Royal Australasian College of Surgeons

The Royal Australian and New Zealand College of Obstetricians and Gynaecologists

Excellence in Women's Health

2021 REPORT

The Western Australian Audit of Surgical Mortality (WAASM)

Western Australian Audit of Surgical Mortality

CONTACTS

T +61 8 6389 8650
F +61 8 6389 8655
E waasm@surgeons.org
www.surgeons.org/waasm

Royal Australasian College of Surgeons
Western Australian Audit of Surgical Mortality
Postal address: M308, University of Western Australia, Crawley WA 6009
Street address: Suite 1, Ground Floor, 216 Stirling Highway, Claremont WA 6009

Clinical Director
Mr James Aitken

Project Manager
Dr Franca Itotoh

Senior Project Officer
Ms Natalie Zorbas

Research Administrative Officer
Mr Andrew Lukman

The information contained in this annual report has been prepared by the Royal Australasian College of Surgeons, Western Australian Audit of Surgical Mortality Management Committee, which, as part of the Australian and New Zealand Audit of Surgical Mortality is a declared quality assurance activity under the *Health Insurance Act 1973 (Cwlth)*, Part VC (gazetted 2 May 2017).

Cover photo by Tobias Keller on Unsplash.

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

- **WAASM Management Committee:**

Mr James Aitken	WAASM Clinical Director and general surgical representative
Mr Tom Bowles	Consultant General Surgeon, rural surgical representative
Dr Jennifer Bruce	Consultant Anaesthetist, anaesthetic representative
Mr Ian Gollow	Consultant Paediatric Surgeon, paediatric surgical representative
Dr Nicole Leeks	Consultant Orthopaedic Surgeon, orthopaedic representative
Mr Stuart Salfinger	Consultant Obstetrician and Gynaecologist, obstetrics & gynaecology representative
Mr Rasa Subramaniam	Consumer representative

- **WAASM staff:**

Dr Franca Itotoh	Project Manager
Ms Natalie Zorbas	Senior Project Officer
Mr Andrew Lukman	Research Administrative Officer

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

Professor Guy Maddern	Chair, ANZASM Steering Committee
A/Professor Wendy Babidge	General Manager, RAAS
Dr Nathan Procter	Acting Manager, Surgical Audit
Dr Kristin Weidenbach	Academic Editorial Manager

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Clinical Director's report

This report covers the calendar year 2020, during which the coronavirus pandemic (COVID-19) became fully established. During this period, Australia had to prepare for the unknown on the basis of a worst-case scenario. As it happened, the impact of COVID-19 in Australia, and in particular Western Australia (WA), was minimal compared with most other countries. From a surgical perspective, the major impact was a reduction in elective surgery in early 2020 (See Section 5 of this report, *A closer look: impact of COVID-19 on surgical deaths*, for more details).

That stated, caution is required as it may be several years before the full surgical impact of COVID-19 is understood. There is now clear evidence that up to 15 per cent of those infected develop so called long COVID. This includes the young and those who had a minor initial infection. The long-term implications of long COVID are unknown and it remains to be determined if the risks of surgery in previously infected patients, even if minor, are greater than those with no history of COVID-19. At present, the data suggests long COVID is rare in those who develop break through infection (that is contract COVID despite being vaccinated). The only way to reduce the potential surgical burden of long COVID is to rapidly achieve a fully vaccinated population.

A key matter to be addressed is a change in access to post mortem reports. Almost all post mortems in WA are undertaken by the Office of the State Coroner. Since the inception of the Western Australian Audit of Surgical Mortality (WAASM) almost 20 years ago, the Office of the State Coroner has been very helpful and supportive when it has received requests for post mortem reports from WAASM.

Post mortems have been the final arbitrator as to the cause of death of a patient for hundreds of years and not infrequently provide additional information of which treating clinicians were unaware. In some cases, post mortems reveal new information that, if previously known to the treating clinicians, could have resulted in different care, and perhaps a different outcome for that patient. The educational value of post mortems cannot be overstated.

In early 2021, WAASM was advised by the Office of the State Coroner that it has received legal advice from the State Solicitor's Office to the effect that disclosing such reports is beyond the statutory functions of the Office of the State Coroner as defined by the *Coroners Act 1996* (WA), and is inconsistent with the purpose for which a post mortem report is obtained by the Office of the State Coroner (i.e. identifying the legal cause of death). Further, to disclose post mortem reports may be in breach of the deceased's confidentiality rights. These restrictions include hospitals, meaning, post mortem reports will no longer be routinely available to WAASM, nor to hospital mortality and morbidity meetings. It may be possible to access the post mortem report if informed consent is obtained from the deceased's senior next of kin. The practicalities of this at a time of great stress would be substantial, and in many cases very insensitive.

The WA Department of Health is fully aware of the importance of post mortem reports to both WAASM and hospitals. It is deeply engaged with the State Solicitor's Office and the Office of the State Coroner. It is hoped that there will be early legislative amendments to the *Coroners Act* that will again permit disclosure of post mortem reports as appropriate.

In late 2020, Fellows were advised that the Royal Australasian College of Surgeons (RACS) was developing a new Continuing Professional Development (CPD) program which would commence on 1 July each year. In transitioning to the new program, RACS approved an interim CPD program from 1 January to 30 June 2021.

Due to anticipated regulatory changes, RACS has reverted to the CPD program being run over a calendar year. To minimise disruption to Fellows, it was agreed to put in place an 18-month period to realign the requirements for the change. This will run from 1 July 2021 – 31 December 2022.

However, Fellows are still required to complete their ANZASM obligations in a timely manner as specifically laid out in RACS CPD regulations. The necessity for surgeons to complete their surgical case forms (SCF) underscores the importance of participation in ANZASM as it continues to be a requirement of the RACS CPD program.

The closing date for Fellows to complete their 2020 CPD obligations remains February. Each year, there are a number of surgeons with outstanding SCF and ensuring these are completed imposes a substantial additional, and unnecessary, burden on the WAASM staff.

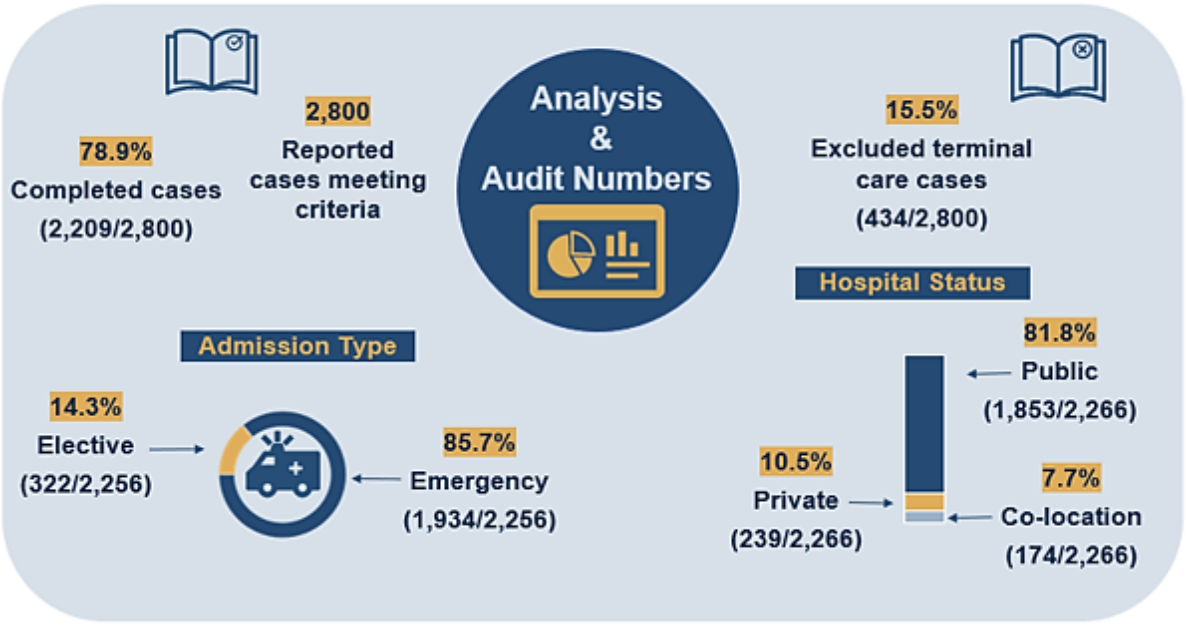
RJ Aitken
WAASM Clinical Director

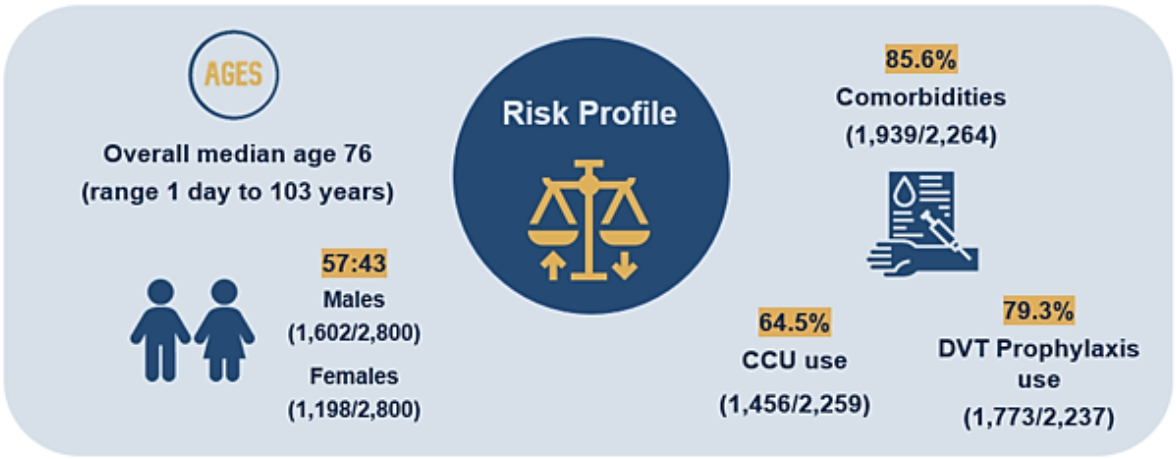
Abbreviations

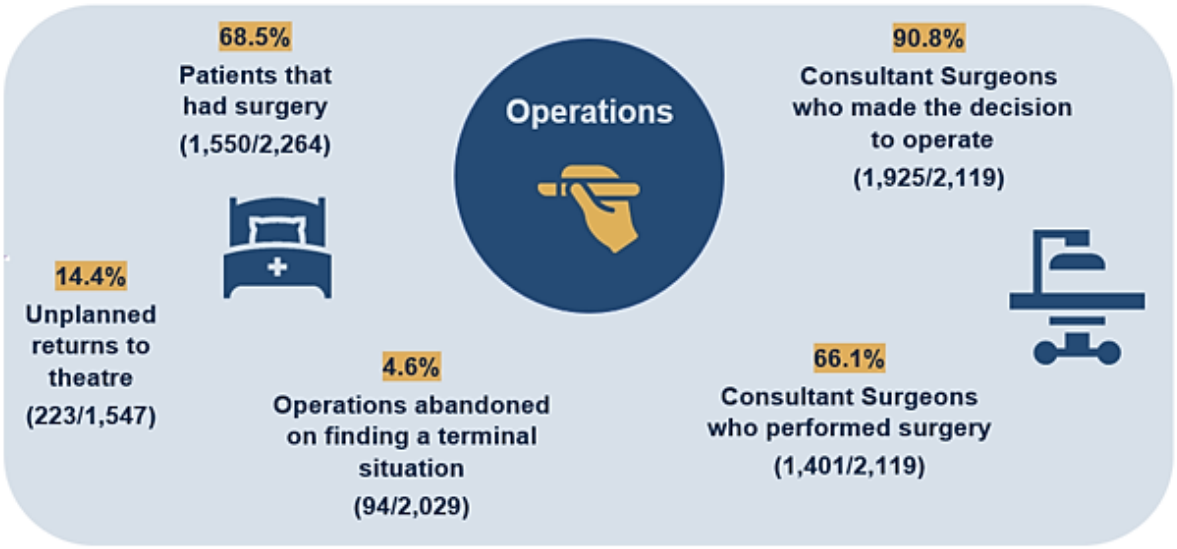
ANZASM	Australian and New Zealand Audit of Surgical Mortality
ASA	American Society of Anesthesiologists
CCU	Critical care unit
CMI	Clinical management issues
CNR	Case note review
CPD	Continuing professional development
DVT	Deep vein thrombosis
FLA	First-line assessment
HDU	High dependency unit
ICU	Intensive care unit
RAAS	Research, Audit and Academic Surgery
RACS	Royal Australasian College of Surgeons
SCF	Surgical case form
SLA	Second-line assessment
SPSS	Statistical Package for Social Sciences
TED	Thromboembolic deterrent
WA	Western Australia/n
WAASM	Western Australian Audit of Surgical Mortality

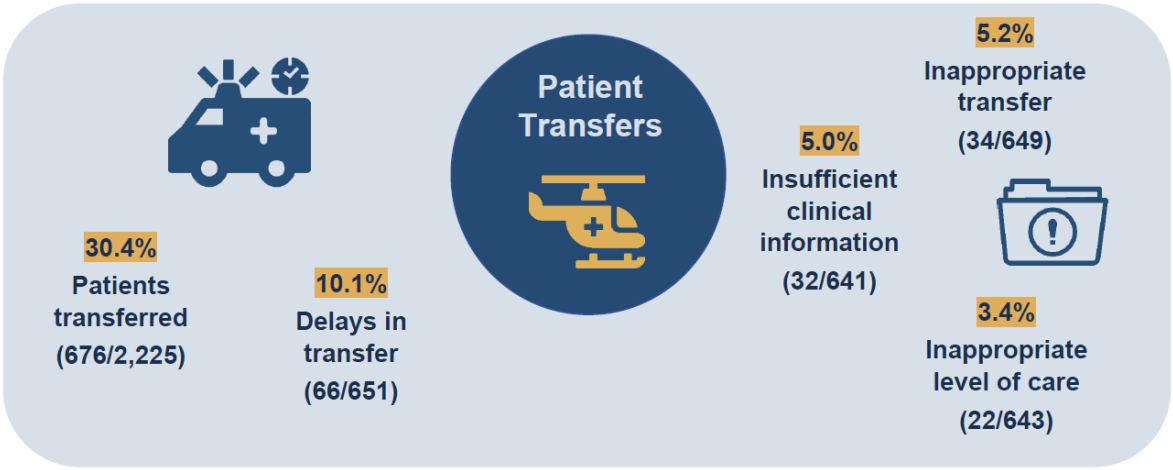
Executive summary

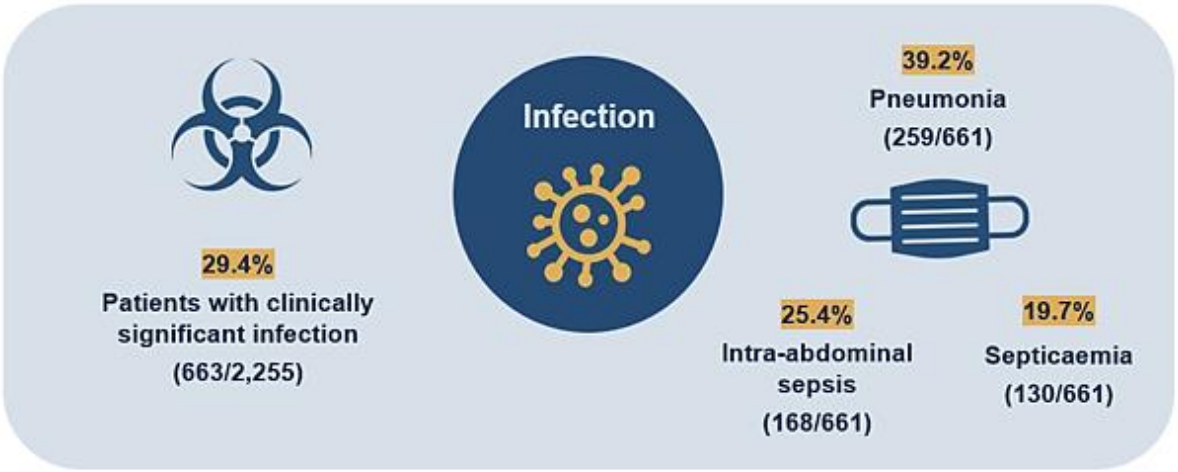
This summary covers cases reported to WAASM from **1 January 2016** to **31 December 2020**.

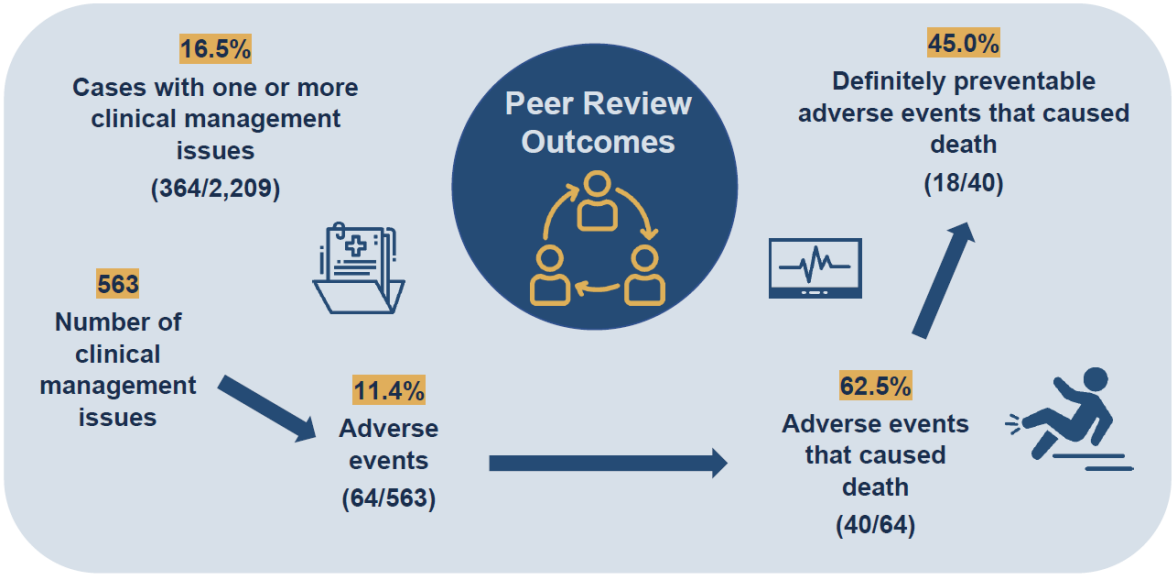



AGES
Overall median age 76
(range 1 day to 103 years)
Risk Profile
85.6%
Comorbidities
(1,939/2,264)
57:43
Males
(1,602/2,800)
Females
(1,198/2,800)
64.5%
CCU use
(1,456/2,259)
79.3%
DVT Prophylaxis use
(1,773/2,237)


68.5%
Patients that had surgery
(1,550/2,264)
Operations
90.8%
Consultant Surgeons who made the decision to operate
(1,925/2,119)
14.4%
Unplanned returns to theatre
(223/1,547)
4.6%
Operations abandoned on finding a terminal situation
(94/2,029)
66.1%
Consultant Surgeons who performed surgery
(1,401/2,119)


Patient Transfers
30.4%
Patients transferred
(676/2,225)
10.1%
Delays in transfer
(66/651)
5.0%
Insufficient clinical information
(32/641)
5.2%
Inappropriate transfer
(34/649)
3.4%
Inappropriate level of care
(22/643)





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

Review of 2020 recommendations

ANZASM

- ***Facilitate a national analysis of change in rate of deaths under a surgeon since the full integration of all the regional audits into ANZASM.***

  The national analysis of changes in surgical death rates is ongoing.

