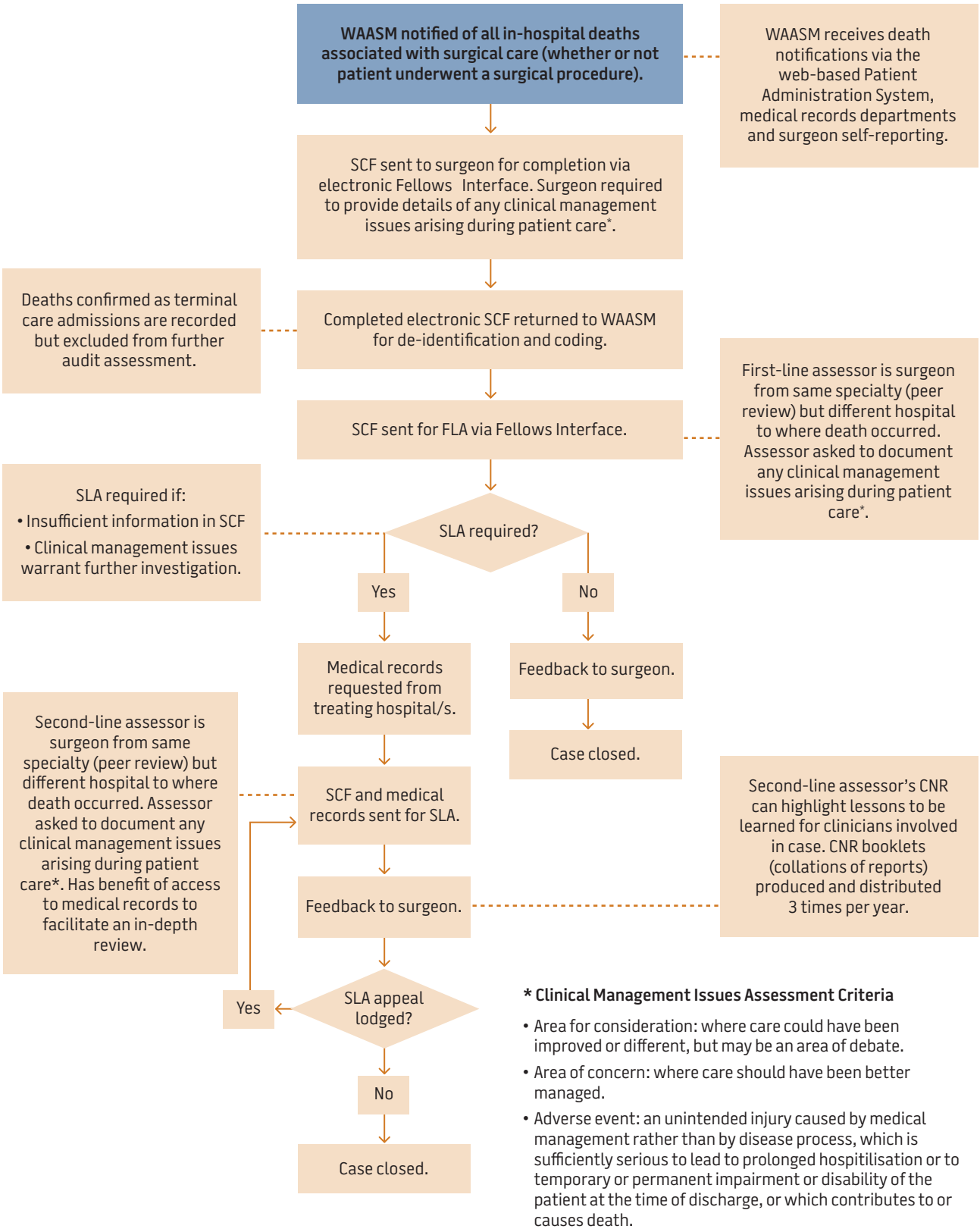
*Obstetric cases are not included in the audit process; only gynaecological cases are audited.

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



*** Clinical Management Issues Assessment Criteria**

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

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 2019 and 2023. Total numbers of deaths reported to WAASM, including 'excluded error' cases (n=3,006).
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=2,888).
Data excluded	All 'excluded error' cases (n=118).
Table 3: Median age, by sex	
Definition	Median age by sex for all cases.
Data included	All deaths falling within WAASM criteria (n=2,888).
Data excluded	All 'excluded error' cases (n=118).
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 2019 and 2023 (n=3,006).
Data excluded	No exclusions.
Figure 2: 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=2,888).
Data excluded	All 'excluded error' cases (n=118).
Figure 3: 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=2,888).
Data excluded	All 'excluded error' cases (n=118).
Figure 4: 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=2,527).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. Data missing=1.
Figure 5: 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=2,526).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. Data missing=2.

Appendix D.2 Figures (continued)

Figure 6: Deaths by age group and sex	
Definition	Counts of deaths by age groups and sex.
Data included	All deaths falling within WAASM criteria (n=2,888).
Data excluded	All 'excluded error' cases (n=118).
Figure 7: Most common causes of death, by Read code*	
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=3,935).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases.
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=173), General Surgery (n=1,036), Neurosurgery (n=416), Obstetrics & Gynaecology (n=5), Ophthalmology (n=2), Otolaryngology Head & Neck Surgery (n=40), Orthopaedic Surgery (n=481), Paediatric Surgery (n=12), Plastic Surgery (n=47), Urology (n=108), Vascular Surgery (n=207).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. Data missing=1.
Figure 9: Consultant surgeon making the decision to operate, by year	
Definition	Percentages of consultant surgeons making the decision to proceed to surgery per year.
Data included	All deaths falling within WAASM criteria where the number of operations performed was reported (n=2,127).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where an operation was not reported.
Figure 10: Consultant surgeon involvement in operations, by year	
Definition	Percentages of consultant surgeons operating, assisting and supervising in theatre per year.
Data included	All deaths falling within WAASM criteria where the number of operations performed was reported (n=2,127).
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: 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=1,604).
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=1.
Figure 12: Postoperative complications, by year	
Definition	Percentages of postoperative complications per year. It is possible for patients to have more than one postoperative complication.
Data included	All deaths falling within WAASM criteria where postoperative complications were reported (n=400).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where an operation was not reported and all operative cases where a postoperative complication was not reported.
Figure 13: 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=922) 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 14: Cases with preoperative diagnostic delays, by year	
Definition	Percentages of cases with preoperative diagnostic delays per year.
Data included	All deaths falling within WAASM criteria where preoperative diagnostic delays were reported (n=2,526).
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 15: Preoperative hospital transfers, by year	
Definition	Percentages of hospital transfers per year.
Data included	All deaths falling within WAASM criteria where transfers were reported (n=2,521).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. Data missing=7.

Appendix D.2 Figures (continued)

Figure 16: Preoperative transfer issues	
Definition	Percentages of issues associated with hospital transfers.
Data included	All deaths falling within WAASM criteria where transfer issues were reported (n=753).
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'=11; 'insufficient clinical information'=10; 'inappropriate transfer'=8; 'delay in transfer'=7.
Figure 17: Cases with specific comorbidities	
Definition	Percentages of cases with comorbidities.
Data included	All deaths falling within WAASM criteria where comorbidities were reported. Some cases reported more than one type of comorbidity.
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where no comorbidities were reported.
Figure 18: 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=2,431).
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=97.
Figure 19: 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=2,522).
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=6.
Figure 20: CCU use, by year	
Definition	Percentages of CCU use/non-use per year.
Data included	All deaths falling within WAASM criteria where use (n=1,477) and non-use (n=1,048) of CCU was reported.
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. Data missing=3.

Appendix D.2 Figures (continued)

Figure 21: 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=1,953) and non-use (n=569) of DVT prophylaxis was reported.
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. Data missing=6.
Figure 22: 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=1,953).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow-up' cases. All cases where non-use of DVT prophylaxis and type of DVT prophylaxis were not reported.
Figure 23: Clinically significant infections during admission	
Definition	Percentages of cases with timing of the clinically significant infections acquired during admission.
Data included	All deaths falling within WAASM criteria where clinically significant infections acquired during admission were reported (n=361).
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.
Figure 24: 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=783).
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.
Figure 25: Assessor opinion on grade/experience of surgeon deciding, by year	
Definition	Percentages of cases where the grade/experience of surgeon deciding on the care of the patient was reviewed, as reported by assessors per year.
Data included	All deaths falling within WAASM criteria using the highest level of assessment in completed cases where grade/experience of surgeon deciding was reported (n=2,045).
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=30.

Appendix D.2 Figures (continued)

Figure 26: Assessor opinion on grade/experience of surgeon operating, by year	
Definition	Percentages of cases where the grade/experience of surgeon operating on the patient was reviewed, as reported by assessors per year.
Data included	All deaths falling within WAASM criteria using the highest level of assessment in completed cases where grade/experience of surgeon operating was reported (n=2,034).
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=41.
Figure 27: Cases with CMIs, by year	
Definition	Percentages of cases with CMIs, as reported by assessors per year.
Data included	All deaths falling within WAASM criteria using the highest level of assessment in completed cases where CMIs were reported (n=2,447).
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 CMIs were not reported.
Figure 28: Categories of CMI, by year	
Definition	Percentages of categories of CMI, as reported by assessors. Based on the number of incidents of CMIs, 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=584).
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 CMIs were not reported.
Figure 29: Assessor perception of impact of adverse event on clinical outcome, by year	
Definition	Numbers of perceived impacts of adverse events, as reported by assessors per year. Based on the number of incidents of CMIs, 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=65).
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 CMIs were not reported; and all cases where 'areas for consideration' and 'areas of concern' were reported.