- ***Review the impact of COVID-19 on deaths under a surgeon.***

  Details of this review can be found in Section 5 of this report.

Clinical management

- ***Monitor and report any trends observed in the proportion of surgical patients who die with trauma being implicated, for the reporting periods over the next two years.***

  For the reporting period 2016–2020, trauma was reported in 27.9% of cases (625/2,242). In most of these cases (70.7%; 442/625), the trauma was the result of a fall. Figure A.1 in Appendix A suggests, however, that there was an overall decline in cases with fall-related trauma during the 5 years. This will be re-examined in 2022.

- ***Monitor and report on any trends in the proportion of surgical patients where there was an issue with communication at any stage of their care, for the reporting periods over the next two years.***

  For the reporting period 2016–2020, issues with communication were reported in 3.1% of cases (69/2,249). Figure A.2 in Appendix A shows a spike in the reporting of these issues in 2017. Reported communication issues included: failure to follow treatment instructions or inform consultant surgeons of changes in treatment decisions; delay in advising consultant surgeons of patient progress; inadequate communication between specialties; and patient/family factors.

Research

- ***Undertake a review of DVT prophylaxis use/non-use in surgical patients in WA.***

  Due to COVID-19, it was not possible to progress this research. WAASM is still interested in reviewing this in the future.

- ***Undertake an analysis of consultant surgeon involvement in theatre.***

  An analysis was undertaken to examine whether consultant involvement in theatre (operating or assisting) changed according to the number of operations performed on a single patient. Figures A.3 and A.4 in Appendix A show the results of this analysis by admission type (emergency or elective). In first operations, more consultants operated in elective admissions (82.2%; 250/304) than emergency admissions (61.6%; 763/1,238). Emergency admissions showed an increase in consultants operating in up to 4 subsequent operations. In elective admissions, that trend is reversed, with a decline in consultants operating up until operation 5.

2021 recommendations

Education

- Since February 2018, WAASM has sought to evaluate surgeon responses to audit feedback received for each case. This has been undertaken using a 'Peer Review Feedback Evaluation Form', which is included with feedback letters relating to all second-line assessment cases and those first-line assessment cases with identified clinical management issues. To help in assessing the impact of the audit on both surgeons and hospitals, WAASM will prepare a data analysis report based on the information received in these forms, to be made available to all WA surgeons and the WA Department of Health.

Clinical management

- Recommendations in WAASM's 2020 Report, stated the intention to 'monitor and report any trends observed in the proportion of surgical patients who die with trauma being implicated, for the reporting periods over the next 2 years.' The results from the first reporting period are presented in Review of 2020 recommendations and Appendix A of this report. WAASM will continue to monitor and report any trends observed for the next reporting period.

- Recommendations in WAASM's 2020 Report, stated the intention to 'monitor and report on any trends in the proportion of surgical patients where there was an issue with communication at any stage of their care, for the reporting periods over the next 2 years.' The results from the first reporting period are presented in Review of 2020 recommendations and Appendix A of this report. WAASM will continue to monitor and report any trends observed for the next reporting period.

Research and reporting on audit data

- Section 5 of this report considers the impact of COVID-19 on surgical deaths. WAASM will continue to review the impact of COVID-19 on deaths under the care of a surgeon.

- In general, deaths occurring in elective cases, in patients aged ≤50 years or in regional hospitals (where complex cases are predominantly transferred to metropolitan tertiary hospitals) are considered unexpected. In order to ensure that these 3 areas are adequately assessed and that any underlying themes are identified, WAASM will undertake a preliminary analysis of reported deaths (considered low risk) in these categories.

1 Introduction

1.1 Background

The Western Australian Audit of Surgical Mortality (WAASM) is an independent, peer-reviewed audit of the processes of care associated with surgery-related deaths in Western Australia (WA). Established in 2001 as a voluntary audit, WAASM is funded by the WA Department of Health and has protection under federal legislation. Participation in WAASM became a mandatory requirement of the Royal Australasian College of Surgeons (RACS) in 2010 and, since 2013, has been part of the RACS continuing professional development (CPD) program.

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

1.2 Objectives

The objectives of WAASM are:

1. to audit all surgery-related deaths within the following criteria:
    - The patient was under the care of a surgeon, regardless of whether an operation was performed.
    - The patient was under the care of a physician and subsequently underwent a surgical procedure.

    (Cases outside of these criteria are excluded from the audit. Patients admitted under the care of a surgeon specifically for terminal care are excluded from the full audit process. These cases do not undergo peer review.)
2. to analyse clinical management issues (CMIs) identified by assessors as follows:
    - **Area for consideration,** where the clinician believes an area of care could have been improved or been different but recognises that this may be an area of debate.
    - **Area of concern,** where the clinician believes that an area of care should have been better.
    - **Adverse event,** an unintended injury caused by medical management rather than by the disease process, which is sufficiently serious to lead to prolonged hospitalisation or to temporary or permanent impairment or disability of the patient at the time of discharge, or which contributes to or causes death.

2 Methods

2.1 Structure and governance

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

WAASM is protected by federal legislation. ANZASM receives legislative protection under the Commonwealth Qualified Privilege Scheme, under part VC of the *Health Insurance Act 1973* (gazetted 2 May 2017).

2.2 Audit process

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

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

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

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

2.3 Providing feedback

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

- Feedback on individual cases

  Consultant surgeons are provided with assessor feedback on individual cases. The identities of assessors remain anonymous at all times. WAASM encourages consultant surgeons to complete a 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.

- Case Note Review Booklet

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

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

- Annual Report

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

2.4 Data analysis

WAASM audits all surgery-related deaths occurring in WA hospitals. This 2021 report covers deaths reported to WAASM from **1 January 2016** to **31 December 2020** (census date 12 April 2021).

The full audit process can take 3 months or longer from initial notification of death, so some 2020 cases were still under review as of the census date and outcomes were unavailable for this report. Case numbers in previous reports may differ from those in this report because some cases were completed after the relevant census dates.

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

Data is entered and stored in the bi-national audit system database and analysed using the Statistical Package for Social Sciences (SPSS version 26) and Microsoft Office Excel (2010). Since not all data were completed for some cases (resulting from incomplete SCFs and assessment forms), the total number of cases used in each analysis may vary.

3 Results

Key results for the period 2016 to 2020:

- 2,800 deaths met WAASM criteria
- 13.9% relative decrease in deaths per 100,000 WA population
- 96.4% of SCFs returned
- 78.9% of cases (2,209/2,800) completed the audit process
- 57.2% of patients were males
- 68.5% of patients had one or more operations
- 4.5% of cases were associated with a preoperative diagnostic delay
- 30.4% of patients had a preoperative transfer
- 85.6% of cases had one or more comorbidities present
- 29.4% of cases had a clinically significant infection.

3.1 Surgical deaths reported to WAASM

Between 1 January 2016 and 31 December 2020, there were 2,899 deaths reported to WAASM. Of these, 99 deaths were excluded for not meeting WAASM inclusion criteria. As a result, a total of 2,800 deaths met the inclusion criteria (Table 1).

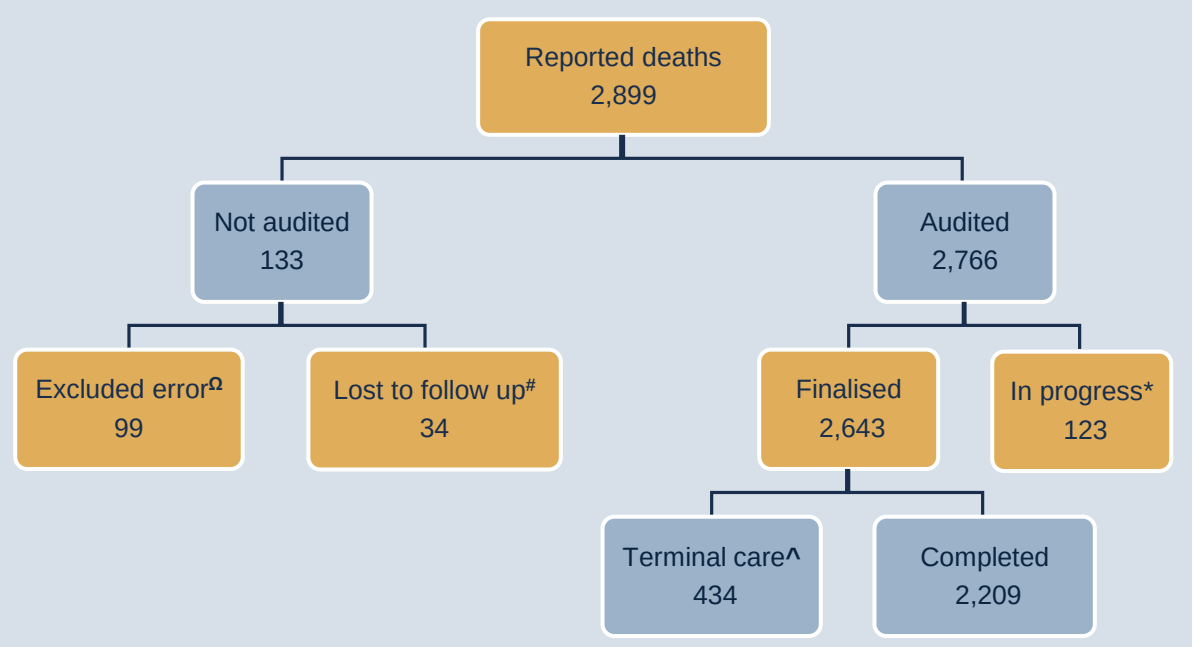
Table 1: Deaths reported to WAASM by year

Year	Number of deaths reported	Deaths not meeting criteria	Deaths meeting criteria
2016	604	13	591
2017	597	27	570
2018	584	29	555
2019	562	10	552
2020	552	20	532
Total	**2,899**	**99**	**2,800**

Note: Number of deaths reported for 2017 and 2018 differ from those reported in WAASM 2020 report, as one hospital reconciled surgical deaths in the second quarter of 2020 and subsequently provided WAASM with this data.
WAASM: Western Australian Audit of Surgical Mortality.
Refer to Appendix D.1 for further information on data.

Figure 1 shows the number of reported deaths that were audited and not audited in the period 2016 to 2020.

Figure 1: Deaths audited by WAASM

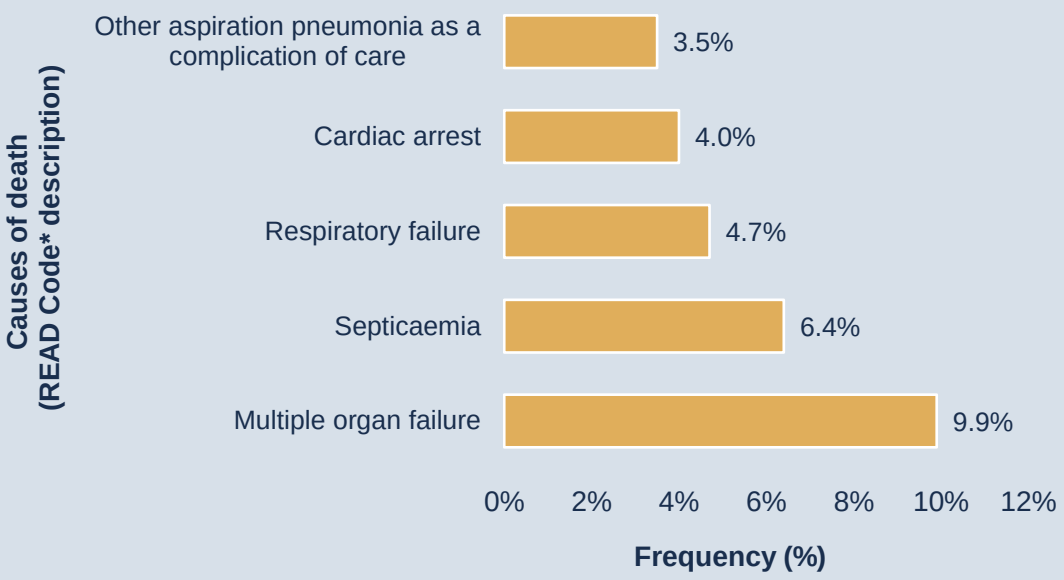


Ω Excluded error: reported deaths not meeting WAASM inclusion criteria.
Lost to follow up: cases remaining incomplete for a period of 2 years or more.
* In progress: cases that have not completed the full audit process.
^ Terminal care: patients admitted specifically for terminal care are excluded from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

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

Some cases have more than one cause of death listed. The most frequently reported causes of death were multiple organ failure (9.9%; 342/3,460) and septicaemia (6.4%; 221/3,460).

Figure 2: Most common causes of death



*READ codes are surgical diagnoses categorised using a coded thesaurus of clinical terms (READ codes). READ codes (a precursor to ICD9 coding) form a clinical decision tree containing terms, synonyms and abbreviations covering all aspects of patient care.
Note: Some 2020 cases still undergoing review so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

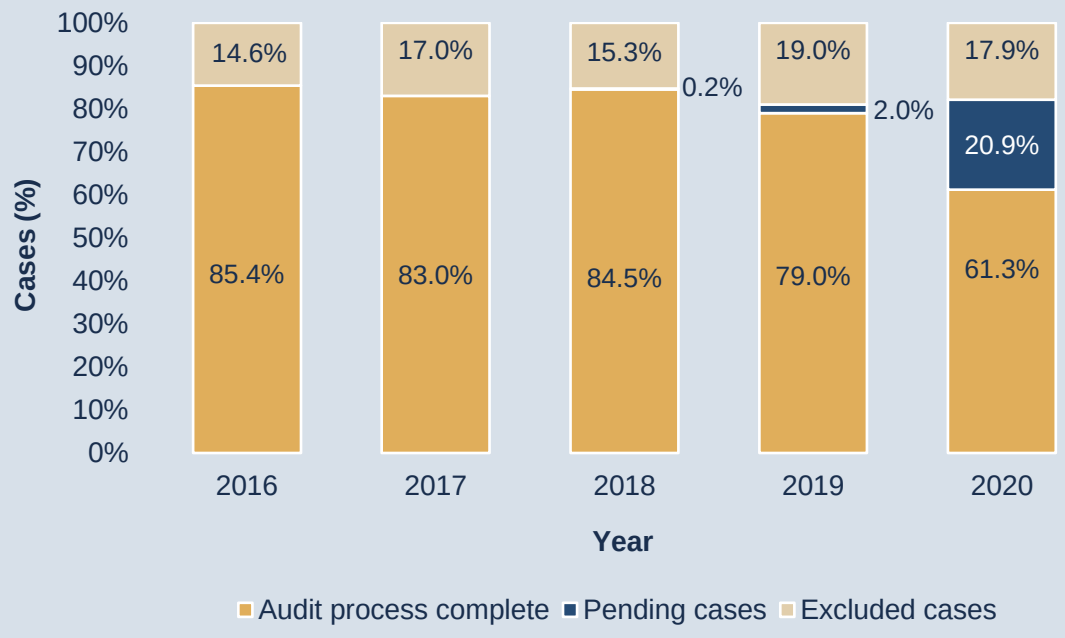
As of 12 April 2021, 78.9% of cases (2,209/2,800) had completed the audit process and 4.4% (123/2,800) were in progress, with 2020 cases constituting a large proportion of that number (4.0%; 111/2,800).

Patients admitted specifically for terminal care (15.5%; 434/2,800) are excluded from the full audit process. The proportion of reported terminal care cases is on the rise (13.7%, 2016; 14.9%, 2017; 13.2%, 2018; 18.1%, 2019; and 17.9%, 2020).

Cases not received by WAASM within 2 years are defined as 'lost to follow up'. For the years 2016, 2017, 2018 and 2019, these accounted for 0.8% (5/591), 2.1% (12/570), 2.2% (12/555) and 0.9% (5/552) of cases, respectively. The total proportion of cases deemed 'lost to follow up' over this 4-year period was 1.5% (34/2,268).

Overall, a total of 16.7% of cases (468/2,800) were excluded from the audit due to being terminal care admissions or those 'lost to follow up' (Figure 3).

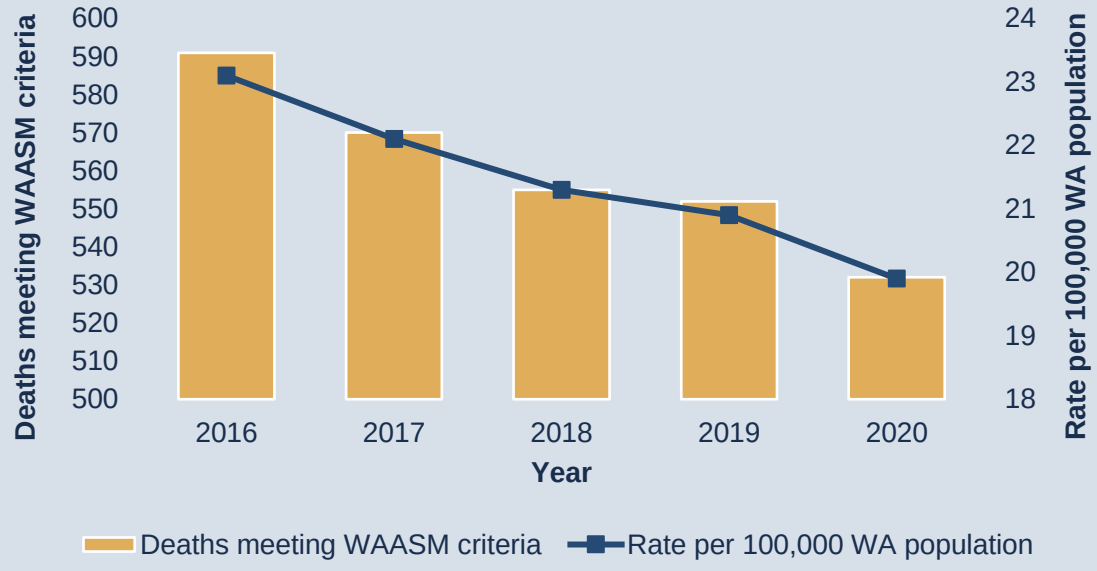
Figure 3: Case status by year



Note: Some 2020 cases still undergoing review so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

WAASM recorded an overall relative decrease of 13.9% (from 23.1% in 2016 to 19.9% in 2020) in the rate of deaths under the care of a consultant surgeon per 100,000 WA population (Figure 4).[(1)]

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



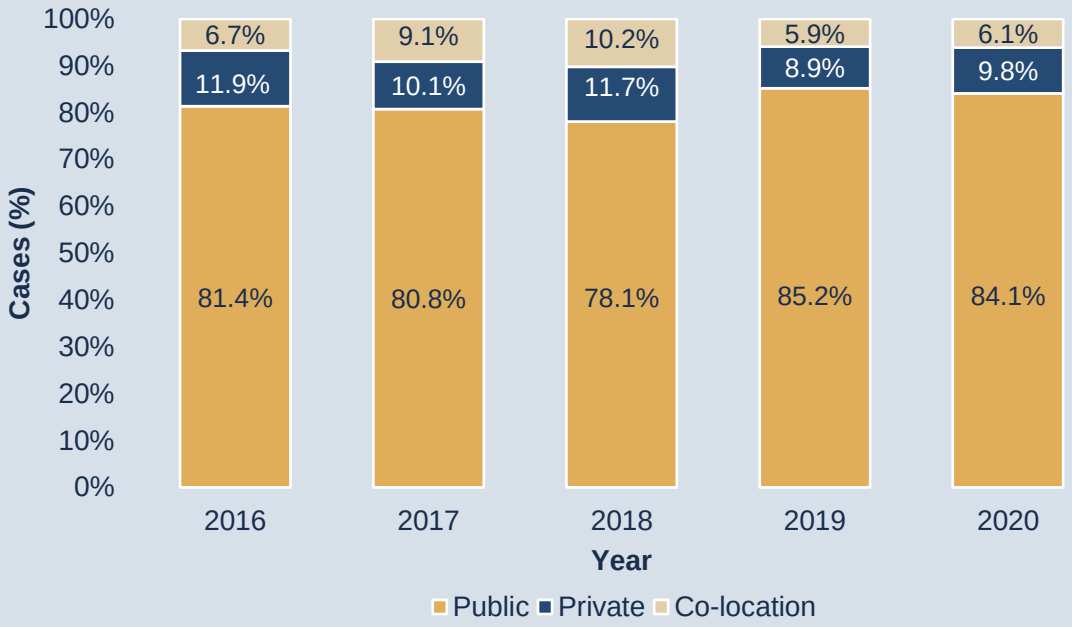
Note: Some 2020 cases still undergoing review so case data unavailable for this report.
WAASM: Western Australian Audit of Surgical Mortality, WA: Western Australia.
Refer to Appendix D.2 for further information on data.