Appendix D.2 Figures (continued)

Figure 30: Assessor perception of preventability of adverse events causing death, by year	
Definition	Numbers of perceived preventability of adverse events causing death, as reported by assessors per year. Based on the number of incidents of CMIs, 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=30).
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 CMIs were not reported; all cases where 'areas for consideration' and 'areas of concern' were not reported; and all cases where adverse events not causing death were reported.
Figure 31: Most frequently reported CMIs, by Read code*	
Definition	Percentages and descriptions (in Read code) of the 8 most common CMIs, as reported by assessors.
Data included	All deaths falling within WAASM criteria where CMIs were reported (n=358).
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 CMIs were not reported.
Figure 32: WAASM deaths 2009–2023, by quarter	
Definition	Number of deaths reported to WAASM by quarter, during the period 2009–2023.
Data included	All deaths falling within WAASM criteria.
Data excluded	All 'excluded error' cases.
Figure 33: WAASM deaths and mortality rate per 100,000 WA population 2009–2023, by quarter	
Definition	Number of deaths falling within WAASM criteria by quarter, and mortality rates per 100,000 WA population during the period 2009–2023.
Data included	All deaths falling within WAASM criteria.
Data excluded	All 'excluded error' cases.
Figure 34: Postoperative deaths and mortality rate per 100,000 WA population 2009–2023, by quarter	
Definition	Number of operative cases reported to WAASM by quarter, and mortality rates per 100,000 WA population during the period 2009–2023.
Data included	All deaths falling within WAASM criteria where the number of operations performed was reported.
Data excluded	All 'excluded error', 'surgical case pending', and 'excluded terminal care' cases. All cases where an operation was not reported.

Appendix D.2 Figures (continued)

Figure 35: Postoperative deaths 2018–2023, by month	
Definition	Number of operative cases reported to WAASM by month, during the period 2018–2023.
Data included	All deaths falling within WAASM criteria where the number of operations performed was reported.
Data excluded	All 'excluded error', 'surgical case pending', and 'excluded terminal care' cases. All cases where an operation was not reported.
Figure 36: Terminal care cases 2009–2023, by quarter	
Definition	Number of terminal care cases reported to WAASM by quarter, during the period 2009–2023.
Data included	All terminal care cases.
Data excluded	All other cases, except terminal care cases.
Figure 37: Nonoperative and terminal care cases 2009–2023, by quarter	
Definition	Number of nonoperative and terminal care cases reported to WAASM by quarter, during the period 2009–2023.
Data included	All nonoperative and terminal care cases.
Data excluded	All 'excluded error' and 'surgical case pending' cases. All cases where an operation was reported.
Figure 38: Nonoperative deaths 2018–2023, by month	
Definition	Number of nonoperative cases reported to WAASM by month, during the period 2018–2023.
Data included	All nonoperative cases.
Data excluded	All 'excluded error', 'surgical case pending' and 'terminal care' cases. All cases where an operation was reported.
Figure 39: Proportion of cases with CMIs 2009–2023, by quarter	
Definition	Percentages of cases with CMIs, as reported by assessors by quarter, during the period 2009–2023.
Data included	All deaths falling within WAASM criteria using the highest level of assessment in completed cases where CMIs were reported.
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 CMIs were not reported.

Appendix D.2 Figures (continued)

Figure 40: Proportion of cases with preventable CMIs 2009–2023, by quarter	
Definition	Percentages of cases with preventable CMIs, as reported by assessors by quarter, during the period 2009–2023.
Data included	All deaths falling within WAASM criteria using the highest level of assessment in completed cases where preventable CMIs were reported.
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 preventable CMIs were not reported.
Figure 41: General Surgery postoperative deaths 2009–2023, by quarter	
Definition	Number of postoperative General Surgery cases reported to WAASM by quarter, during the period 2009–2023.
Data included	All General Surgery deaths falling within WAASM criteria where the number of operations performed was reported.
Data excluded	All non-General Surgery specialty cases. All General Surgery cases where an operation was not reported.
Figure 42: General Surgery postoperative deaths and mortality rate per 100,000 WA population 2009–2023, by quarter	
Definition	Number of postoperative General Surgery cases reported to WAASM by quarter, and mortality rates per 100,000 WA population during the period 2009–2023.
Data included	All General Surgery deaths falling within WAASM criteria where the number of operations performed was reported.
Data excluded	All non-General Surgery specialty cases. All General Surgery cases where an operation was not reported.
Figure 43: Non-General Surgery postoperative deaths and mortality rate per 100,000 WA population 2009–2023, by quarter	
Definition	Number of all non-General Surgery postoperative cases reported to WAASM by quarter, during the period 2009–2023.
Data included	All non-General Surgery deaths falling within WAASM criteria where the number of operations performed was reported.
Data excluded	All General Surgery specialty 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

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