3.2 Hospital participation

All hospitals in WA where surgery is performed currently participate in the audit. Between 2016 and 2020, there were 26 hospitals (of 52) associated with the 2,800 deaths meeting WAASM criteria.

Between 2016 and 2020, public hospitals accounted for more than three-quarters of admissions (81.8%; 1,853/2,266), with private and co-location hospitals accounting for 10.5% (239/2,266) and 7.7% (174/2,266) of admissions, respectively (Figure 5). (Co-location hospitals are those that provide both privately and publicly funded surgical services. Data for co-location hospitals includes public and private patients).

Figure 5: Deaths by hospital status by year



Note: Some 2020 cases still undergoing review so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.3 Surgeon participation

The return rate for SCFs, including terminal care cases, was 96.4% (2,700/2,800).

Table 2 shows WAASM deaths for each surgical specialty in the period 2016 to 2020. General Surgery reported the most deaths at 42.6% (1,193/2,800), followed by Neurosurgery at 17.1% (478/2,800) and Orthopaedic Surgery at 16.5% (462/2,800).

Table 2: WAASM deaths by surgical specialty

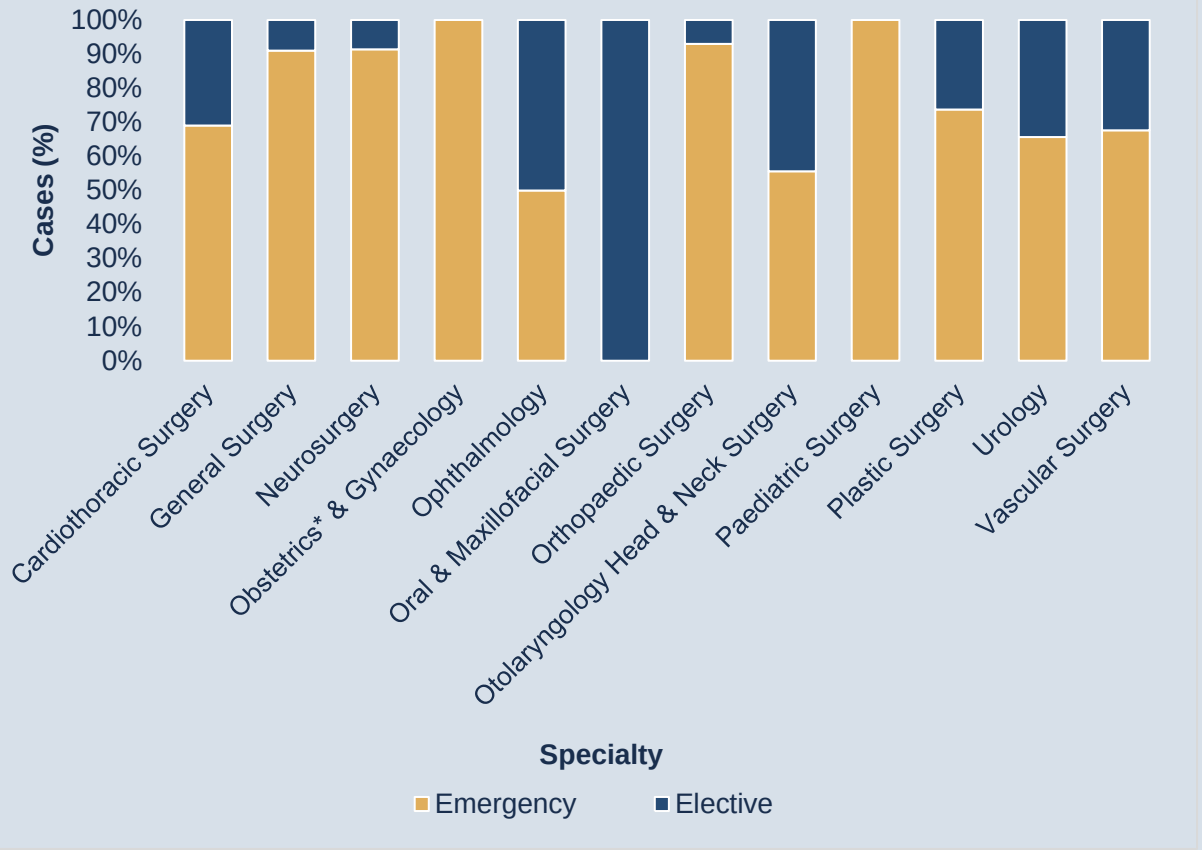
Surgical specialty	Number of deaths	Percentage (%)
General Surgery	1,193	42.6
Neurosurgery	478	17.1
Orthopaedic Surgery	462	16.5
Cardiothoracic Surgery	212	7.6
Vascular Surgery	211	7.5
Urology	111	4.0
Plastic Surgery	59	2.1
Otolaryngology Head & Neck Surgery	39	1.4
Paediatric Surgery	15	0.5
Obstetrics* & Gynaecology	13	0.5
Ophthalmology	6	0.2
Oral & Maxillofacial Surgery	1	0.04

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

Emergency admissions accounted for 85.7% of hospital admissions (1,934/2,256); elective admissions accounted for 14.3% (322/2,256) in the period 2016 to 2020.

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

Figure 6: Deaths by surgical specialty and hospital admission



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

3.4 Age and gender distribution

The median age at death for all patients and the age breakdown by gender are presented in Table 3. Males accounted for 57.2% (1,602/2,800) and females 42.8% (1,198/2,800) of all deaths.

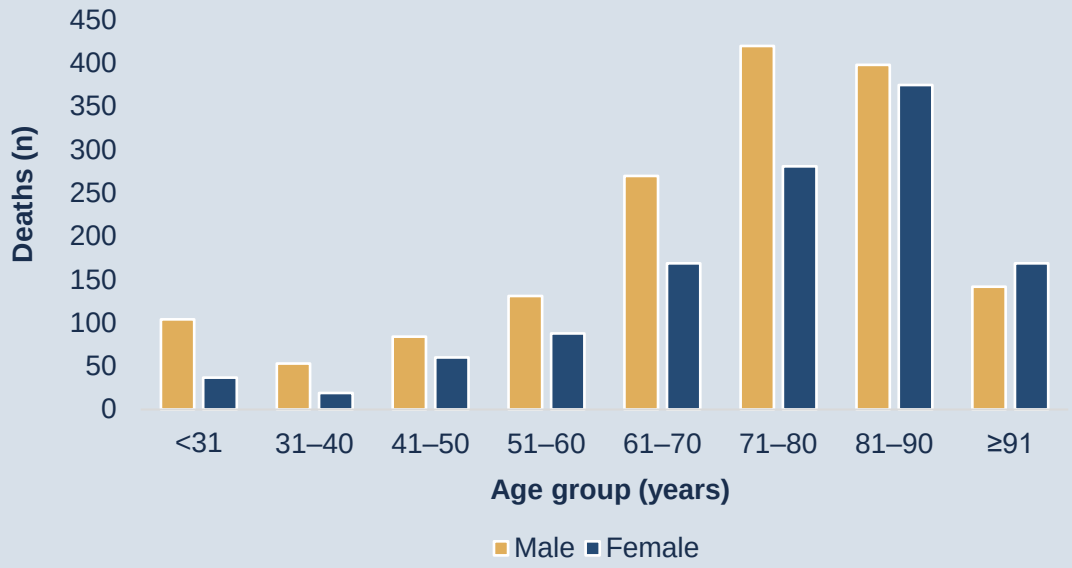
Table 3: Median age by gender

Gender	Number of cases	Median age (years)	Interquartile range (years)
All patients	2,800	76	64–85
Males	1,602	75	62–84
Females	1,198	79	67–87

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

The distribution of deaths by age group and gender is displayed in Figure 7. Males represented a greater proportion of deaths than females in those patients age 90 years or younger. This trend reversed in patients age 91 years and older, where females represented the larger proportion of deaths. While a rise in the number of deaths is noted after the age of 50 years, 52.6% of deaths (1,474/2,800) occurred in patients age 71–90 years. The decrease in deaths after the age of 90 years (11.1%; 311/2,800) is possibly attributed to the smaller population in this age group.

Figure 7: Deaths by age group and gender

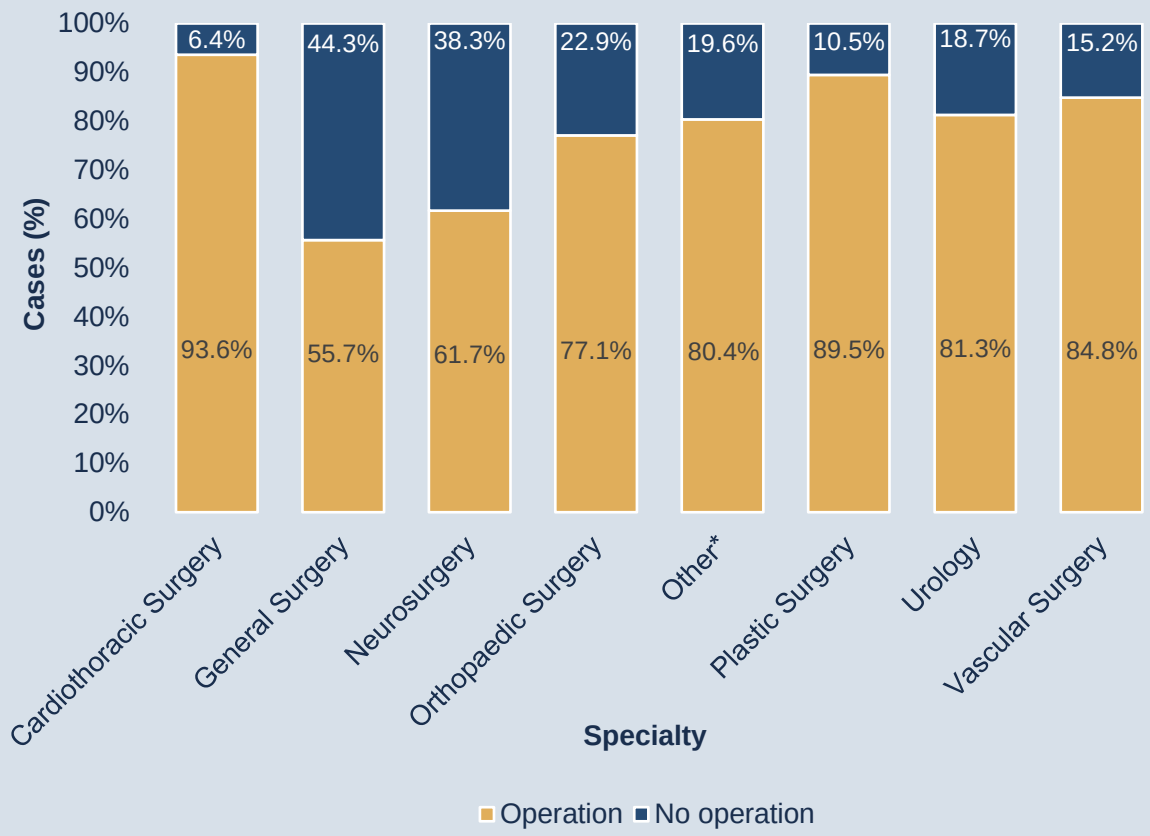


Refer to Appendix D.2 for further information on data.

3.5 Operative and nonoperative cases

In the period 2016 to 2020, most patients (68.5%; 1,550/2,264) underwent one operation or more. Figure 8 shows that Cardiothoracic Surgery reported the highest operation rate (93.6%; 176/188) while General Surgery had the lowest operation rate (55.7%; 496/890).

Figure 8: Operative and nonoperative cases by specialty

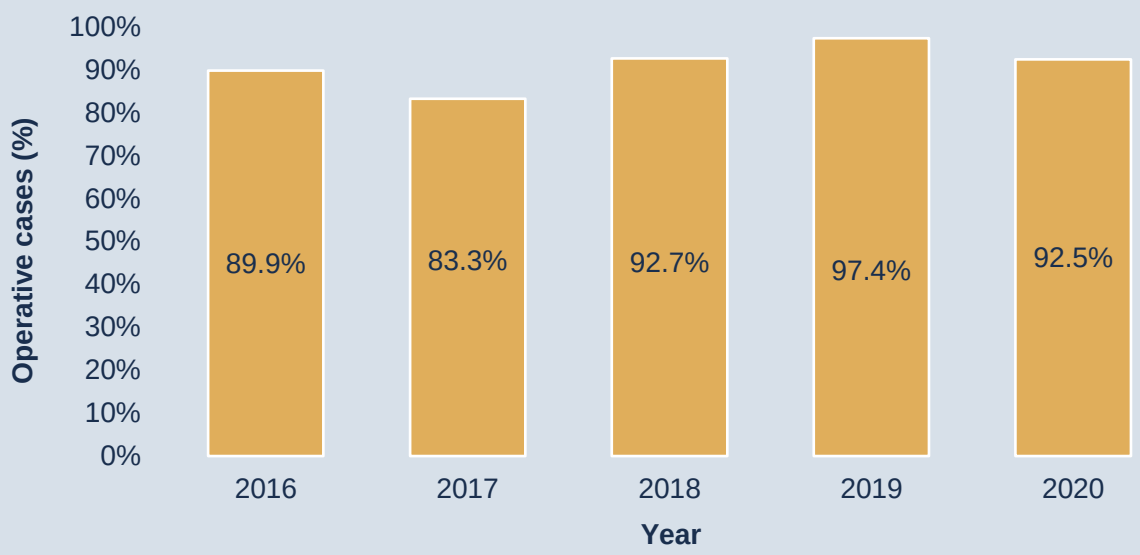


*Other includes Otolaryngology, Head & Neck Surgery, Ophthalmology, Paediatric Surgery, Obstetrics[#] & Gynaecology and Oral/Maxillofacial Surgery.
[#]Obstetric cases are not included in the audit process; only gynaecological cases are audited.
Refer to Appendix D.2 for further information on data.

The proportion of emergency and elective admissions involving an operation remained relatively steady in the period 2016 to 2020, with 80.3% of patients (1,238/1,542) admitted as an emergency.

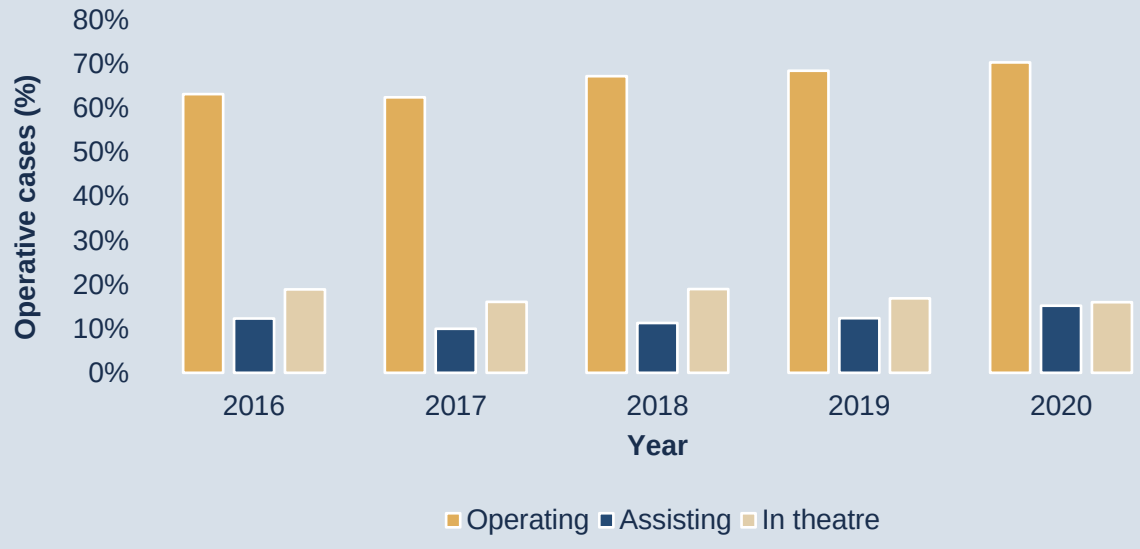
Overall, 2,119 operations were performed on 1,550 patients between 2016 and 2020. The SCF asks consultant surgeons to indicate their involvement in operations. In 90.8% of reported operations (1,925/2,119), a consultant surgeon made the decision to proceed to surgery (Figure 9). A consultant surgeon performed the surgery in 66.1% of operations (1,401/2,119) (Figure 10).

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



Note: Some 2020 cases still undergoing review so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

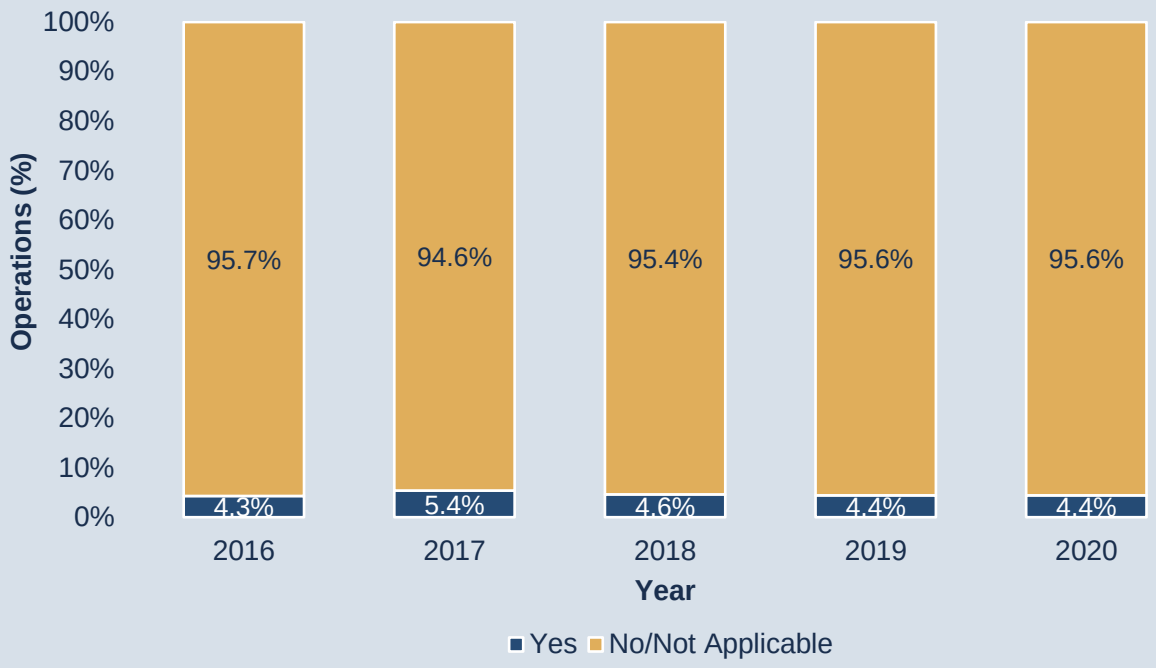
Figure 10: Consultant surgeon involvement in operations, by year



Note: Some 2020 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 4.6% of operations (94/2,029) (Figure 11).

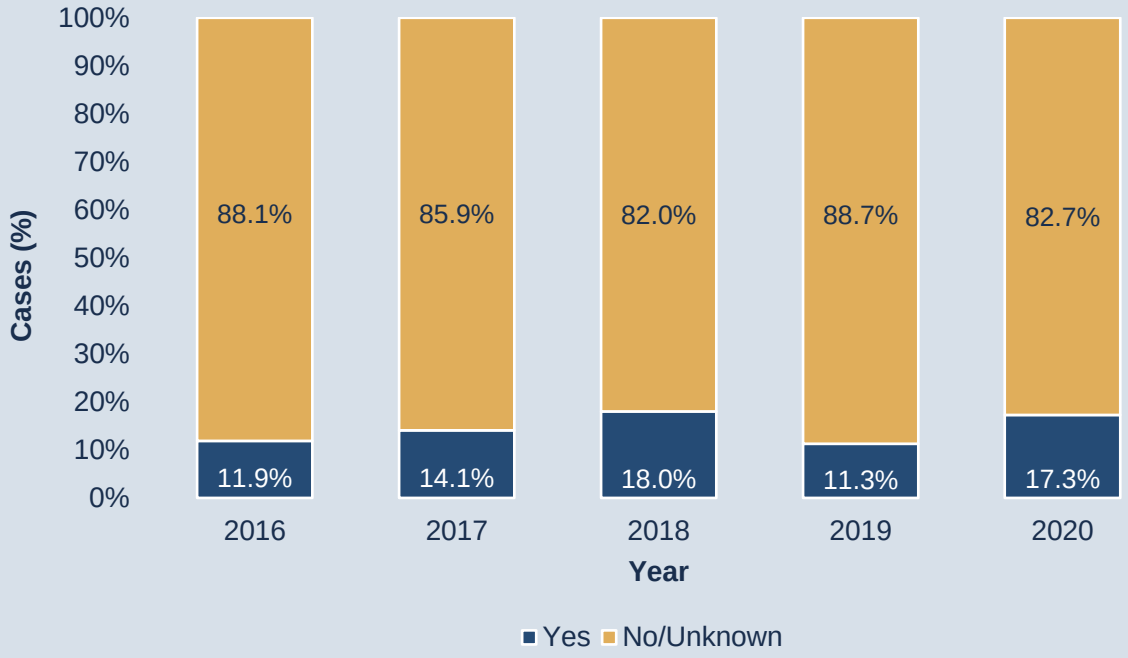
Figure 11: Operations abandoned on finding a terminal situation, by year



Note: Some 2020 cases still undergoing review so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

Consultant surgeons are asked to report on any unplanned returns to the operating theatre after an initial operation (Figure 12). Unplanned return to the operating theatre may indicate a complication from the previous operation. In the period 2016 to 2020, 14.4% of operative cases (223/1,547) had an unplanned return to the operating theatre. This rate has fluctuated between 11.3% (2019) and 18.0% (2018).

Figure 12: Unplanned return to operating theatre, by year

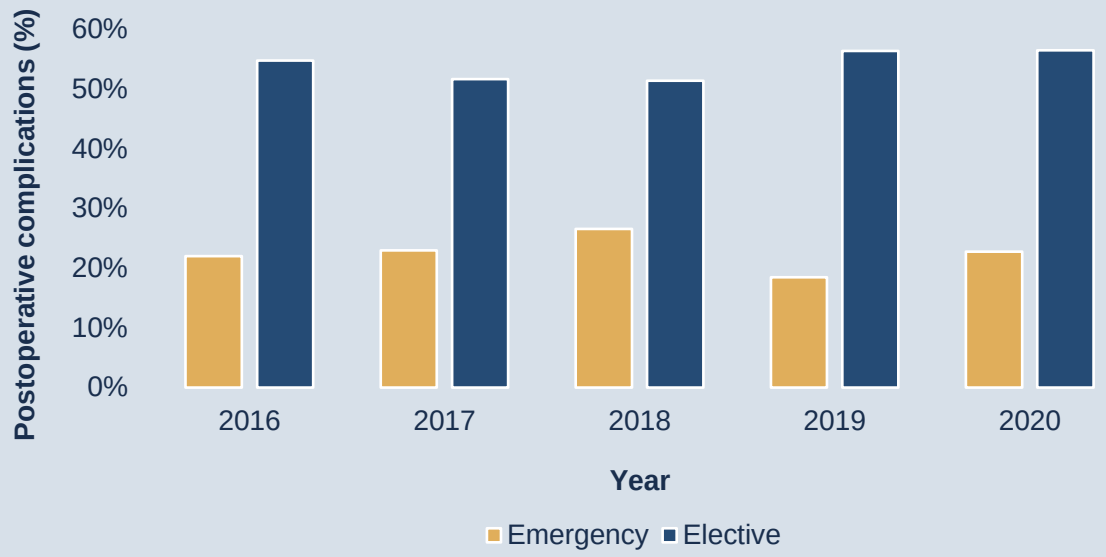


Refer to Appendix D.2 for further information on data.

Postoperative complications may occur, and these have been shown to be a major contributor to surgical outcome.[2] Consultant surgeons reported a postoperative complication in 28.8% of operative patients (445/1,544) between 2016 and 2020. There was a total of 547 postoperative complications amongst 445 operative patients. (Patients may have more than one postoperative complication listed.) The most frequently reported postoperative complications amongst these operative patients were postoperative bleeding (13.9%; 62/445), tissue ischaemia (12.1%; 54/445) and sepsis (9.2%; 41/445).

Figure 13 shows the distribution of postoperative complications by hospital admission and year. A higher proportion of elective patients (53.9%; 164/304) had a postoperative complication compared to emergency patients (22.6%; 280/1,238) between 2016 and 2020.

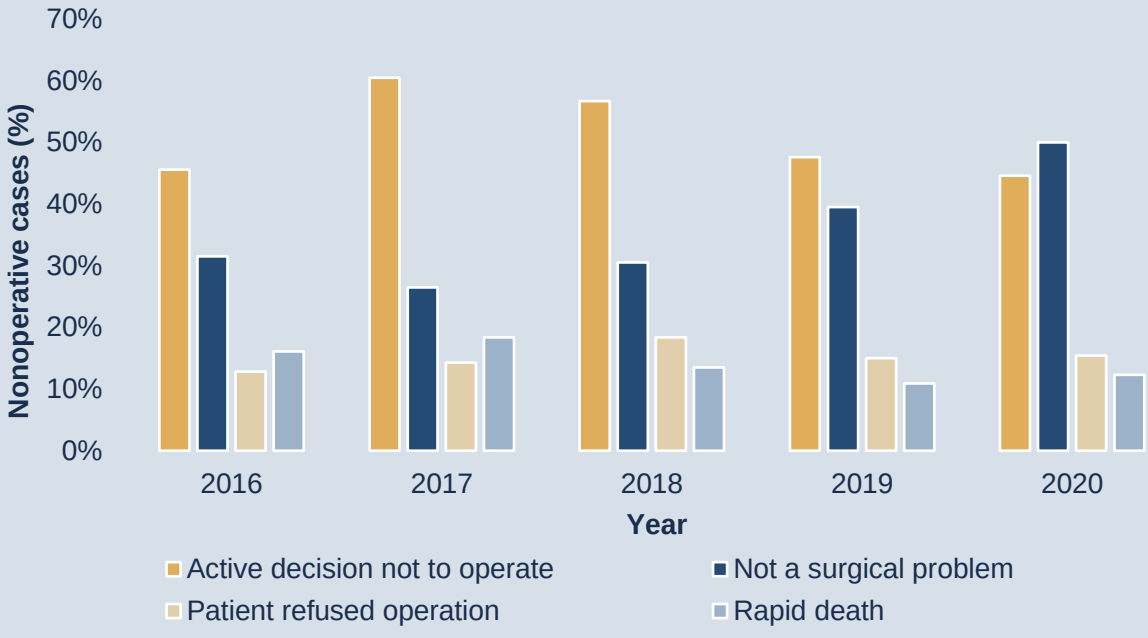
Figure 13: Postoperative complications by hospital admission and year



Note: Some 2020 cases still undergoing review so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

Not all patients underwent surgery (31.5%; 714/2,264). For some patients, consultant surgeons considered that an operation was not the best treatment option. Figure 14 illustrates some reasons why patients did not undergo an operation. Some cases reported more than one reason for not operating. Most nonoperative cases were emergency admissions (97.6%; 695/712).

Figure 14: Reasons for not operating, by year



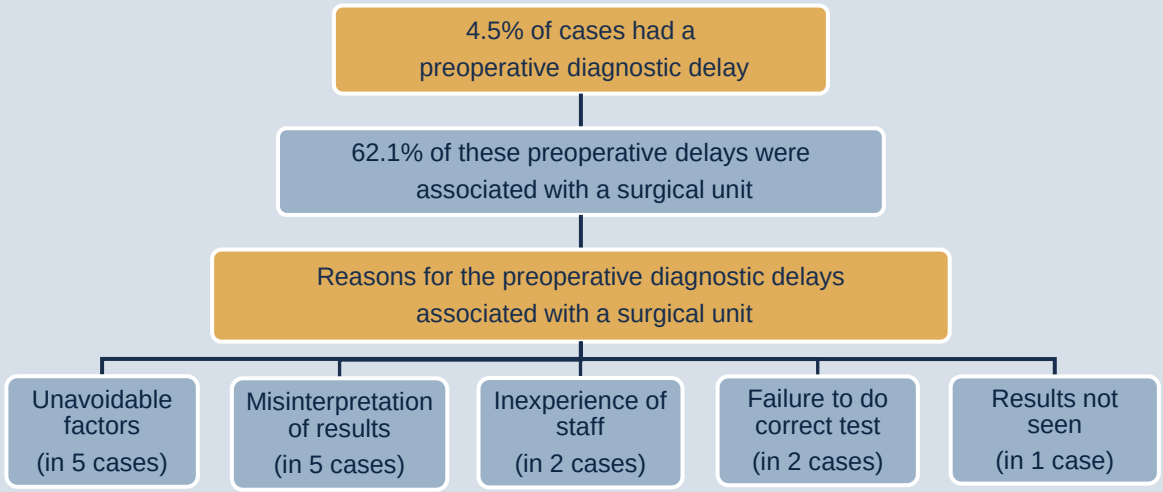
Note: Some 2020 cases still undergoing review so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.6 Preoperative diagnostic delays

Consultant surgeons are asked to indicate if there was a preoperative diagnostic delay in confirming the main surgical diagnosis (Figure 15).

In the period 2016 to 2020, a preoperative delay in diagnosis was recorded by the consultant surgeon in 4.5% of cases (101/2,261). Of these delays, 62.1% (18/29, missing data = 72) were associated with the surgical unit. The 2 most common reasons stated for preoperative diagnostic delays associated with a surgical unit were ‘unavoidable factors’ and ‘misinterpretation of results’, each reported in 5 cases.

Figure 15: Cases with preoperative diagnostic delays

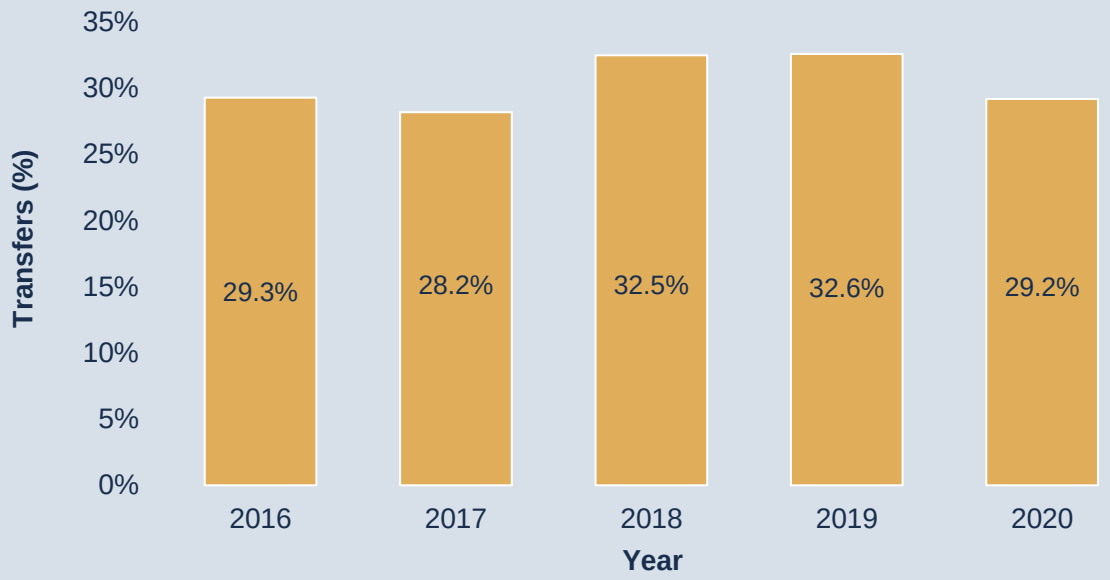


Refer to Appendix D.2 for further information on data.

3.7 Hospital transfers

Between 2016 and 2020, preoperative hospital transfers occurred for 30.4% of patients (676/2,225). Emergency admissions accounted for 97.5% (657/674) of this group.

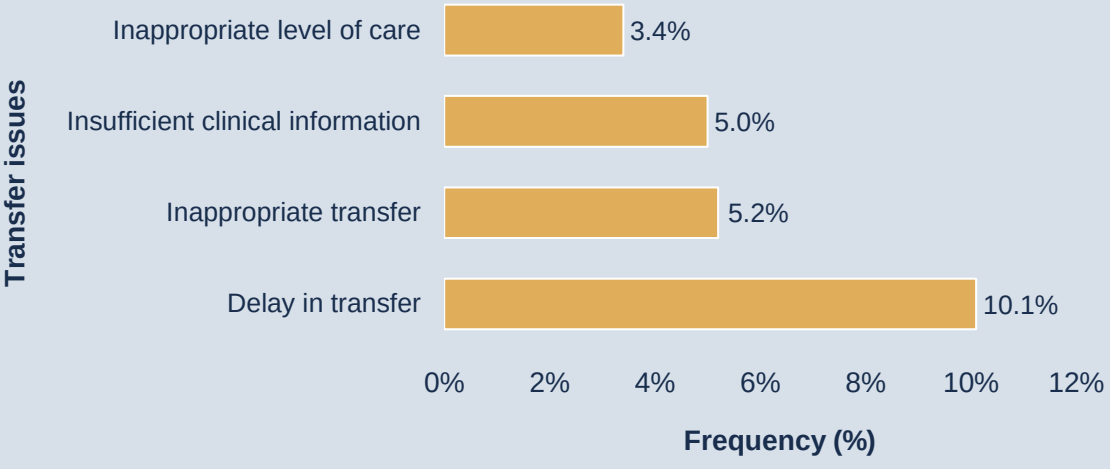
Figure 16: Hospital transfers by year



Note: Some 2020 cases still undergoing review so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

In the period 2016 to 2020, most preoperative transfers occurred without incident. However, when transfer issues arose, there was a range of concerns reported (Figure 17). The most frequently reported transfer issue was 'delay in transfer' (10.1%; 66/651).

Figure 17: Hospital transfer issues



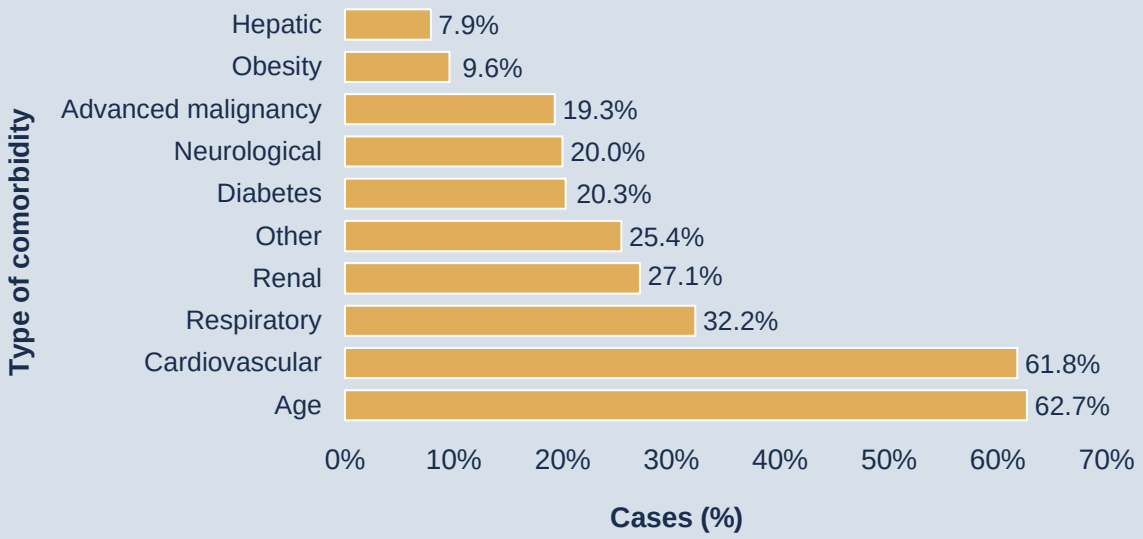
Refer to Appendix D.2 for further information on data.

3.8 Comorbidities

Consultant surgeons are asked to identify any associated significant factors (comorbidities) that may increase a patient's risk of death. The majority of patients (85.6%; 1,939/2,264) had at least one

comorbidity, with more than one comorbidity noted in some instances. As shown in Figure 18, the 2 most commonly reported comorbidities amongst these patients were age (62.7%; 1,215//1,939) and cardiovascular disease (61.8%; 1,198/1,939).

Figure 18: Cases with specific comorbidities

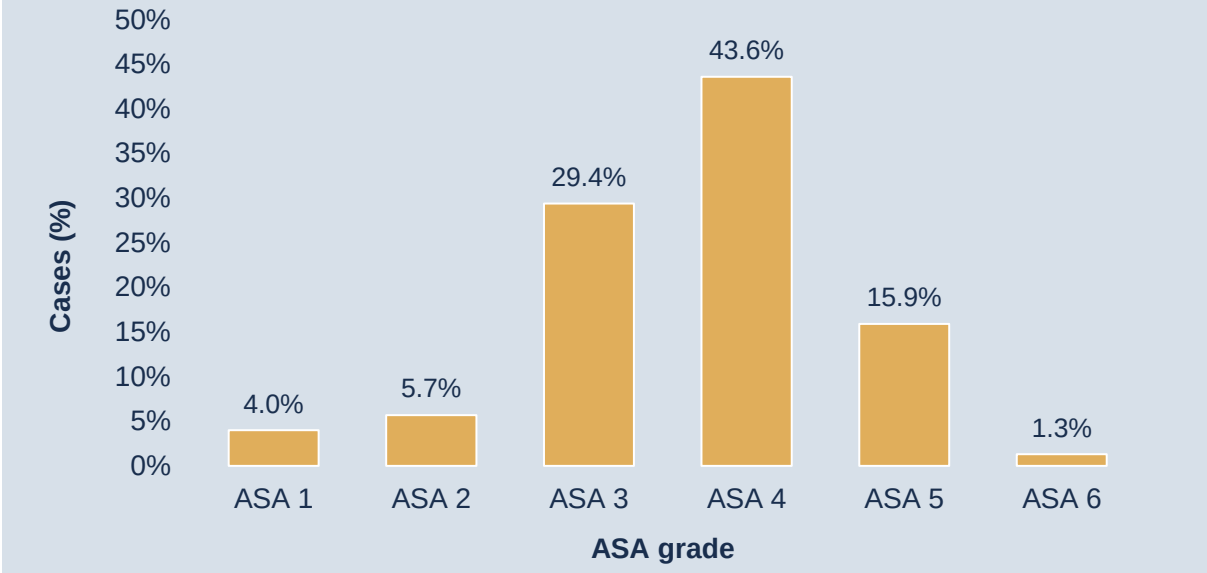


Note: 'Other' includes comorbidities other than those listed on the surgical case form, which may include the presence of other chronic illnesses, haematological or drug-related conditions, vasculopathy, hypertension, dementia, malnutrition, alcoholism and cachexia.
Refer to Appendix D.2 for further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

Patients are assigned grades according to the American Society of Anesthesiologists (ASA) grading system, which is an internationally recognised measure of a patient's physical status.[3] (ASA grade definitions are listed in Appendix D.3) When combined with factors such as a patient's age, frailty, degree of deconditioning, comorbidities, medications, and type and duration of surgery, the ASA grade can assist in predicting a patient's perioperative risk – a higher ASA grade indicates an increased risk of perioperative complications.[3,4,5]

As presented in Figure 19, patients were most commonly assigned ASA grade 4, defined as a patient with severe systemic disease that is a constant threat to life (43.6%; 862/1,975). ASA grade 3, defined as a patient with moderate systemic disease, was the second most frequently assigned (29.4%; 581/1,975).

Figure 19: Frequency of ASA grades

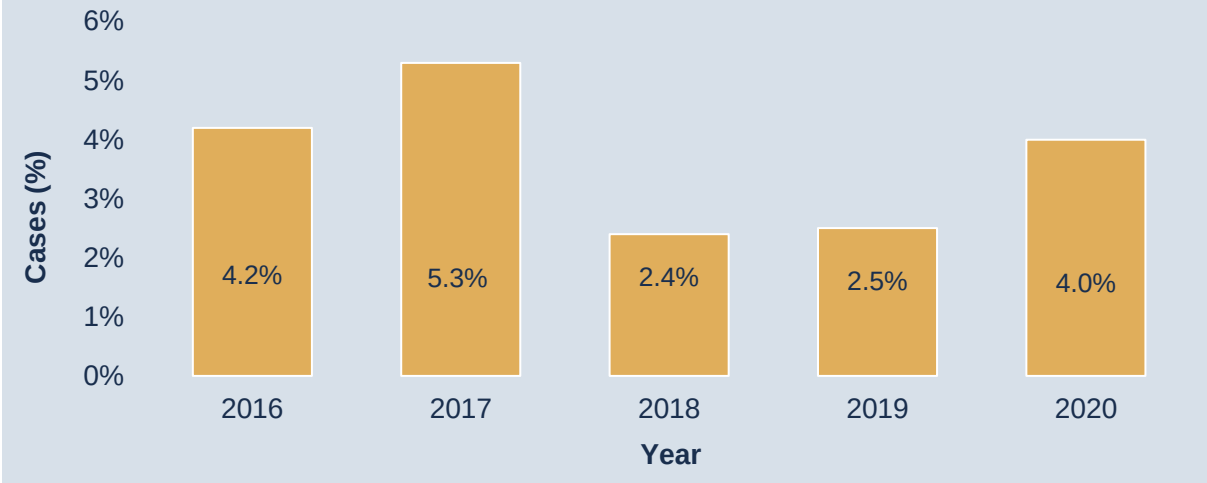


ASA: American Society of Anesthesiologists.
Refer to Appendix D.3 for definitions of ASA grades.
Refer to Appendix D.2 for further information on data.

3.9 Fluid balance

Consultant surgeons indicated that there was an issue with fluid balance in 3.7% of cases (83/2,250) between 2016 and 2020. Figure 20 shows the frequency of these cases by year.

Figure 20: Cases with fluid balance issues by year



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

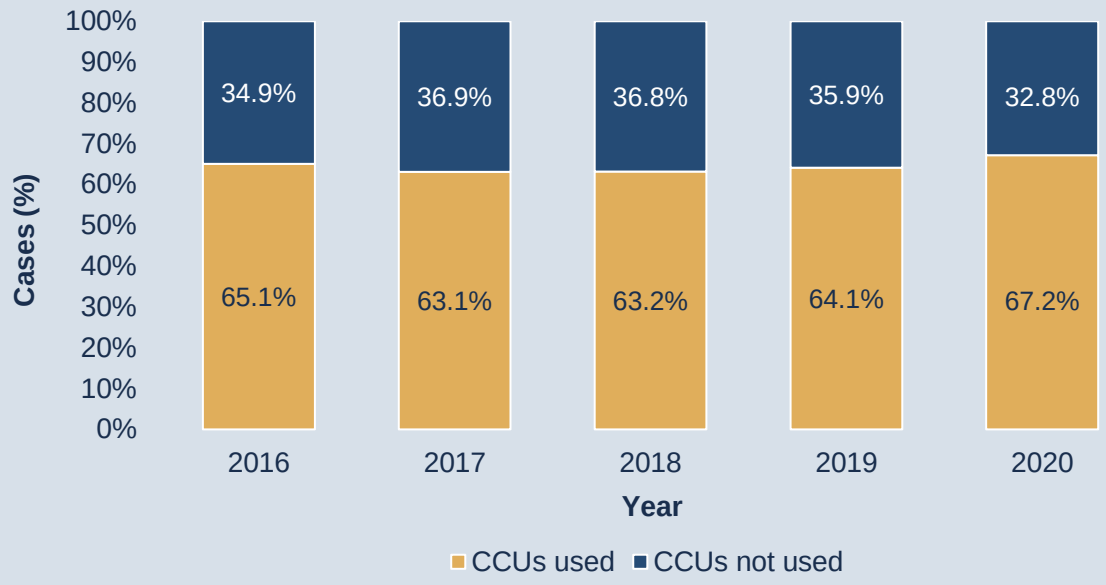
Emergency admissions and elective admissions accounted for 80.5% (66/82) and 19.5% (16/82) of cases with fluid balance issues, respectively. Operative cases (4.3%; 66/1,539) had more fluid balance issues than did nonoperative cases (2.4%; 17/710).

3.10 Critical care units

The use of critical care units (CCUs), encompassing intensive care units (ICUs) or high dependency units (HDUs), is reported by consultant surgeons. Between 2016 and 2020, CCUs were utilised in 64.5% of cases (1,456/2,259) (Figure 21).

Emergency admissions and elective admissions accounted for 84.3% (1,223/1,451) and 15.7% (228/1,451) of CCU use, respectively.

Figure 21: Critical care unit use by year

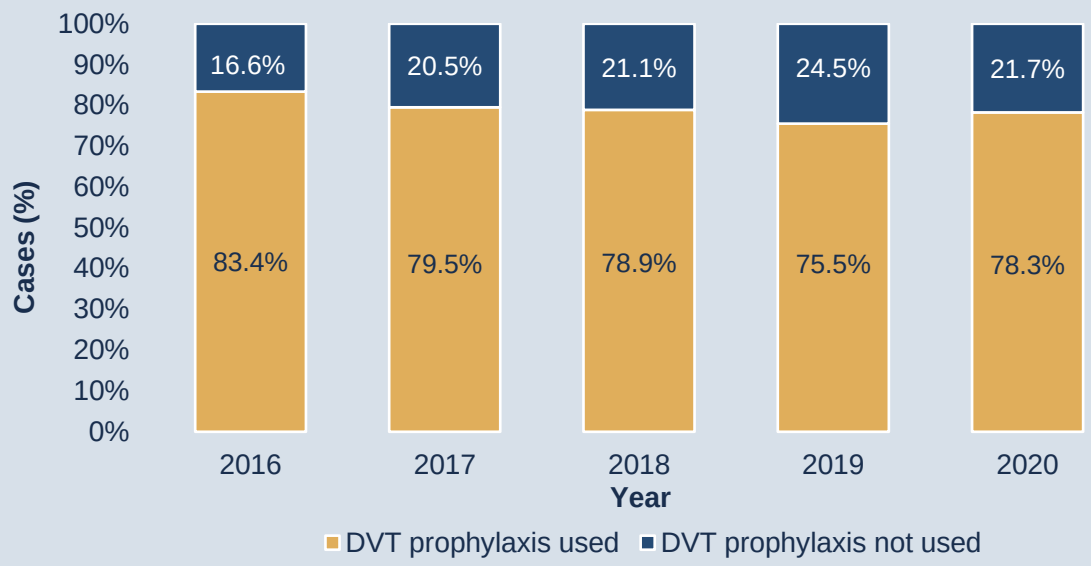


Note: Some 2020 cases still undergoing review so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

3.11 Deep vein thrombosis prophylaxis

Consultant surgeons reported the use of deep vein thrombosis (DVT) prophylaxis in 79.3% of cases (1,773/2,237). The use and non-use of DVT prophylaxis by year is presented in Figure 22.

Figure 22: DVT prophylaxis use by year

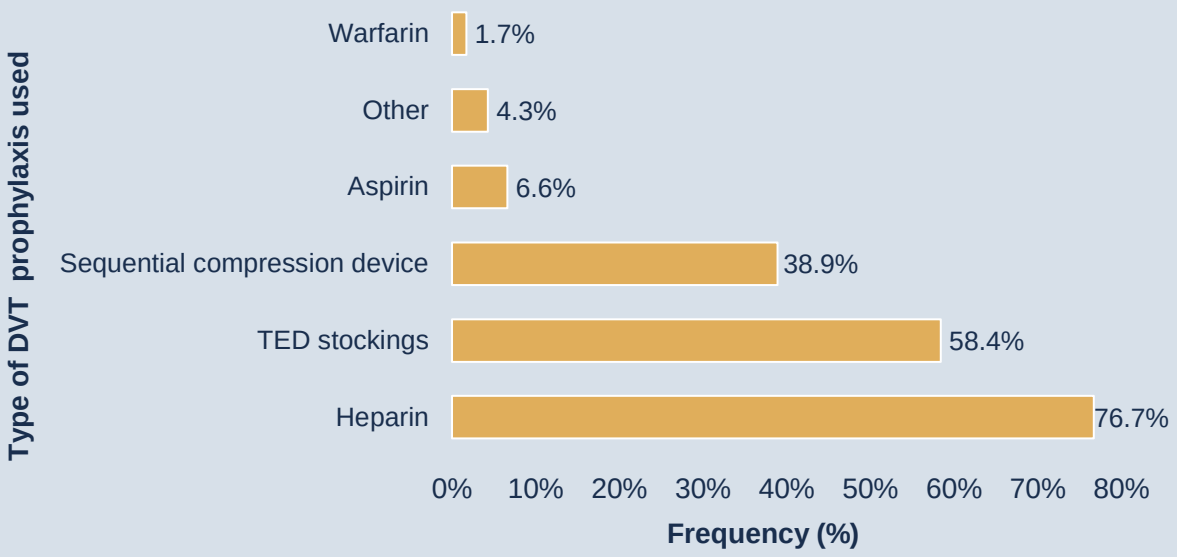


DVT: Deep vein thrombosis
Note: Some 2020 cases still undergoing review so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

Information on the type of DVT prophylaxis used is also requested in the SCF. In many cases, more than one type of DVT prophylaxis was used. Heparin (76.7%; 1,360/1,773) and TED (thromboembolic deterrent) stockings (58.4%; 1,036/1,773) were the most frequently used DVT prophylaxis (Figure 23).

DVT prophylaxis was not used in 20.7% of cases (464/2,237). This was because it was either not appropriate (64.5%; 293/454), there was an active decision to withhold it (33.3%; 151/454), or it was not considered (2.2%, 10/454).

Figure 23: Type of DVT prophylaxis used



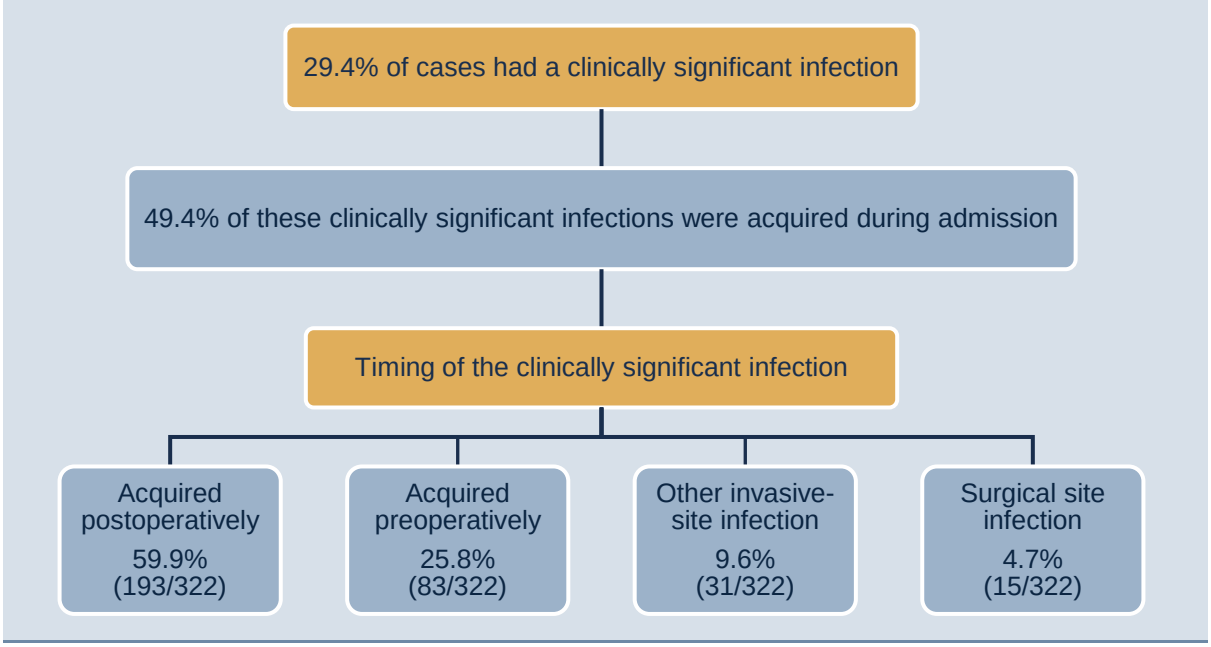
DVT: Deep vein thrombosis, TED: Thromboembolic deterrent.
Note: 'Other' could include enoxaparin sodium, clopidogrel bisulfate, danaparoid sodium, and enoxaparin sodium combined with early mobilisation.
Refer to Appendix D.2 for further information on data.

3.12 Infections

Between 2016 and 2020, 29.4% of patients (663/2,255) died with a clinically significant infection. Figure 24 shows the stage at which these clinically significant infections were acquired.

Consultant surgeons reported that the clinically significant infection was acquired prior to admission in 50.6% of cases (333/658). In 49.4% of cases (325/658) the clinically significant infection was acquired during admission, and of these infections, more than half were acquired postoperatively (59.9%; 193/322).

Figure 24: Clinically significant infections



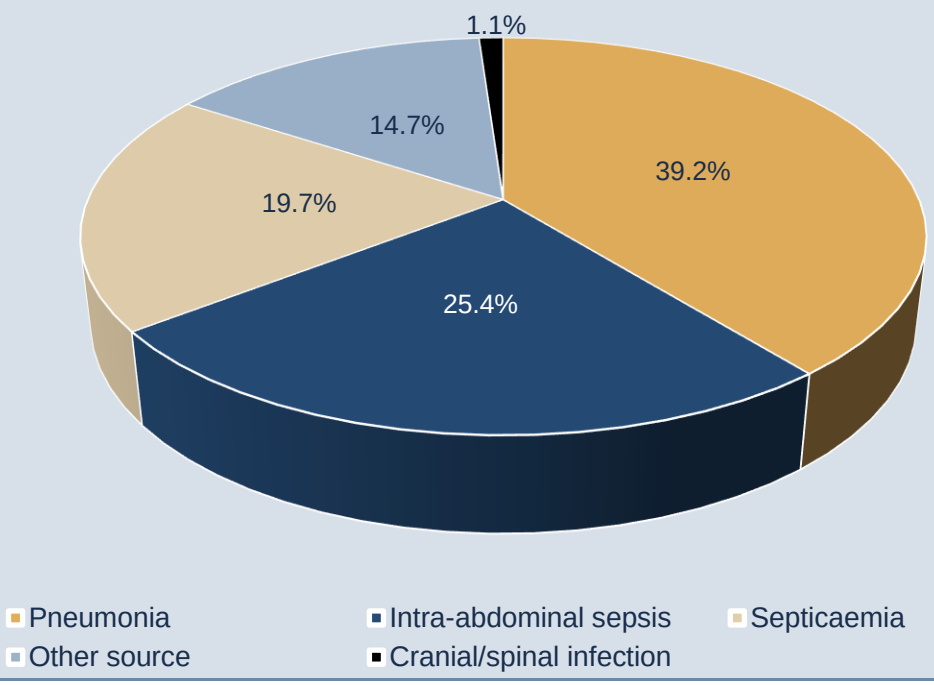
Refer to Appendix D.2 for further information on data.

Figure 25 shows the types of clinically significant infections reported by consultant surgeons prior to or during admission, in the period 2016 to 2020.

Pneumonia was the most common clinically significant infection reported, accounting for 39.2% of cases (259/661). Intra-abdominal sepsis accounted for 25.4% of cases (168/661), followed by septicaemia (19.7%; 130/661). 'Other source' and cranial/spinal infection accounted for 14.7% (97/661) and 1.1% (7/661) of cases, respectively.

Where information was provided, consultant surgeons reported that the antibiotic regime was appropriate in 96.5% of cases of clinically significant infections (633/656). In 3.4% of cases (22/656) the appropriateness of the antibiotic regime was unknown, and in 0.2% (1/656) it was considered inappropriate.

Figure 25: Type of clinically significant infection reported



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

4 Outcomes of peer-review assessment

Key results for the period 2016 to 2020:

- 15.3% of cases were referred for second-line assessment
- 88.0% of cases had appropriate use/non-use of DVT prophylaxis
- 1.4% and 5.1% of cases would have benefitted from ICU/HDU use
- 563 CMIs were identified in 364 cases
- 11.4% (64/563) of CMIs were classified as adverse events
- 62.5% (40/64) of adverse events were deemed to have caused the death of the patient
- 45.0% (18/40) of adverse events that caused the death of a patient were considered definitely preventable.

4.1 Second-line assessment

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

Between 2016 and 2020, the rate of FLA returns was 98.9% (2,242/2,266). Of the 2,242 FLAs returned, 15.3% (343/2,242) were referred for SLA (Table 4).

Table 4: Peer-review assessments by year

Year	FLAs returned	Cases referred for SLA	
		Number	Percentage (%)
2016	505	74	14.7
2017	473	82	17.3
2018	470	76	16.2
2019	439	62	14.1
2020	355	49	13.8
Total	**2,242**	**343**	**15.3**

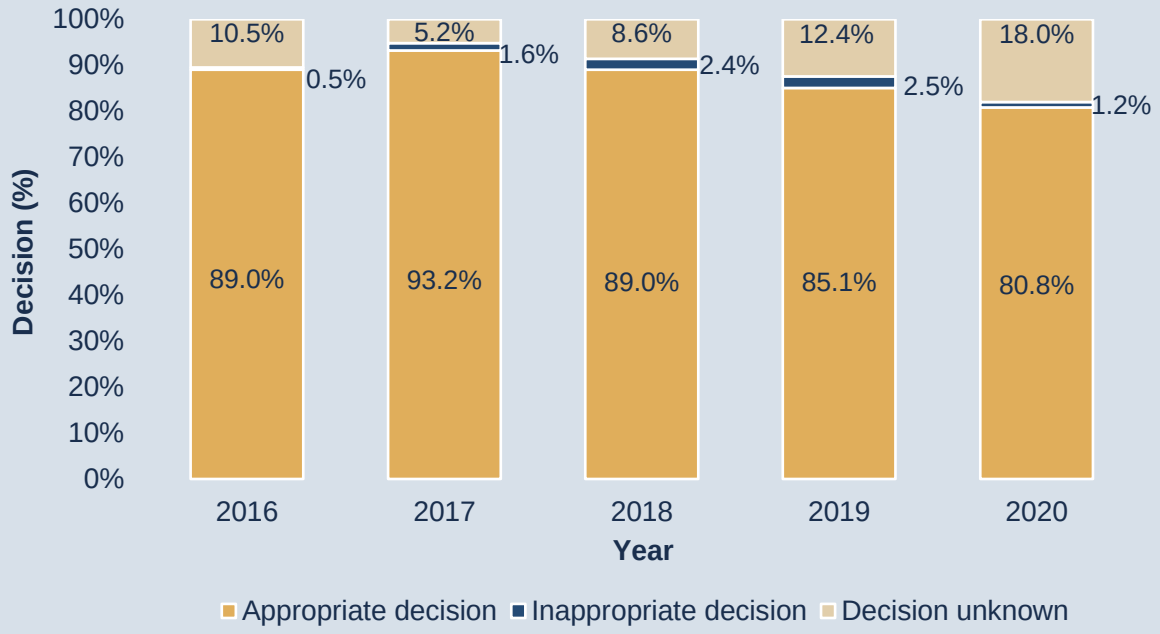
FLA: first-line assessment, SLA: second-line assessment.
Note: Some 2020 cases still undergoing review so case data unavailable for this report.
Refer to Appendix D.1 for further information on data.

4.2 Decision on deep vein thrombosis prophylaxis

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

Between 2016 and 2020, assessors indicated that the decision to use or withhold DVT prophylaxis was appropriate in 88.0% of cases (1,558/1,771). In 1.6% of cases (29/1,771), assessors reported that there had been an inappropriate decision on the use/non-use of DVT prophylaxis. Assessors could not comment on the appropriateness of the DVT prophylaxis decision in 10.4% of cases (184/1,771).

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



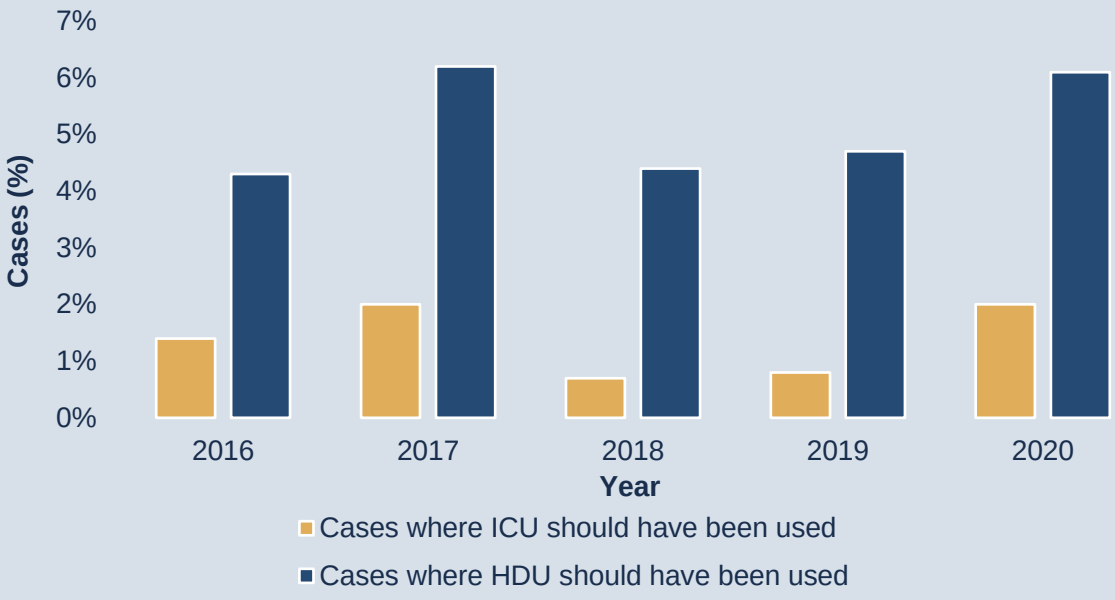
DVT: deep vein thrombosis.
Refer to Appendix D.2 for further information on data.

4.3 Non-use of critical care units

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

Assessors were of the opinion that 1.4% (9/656) and 5.1% (33/650) of patients would have benefitted from the use of ICU and HDU, respectively, between 2016 and 2020.

Figure 27: Assessor opinion on non-use of critical care units, by year



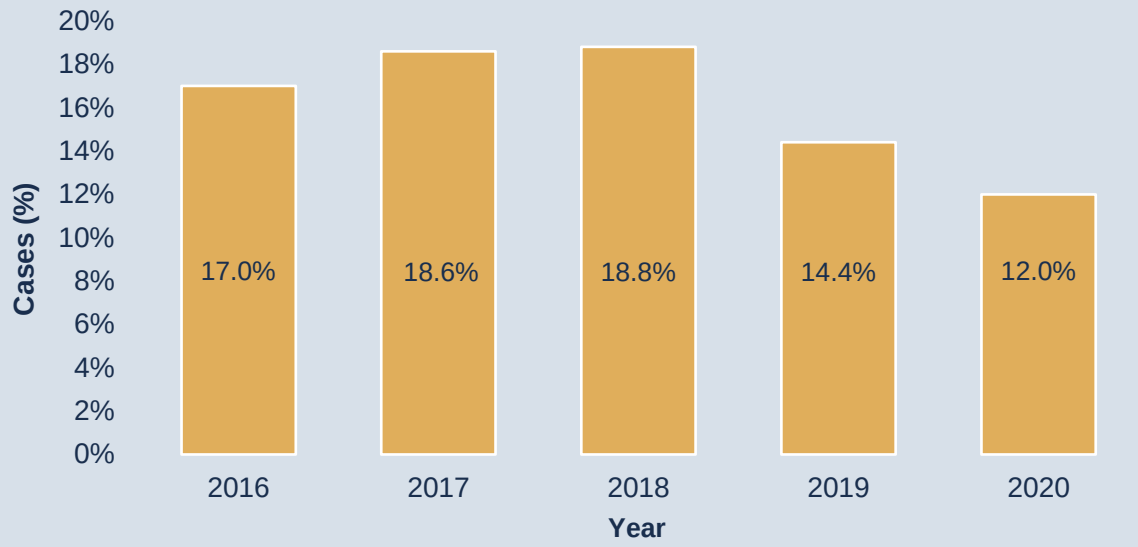
HDU: High dependency unit, ICU: Intensive care unit.
Refer to Appendix D.2 for further information on data.

4.4 Clinical management issues

The peer-review process determines whether a CMI occurred. CMIs are further 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 28. (Where cases underwent both FLA and SLA, the analysis in this section uses data from the SLA. Data from the FLA are used for cases not referred for SLA. Some 2020 cases are still undergoing the review process, meaning this data is incomplete.)

Figure 28: Cases with clinical management issues, by year



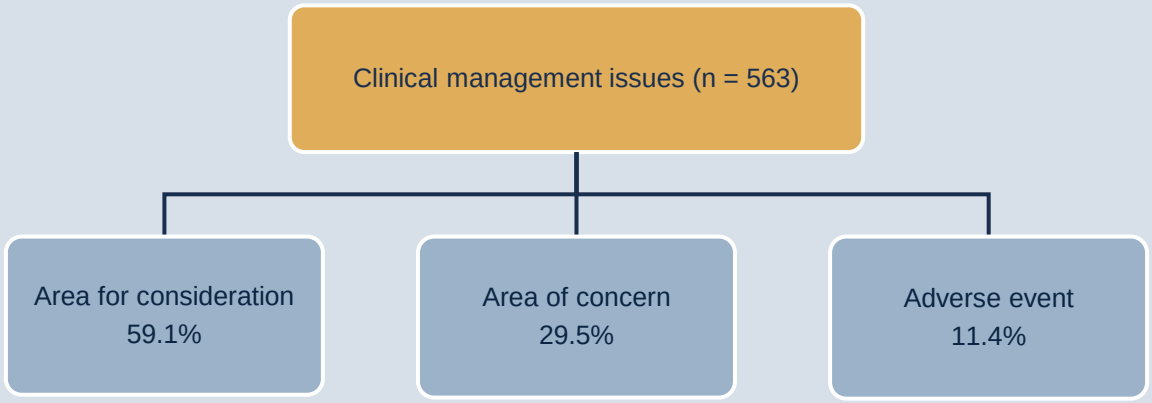
Note: Some 2020 cases still undergoing review so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

One or more CMIs were identified in 16.5% of cases (364/2,209) in the period 2016 to 2020. There were no CMIs identified in 83.5% of cases (1,845/2,209), with death resulting from the disease process alone.

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

Assessors reported 563 CMIs in 364 cases (Figure 29). Between 2016 and 2020 over half (59.1%; 333/563) of the CMIs identified were areas for consideration. Areas of concern and adverse events comprised 29.5% (166/563) and 11.4% (64/563) of CMIs, respectively.

Figure 29: Categories of clinical management issues

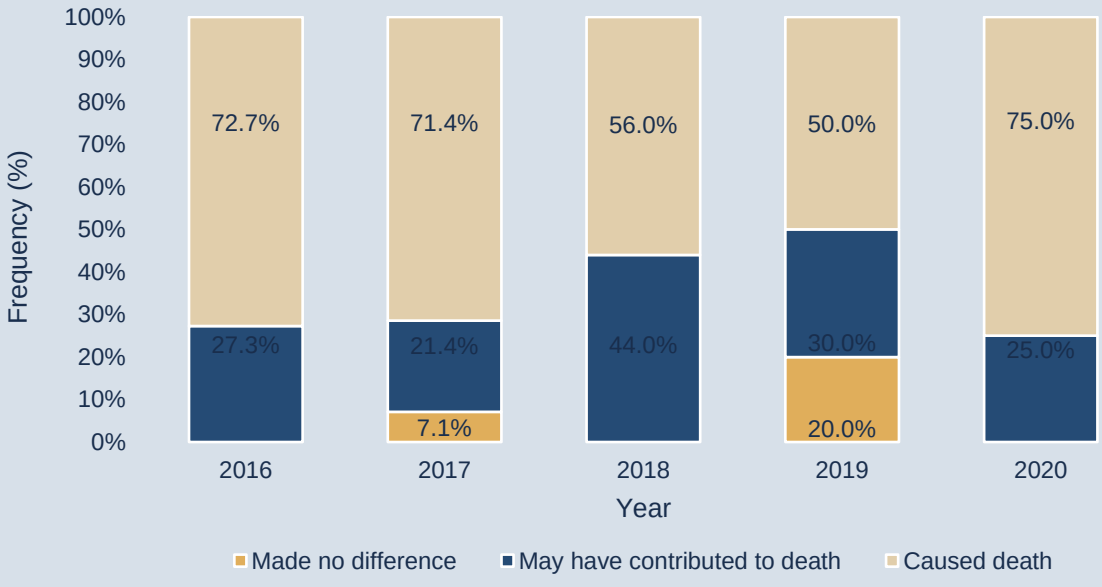


Refer to Appendix D.2 for further information on data.

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

In the period 2016 to 2020, assessors perceived that 32.8% of the reported adverse events (21/64) may have contributed to the death and 62.5% (40/64) caused the death of the patient. For 4.7% of reported adverse events (3/64), assessors perceived that it made no difference to the outcome of the patient. This varied widely by year.

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



Note: Some 2020 cases still undergoing review so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

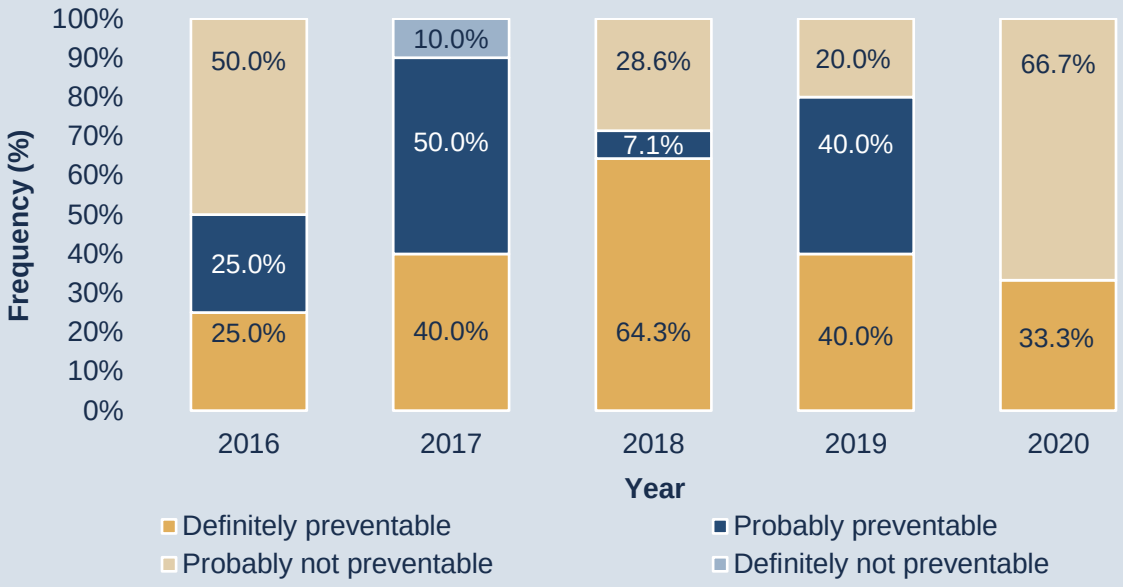
Assessors also report on the preventability of any adverse event that caused the death of a patient (Figure 31).

Assessors indicated that 2.5% of adverse events (1/40) that caused the death of a patient were definitely not preventable. In 27.5% of adverse events (11/40) that caused the death of a patient, assessors stated that the deaths were probably not preventable.

Assessors considered that 25.0% of adverse events (10/40) that resulted in the death of a patient were probably preventable. In 45.0% of adverse events (18/40) that caused the death of a patient, assessors indicated that the deaths were definitely preventable.

In 2020, assessors indicated that an adverse event caused the death of 3 patients. Assessors considered that 2 of these adverse events were probably not preventable; the other was considered definitely preventable.

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

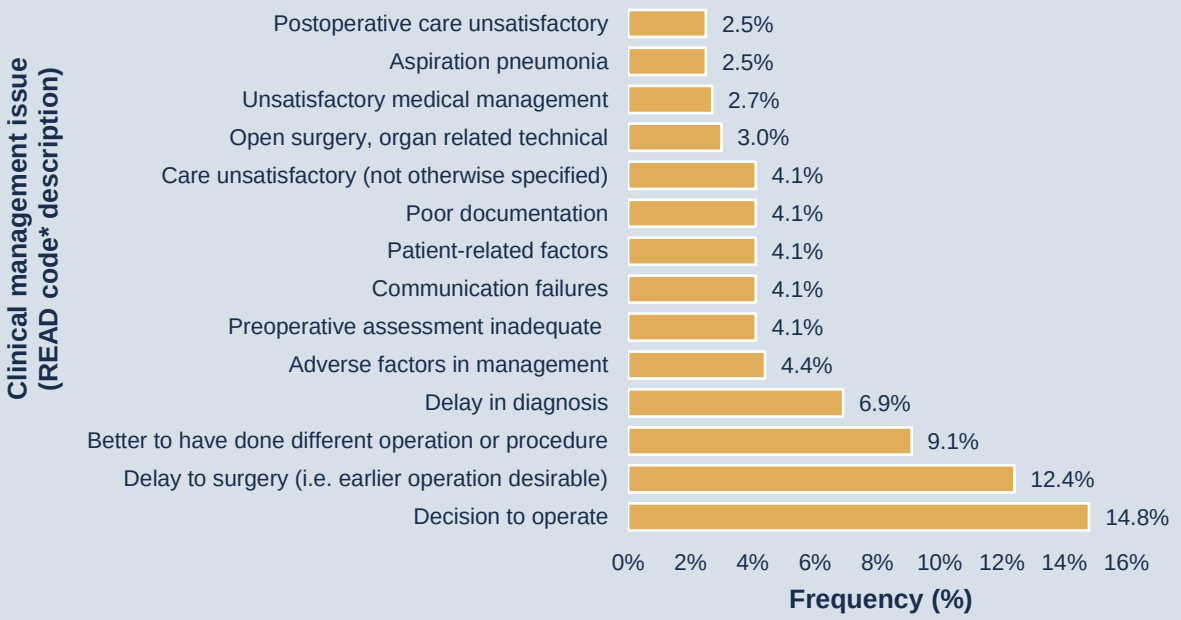


Note: Some 2020 cases still undergoing review so case data unavailable for this report.
Refer to Appendix D.2 for further information on data.

The 14 most common CMIs are shown in Figure 32.

Assessors identified more than one CMI in some patients. Decision to operate (14.8%; 54/364) and delay to surgery (12.4%; 45/364) were the 2 most frequently reported CMIs.

Figure 32: Most frequently reported clinical management issues



*READ codes are surgical diagnoses categorised using a coded thesaurus of clinical terms (READ codes). READ codes (precursor to ICD9 coding) form a clinical decision tree containing terms, synonyms and abbreviations covering all aspects of patient care.
Refer to Appendix D.2 for further information on data.

5 A closer look: impact of COVID-19 on surgical deaths

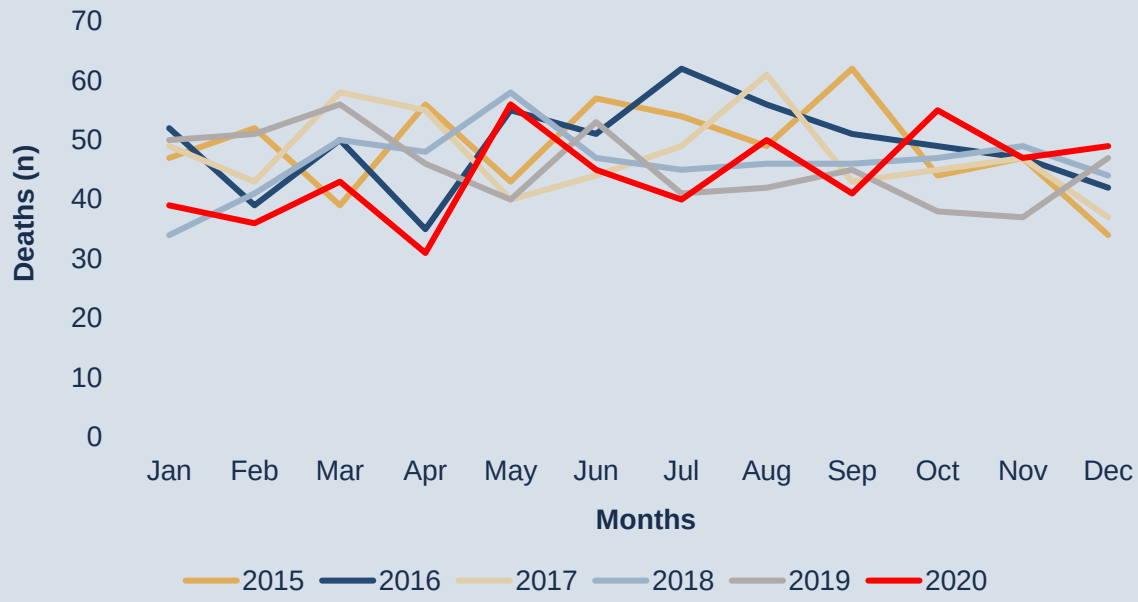
The data in this section considers the impact of COVID-19 in WA. Until other states report their data, it will not be possible to determine if WA is typical of the Australian experience. Additionally, the substantial monthly variation, not only between months in any year but also between the same month in different years, makes interpretation difficult. The long-term surgical impact remains unknown.

At the time of writing this report, WAASM is unaware of any surgery-related deaths in WA directly related to COVID-19 in 2020. Hopefully, this will remain so. The question remains, whether COVID-19 had an indirect impact on deaths under the care of a consultant surgeon.

The annual number of deaths reported to WAASM has continually fallen since 2010, from 25.5 to 19.9 deaths per 100,000 population when corrected for WA's growing population (Figure 4). To interpret the impact of COVID-19, the data are presented on a monthly and quarterly basis (Figures 33 and 34). On initial inspection of the monthly data (Figure 33), it might appear that the fall in April 2020 was secondary to the state-imposed restriction on elective surgery, which was then followed by a bounce back in May when restrictions were lifted, and elective surgery recommenced. However, a very similar fall was seen in 2016 and may merely reflect the wide monthly variation. To 'smooth' this monthly variation, the data is also presented by quarter (Figure 34).

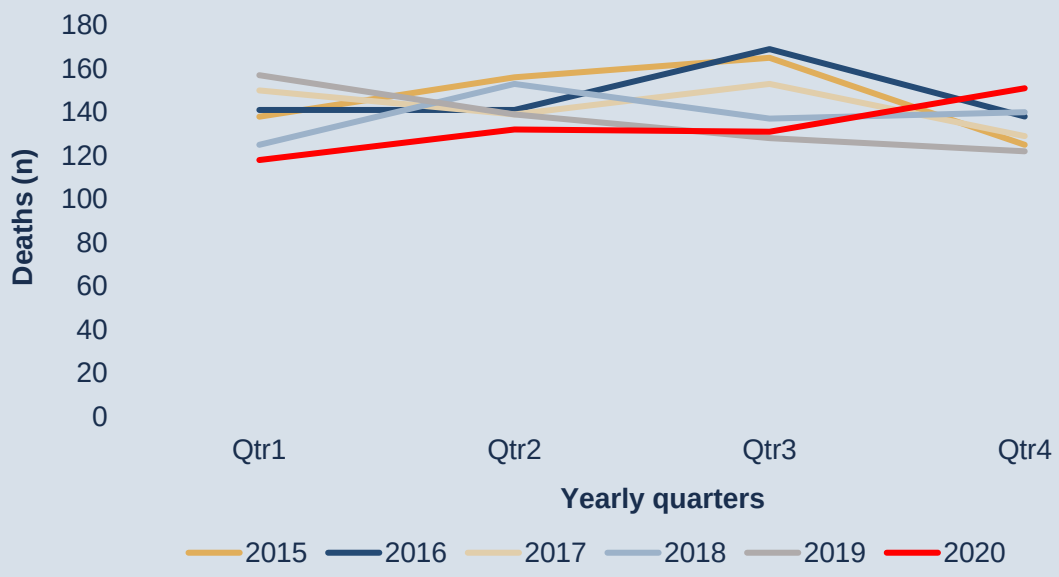
The number of deaths in the second half of 2019 was lower than in previous years (cause unknown) and the lesser number of deaths in early 2020 may have been a continuation of that trend. In the second half of 2020, the numbers were consistent with those in previous years, although slightly higher in the last quarter.

Figure 33: Surgical deaths by month, 2015–2020



Note: 2015 is included to produce a full 5-year data period to compare surgical deaths in 2020.
Refer to Appendix D.2 for further information on data.

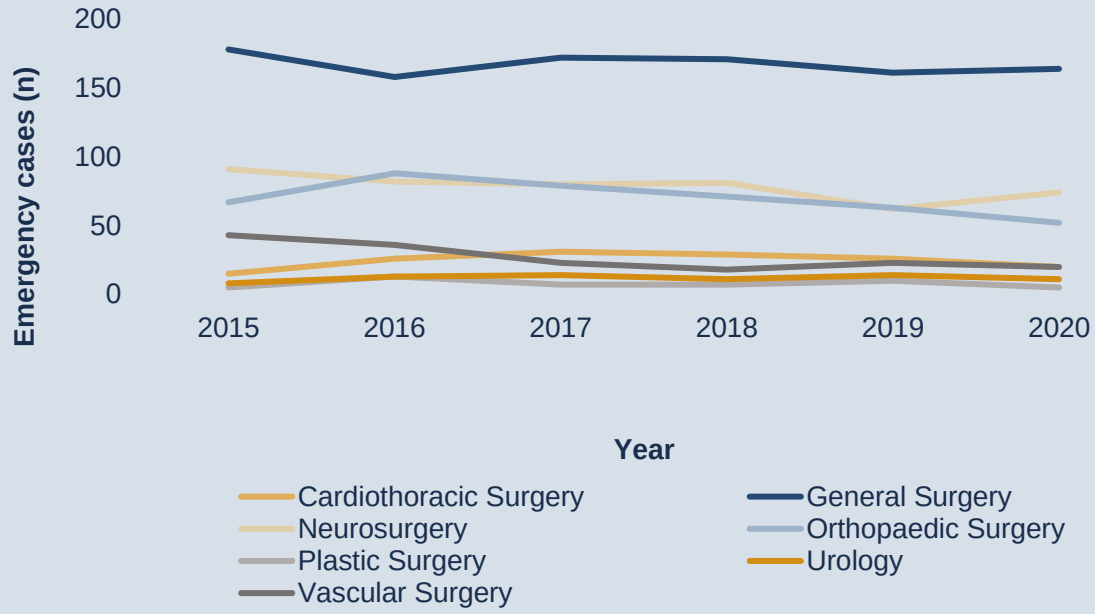
Figure 34: Surgical deaths by quarter, 2015–2020



Note: 2015 is included to produce a full 5-year data period to compare surgical deaths in 2020.
Refer to Appendix D.2 for further information on data.

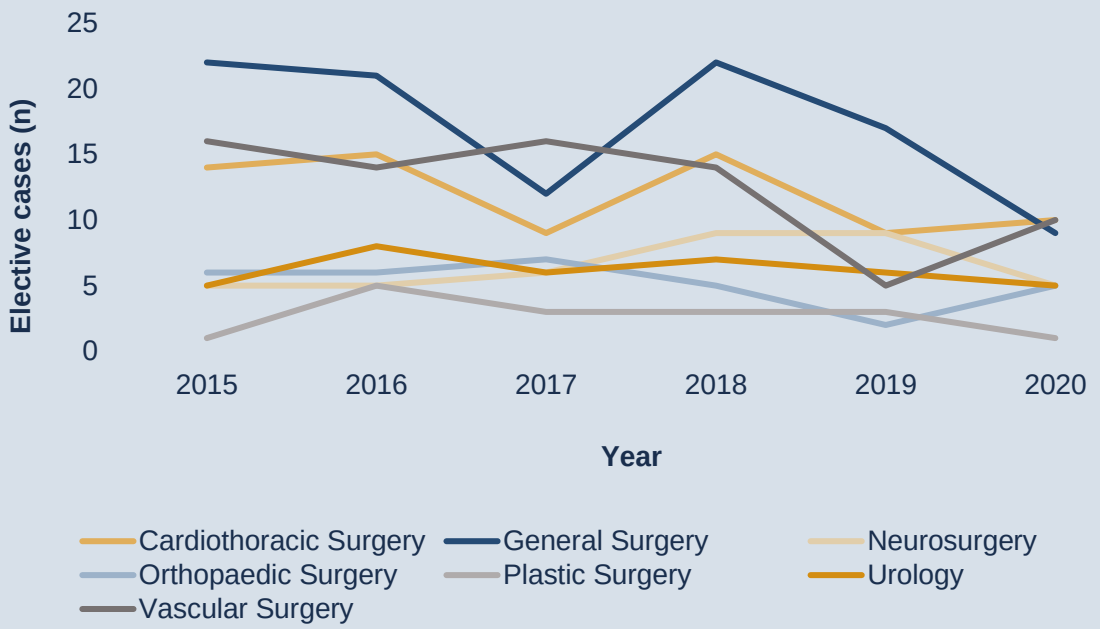
The data have also been examined for emergency and elective admissions in the major specialties (summarised in Figures 35 and 36). The only notable change was that deaths following elective General Surgery in 2020 were reduced by more than half with respect to previous years (Figure 36). Whilst this might merely reflect natural annual variation, it seems a large decrease and this might be a consequence of reduced elective surgery. The cause of this fall will be clearer when there is data from other states and for 2021.

Figure 35: Emergency cases by major surgical specialty and year



'Excluded error', 'surgical case pending' and 'terminal care' cases have been excluded from this analysis.
Refer to Appendix D.2 for further information on data.

Figure 36: Elective cases by major surgical specialty and year



'Excluded error', 'surgical case pending' and 'terminal care' cases have been excluded from this analysis.
Refer to Appendix D.2 for further information on data.

The full surgical impact of COVID-19 may not be known for some years. Two issues merit close observation.

The first issue is whether there is any impact from delayed elective surgery. During early 2020, elective surgery was reduced. The concern is that when these patients come to elective surgery, it is possible that their disease will have progressed to the point that more radical surgery is required, and so the operative risk is greater. Some may present as an emergency, and so require high risk surgery before being admitted for their rescheduled elective operation.

The second issue is the possible impact of long COVID on patients who later require surgery. Although at present there is no agreed definition of long COVID, it seems 15 to 30 per cent of those infected have symptoms that persist beyond 4 weeks. At the time of writing, the impact of long COVID has received little attention in Australia, [6] but it has been widely reported overseas.[7,8] The number of scientific articles is rapidly increasing.[9-11] Long COVID affects people of all ages and is not related to the severity of their initial COVID-19 infection, so impacts on both hospitalised and non-hospitalised patients.

COVID-19 causes an inflammatory response that appears to be particularly pronounced in organs that rely on microvascular circulation, notably the lungs and kidneys. It is well known that conditions that impact on these organs, for example smoking and diabetes, increase the risk of surgery. It remains to be determined if the damage from long COVID increases the risk of surgery, particularly in those who already have pre-existing organ damage.

In addition, the impact of vaccination on surgery remains unknown. For example, there are increasing reports of myocarditis following Pfizer inoculation and this includes the young.[12-14] Although the acute symptoms appear to be mild and short lived, the long impact is quite unknown.

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Appendices

Appendix A: Review of 2020 recommendations data

Figure A.1: Deaths with trauma implicated, 2016-2020

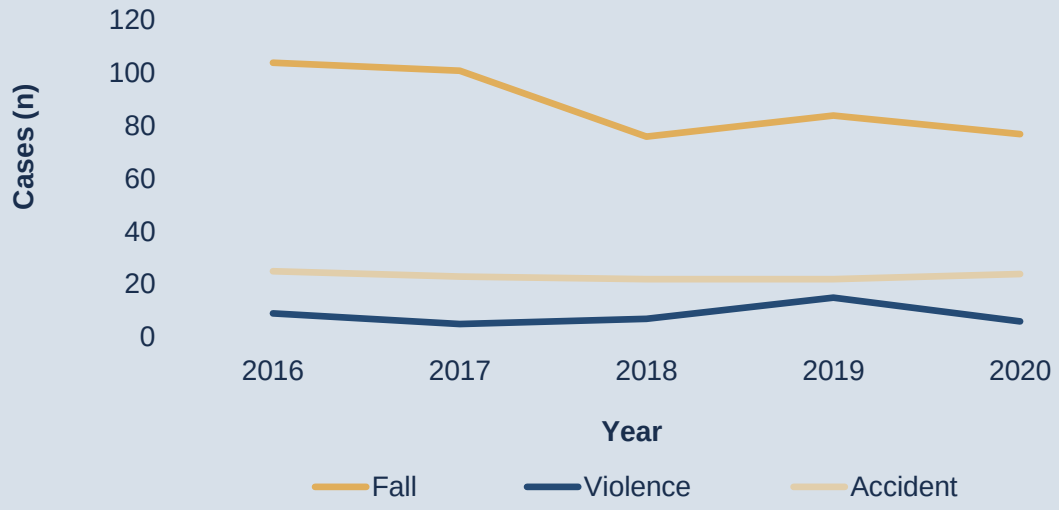


Figure A.2: Deaths with communication issues cited during care, 2016-2020

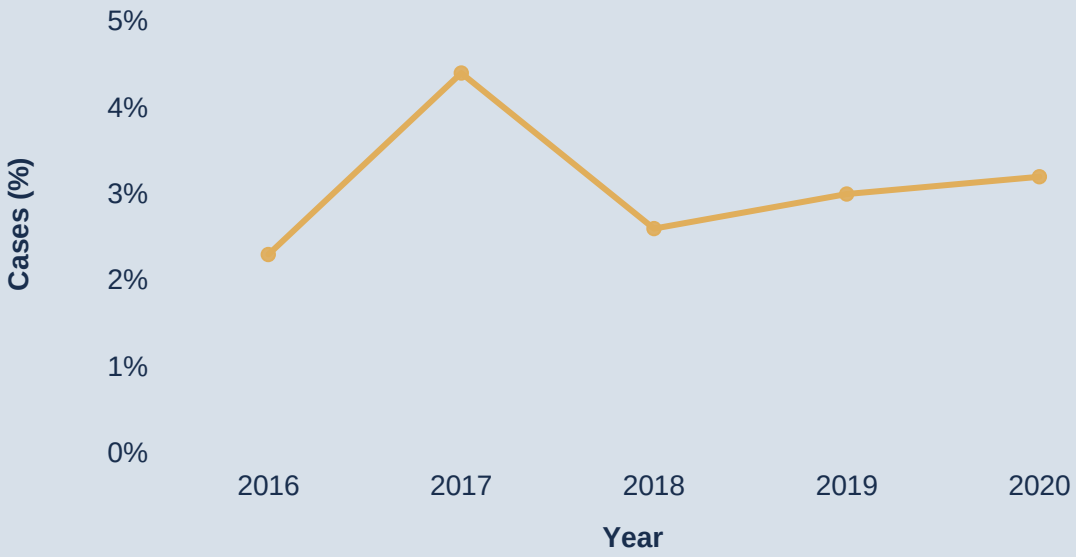


Figure A.3: Consultant surgeon involvement in theatre in emergency admissions, 2016-2020

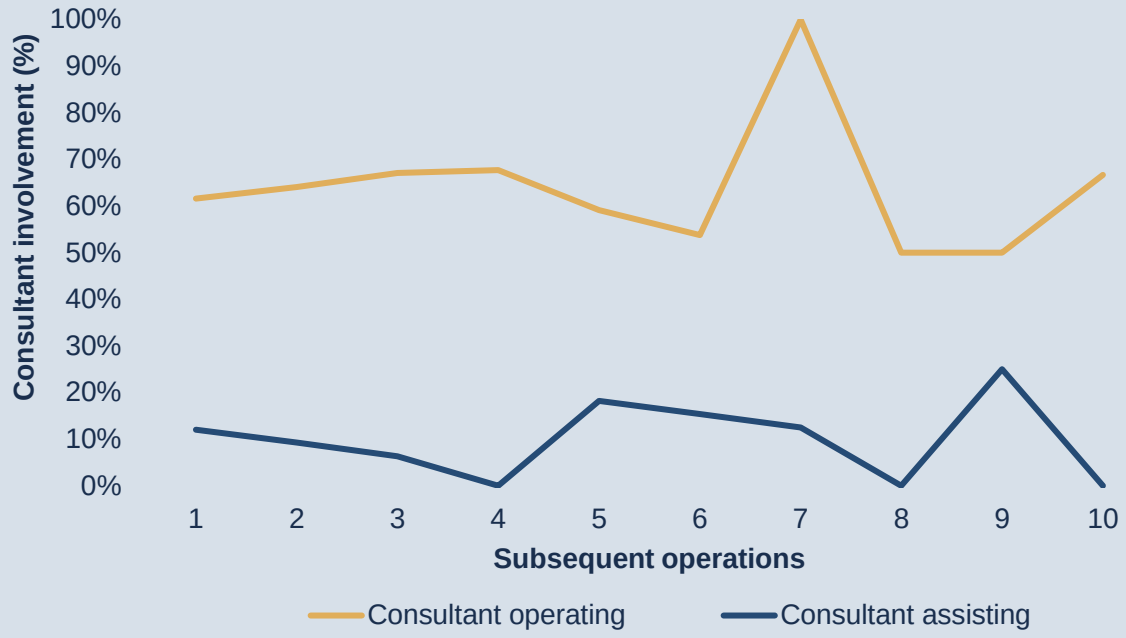
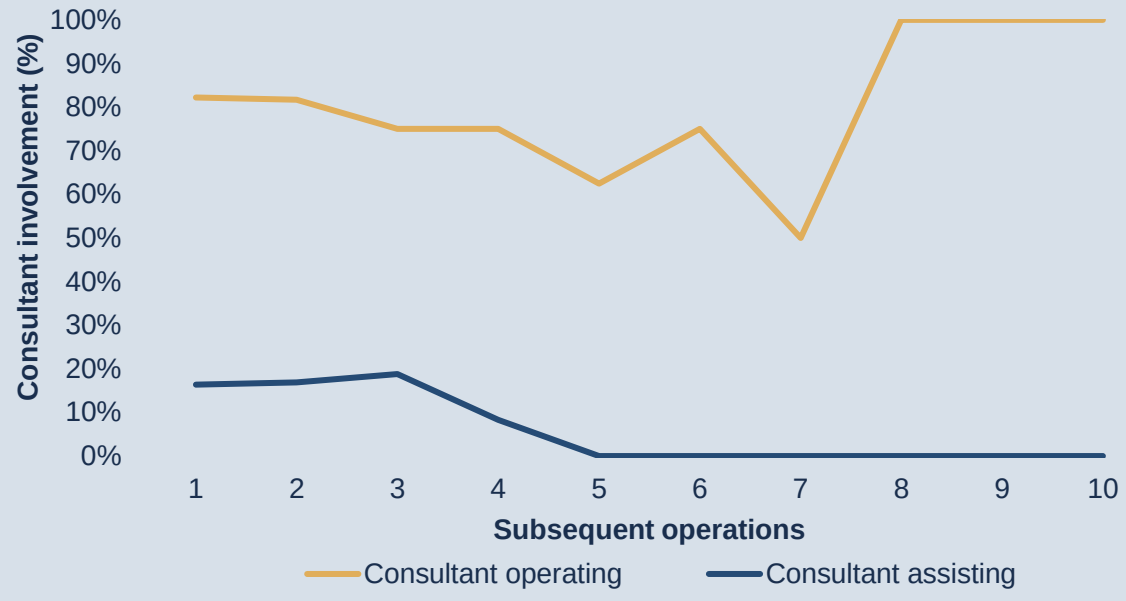
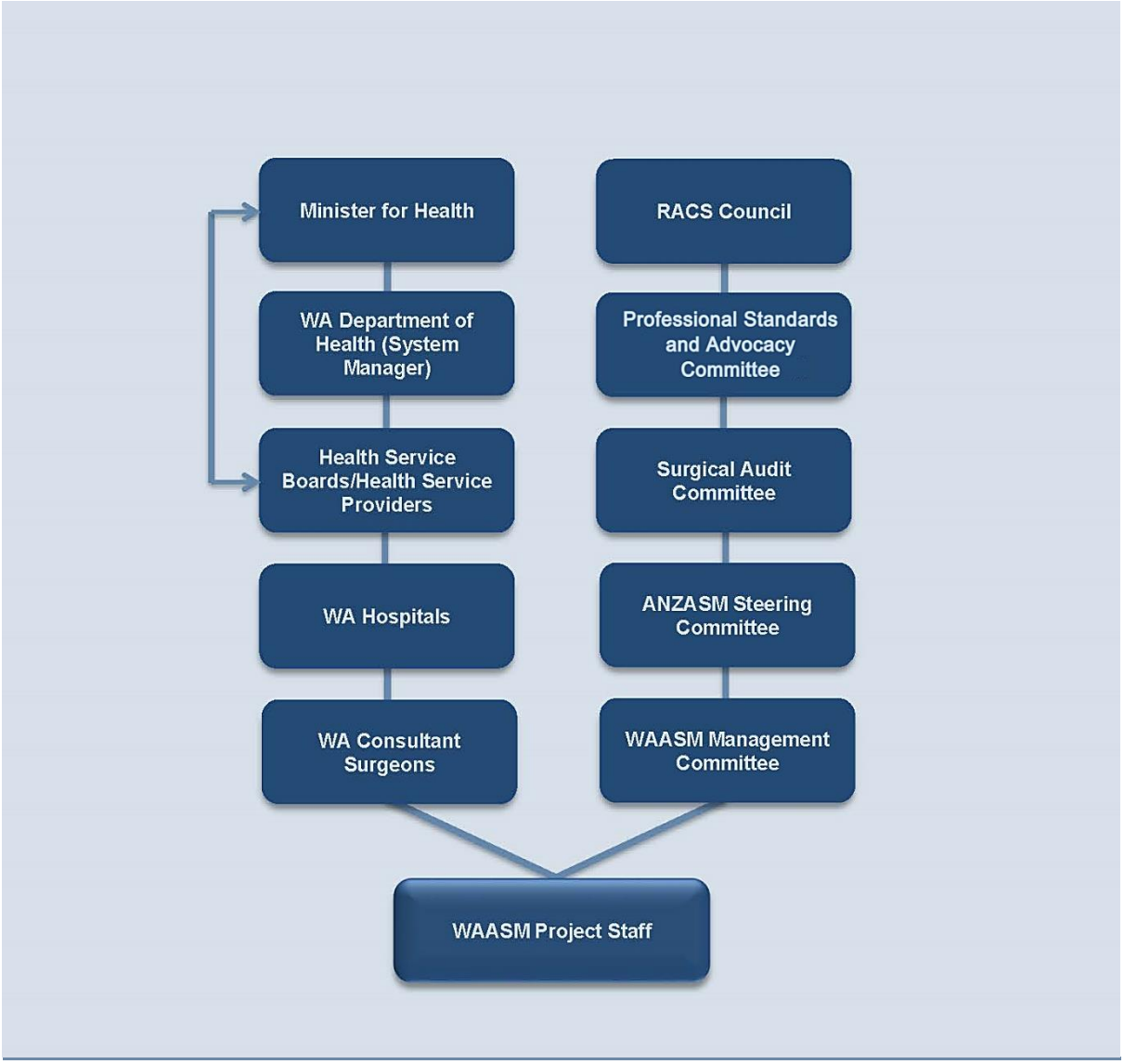


Figure A.4: Consultant surgeon involvement in theatre in elective admissions, 2016-2020

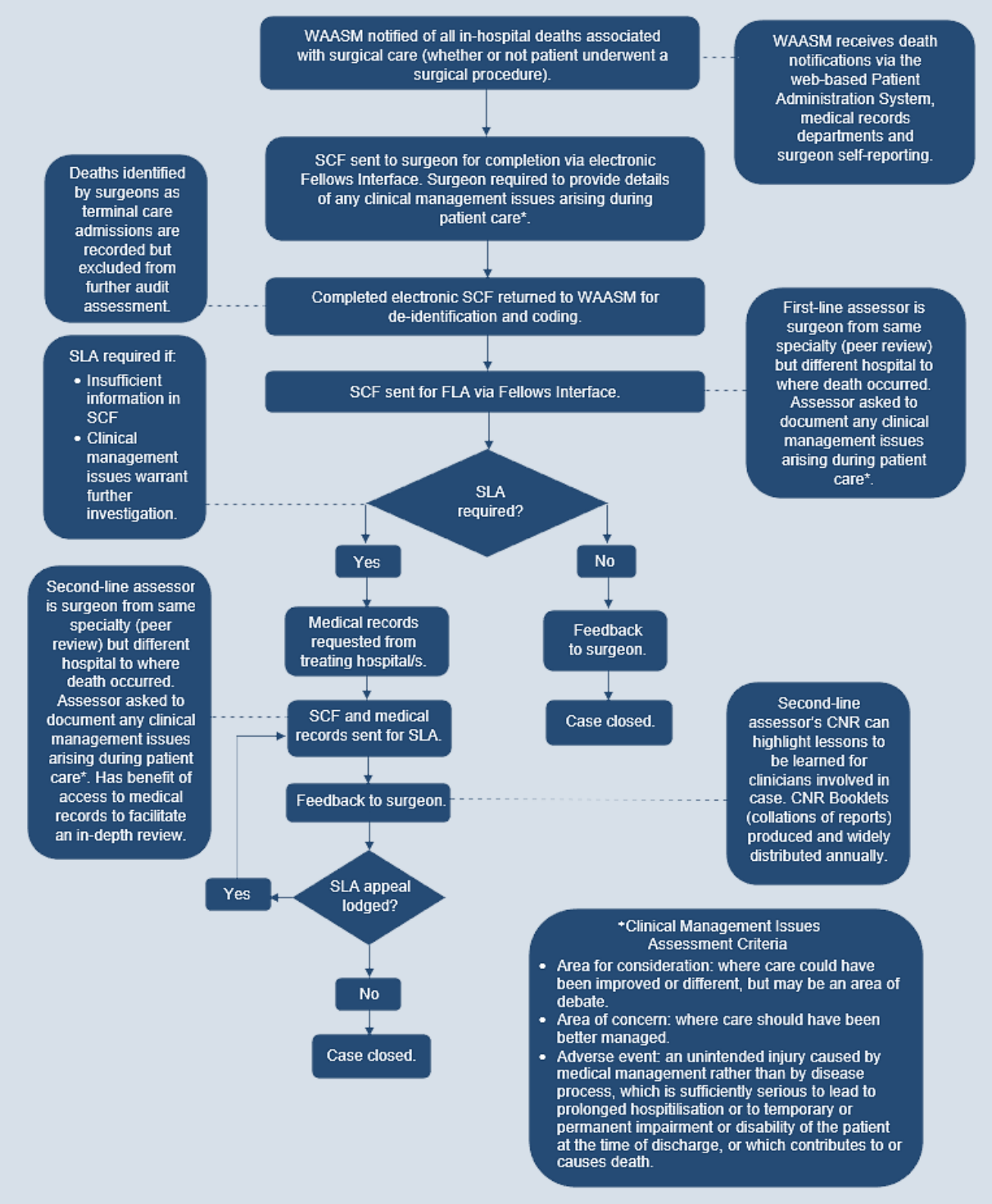


Appendix B: WAASM governance structure



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

Appendix C: WAASM audit process



WAASM: Western Australian Audit of Surgical Mortality, SCF: Surgical case form, FLA: first-line assessment, SLA: second-line assessment, CNR: case note review.
*See Clinical Management Issues Assessment Criteria.

Appendix D: Data definitions

Appendix D.1 Tables

Table 1: Deaths reported to WAASM by year	
Definition	Counts of deaths reported to WAASM by year.
Data included	All data collected between 2016 and 2020. Total numbers of deaths reported to WAASM, including 'excluded error' cases (n=2,899).
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=2,800).
Data excluded	All 'excluded error' cases (n=99).
Table 3: Median age by gender	
Definition	Median age by gender for all cases.
Data included	All deaths falling within WAASM criteria (n=2,800).
Data excluded	All 'excluded error' cases (n=99).
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 incomplete', 'first-line assessment complete', 'second-line assessment pending' and 'medical records pending' cases].
Data included	All data collected between 2016 and 2020 (n=2,899).
Data excluded	No exclusions.
Figure 2: Most common causes of death	
Definition	Percentages of the 5 most common causes of deaths.
Data included	All deaths falling within WAASM criteria. Some cases had more than one cause of death reported (n=3,460).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases.
Figure 3: Case status by year	
Definition	Deaths falling within WAASM criteria and audit case status by year. *Audit process complete* comprised all cases that have completed the entire audit process. *Pending cases* comprised all 'surgical case pending', 'first-line assessment pending', 'first-line assessment incomplete', 'first-line assessment complete', 'second-line assessment pending' and 'medical records pending' cases. *Excluded cases* comprised 'excluded terminal care' and lost to follow up' cases.
Data included	All deaths falling within WAASM criteria (n=2,800).
Data excluded	All 'excluded error' cases (n=99).
Figure 4: WAASM deaths and mortality rate per 100,000 WA population, by year	
Definition	Number of deaths falling within WAASM criteria per year and mortality rates per 100,000 WA population.
Data included	All deaths falling within WAASM criteria (n=2,800).
Data excluded	All 'excluded error' cases (n=99).
Figure 5: Deaths by hospital status by year	
Definition	Percentages of all cases by hospital status per year. *Co-location hospitals* are those that provide privately and publicly funded surgical services; data for co-location hospitals includes public and private patients.
Data included	All deaths falling within WAASM criteria where hospital status was reported (n=2,266).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases.

Figure 6: Deaths by surgical specialty and hospital admission	
Definition	Percentages of surgical mortality data in relation to surgeon specialty and hospital admission.
Data included	All deaths falling within WAASM criteria where hospital admission was reported (n=2,256).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. Data missing=10.
Figure 7: Deaths by age group and gender	
Definition	Counts of deaths by age groups and gender.
Data included	All deaths falling within WAASM criteria (n=2,800).
Data excluded	All 'excluded error' cases (n=99).
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=188), General Surgery (n=890), Neurosurgery (n=410), Obstetrics & Gynaecology (n=5), Ophthalmology (n=6), Otolaryngology, Head & Neck Surgery (n=26), Oral/Maxillofacial (n=1), Orthopaedic Surgery (n=388), Paediatric Surgery (n=13), Plastic Surgery (n=57), Urology (n=96), Vascular Surgery (n=184).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. Data missing=2.
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=2,119).
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=2,119).
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 11: Operations abandoned on finding a terminal situation, by year	
Definition	Percentages of operations abandoned on finding a terminal situation per year.
Data included	All deaths falling within WAASM criteria where operations abandoned were reported (n=2,029).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All nonoperative cases and all operative cases where a terminal situation was not reported. Data missing=90.
Figure 12: Unplanned return to theatre, by year	
Definition	Percentages of unplanned returns to operating theatre per year.
Data included	All deaths falling within the WAASM criteria where unplanned returns to operating theatre were reported (n=1,547).
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=3.
Figure 13: Postoperative complications by hospital admission and year	
Definition	Percentages of postoperative complications by hospital admission and year. It is possible for patients to have more than one postoperative complication.
Data included	All deaths falling within WAASM criteria where postoperative complications by hospital admission were reported (n=444).
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. Data missing=1.
Figure 14: Reasons for not operating, by year	
Definition	Percentages of cases with reasons for not operating per year. Some cases reported more than one reason for not operating.
Data included	All nonoperative deaths (n=714) falling within WAASM criteria where reasons for no operation were reported.
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All cases where an operation was reported.
Figure 15: Cases with preoperative diagnostic delays	
Definition	Percentages and counts of cases with preoperative diagnostic delays.
Data included	All deaths falling within WAASM criteria where preoperative diagnostic delays were reported (n=2,261).
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=5.
Figure 16: Hospital transfers by year	
Definition	Percentages of hospital transfers per year.
Data included	All deaths falling within WAASM criteria where transfers were reported (n=2,225).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. Data missing=41.

Figure 17: Hospital transfer issues	
Definition	Percentages of issues associated with hospital transfers.
Data included	All deaths falling within WAASM criteria where transfer issues were reported (n=676).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All cases where transfers and transfer issues were not reported. Data missing: 'inappropriate level of care'=33; 'insufficient clinical information'=35; 'inappropriate transfer'=27; 'delay in transfer'=25.
Figure 18: Cases with specific comorbidities	
Definition	Percentages of cases with comorbidities.
Data included	All deaths falling within WAASM criteria where comorbidities were reported. Some cases reported more than one type of comorbidity.
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All cases where no comorbidities were reported.
Figure 19: Frequency of ASA grades	
Definition	Percentages of cases by ASA grades.
Data included	All deaths falling within WAASM criteria where ASA grades were reported (n=1,975).
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=291.
Figure 20: Cases with fluid balance issues by year	
Definition	Percentages of cases with fluid balance issues per year.
Data included	All deaths falling within WAASM criteria where presence/non-presence of fluid balance issues were reported (n=2,250).
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=16.
Figure 21: Critical care unit use by year	
Definition	Percentages of critical care unit (intensive care and high dependency units) use/non-use per year.
Data included	All deaths falling within WAASM criteria where use (n=1,456) and non-use (n=803) of critical care units was reported.
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. Data missing=7.
Figure 22: DVT prophylaxis use by year	
Definition	Percentages of DVT prophylaxis use/non-use by year.
Data included	All deaths falling within WAASM criteria where use (n=1,773) and non-use (n=464) of DVT prophylaxis was reported on.
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. Data missing=29.

Figure 23: Type of DVT prophylaxis used	
Definition	Percentages of type of DVT prophylaxis used.
Data included	All deaths falling within WAASM criteria where DVT prophylaxis was used. Some cases reported more than one type of DVT prophylaxis used (n=1,773).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All cases where non-use of DVT prophylaxis and type of DVT prophylaxis were not reported.
Figure 24: Clinically significant infections	
Definition	Percentages and counts of cases with clinically significant infections.
Data included	All deaths falling within WAASM criteria where clinically significant infections were reported (n=2,255).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All cases where a clinically significant infection was not reported. Data missing=11.
Figure 25: Type of clinically significant infection reported	
Definition	Percentages of type of clinically significant infections reported.
Data included	All deaths falling within WAASM criteria where type of clinically significant infections was reported on (n=661).
Data excluded	All 'excluded error', 'surgical case pending', 'excluded terminal care' and 'lost to follow up' cases. All cases where a clinically significant infection was not reported. Data missing=2.
Figure 26: Assessor opinion on appropriateness of DVT prophylaxis decision, by year	
Definition	Percentages of appropriateness of DVT prophylaxis decision as reported by assessors by year.
Data included	All deaths falling within WAASM criteria using the highest level of assessment in completed cases where appropriateness of DVT prophylaxis was reported on (n=1,771).
Data excluded	All 'excluded error', 'surgical case pending', 'first-line assessment pending', 'first-line assessment incomplete', 'second-line assessment pending', 'excluded terminal care', 'medical record pending' and 'lost to follow up' cases. All neurosurgery cases. Data missing=29.
Figure 27: Assessor opinion on non-use of critical care units, by year	
Definition	Percentages of cases where use of critical care units (intensive care and high dependency units) would have been beneficial, as reported by assessors per year.
Data included	All deaths falling within WAASM criteria using the highest level of assessment in completed cases where critical care units were reported on (ICU, n=656; HDU, n=650).
Data excluded	All 'excluded error', 'surgical case pending', 'first-line assessment pending', 'first-line assessment incomplete', 'second-line assessment pending', 'excluded terminal care', 'medical record pending' and 'lost to follow up' cases; and all neurosurgery cases. Data missing ICU=41, HDU=47.

Figure 28: Cases with clinical management issues, by year	
Definition	Percentages of cases with clinical management issues, as reported by assessors per year.
Data included	All deaths falling within WAASM criteria using the highest level of assessment in completed cases where clinical management issues were reported (n=2,209).
Data excluded	All 'excluded error', 'surgical case pending', 'first-line assessment pending', 'first-line assessment incomplete', 'second-line assessment pending', 'excluded terminal care', 'medical record pending' and 'lost to follow up' cases; and all cases where clinical management issues were not reported.
Figure 29: Categories of clinical management issues	
Definition	Counts and percentages of categories of clinical management issues, as reported by assessors. Based on the number of incidents of clinical management issues, not the number of patients.
Data included	All deaths falling within WAASM criteria using the highest level of assessment in completed cases where categories of clinical management issues were reported (n=563).
Data excluded	All 'excluded error', 'surgical case pending', 'first-line assessment pending', 'first-line assessment incomplete', 'second-line assessment pending', 'excluded terminal care', 'medical record pending' and 'lost to follow up' cases; and all cases where clinical management issues were not reported.
Figure 30: Assessor perception of impact of adverse event on clinical outcome, by year	
Definition	Percentages of perceived impacts of adverse events, as reported by assessors per year. Based on the number of incidents of clinical management issues, 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=64).
Data excluded	All 'excluded error', 'surgical case pending', 'first-line assessment pending', 'first-line assessment incomplete', 'second-line assessment pending', 'excluded terminal care', 'medical record pending' and 'lost to follow up' cases; all cases where clinical management issues were not reported; and all cases where 'areas for consideration' and 'areas of concern' were reported.
Figure 31: Assessor perception of preventability of adverse event causing death, by year	
Definition	Percentages of perceived preventability of adverse events causing death, as reported by assessors per year. Based on the number of incidents of clinical management issues, 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=40).
Data excluded	All 'excluded error', 'surgical case pending', 'first-line assessment pending', 'first-line assessment incomplete', 'second-line assessment pending', 'excluded terminal care', 'medical record pending' and 'lost to follow up' cases; all cases where clinical management issues were not reported; all cases where 'areas for consideration' and 'areas of concern' were not reported; and all cases where adverse events not causing death were reported.

Figure 32: Most frequently reported clinical management issues	
Definition	Percentages and descriptions (in READ code) of the 14 most common clinical management issues, as reported by assessors.
Data included	All deaths falling within WAASM criteria where clinical management issues were reported (n=364).
Data excluded	All ‘excluded error’, ‘surgical case pending’, ‘first-line assessment pending’, ‘first-line assessment incomplete’, ‘second-line assessment pending’, ‘excluded terminal care’, ‘medical record pending’ and ‘lost to follow up’ cases; and all cases where clinical management issues were not reported.
Figure 33: Surgical deaths by month, 2015–2020	
Definition	Counts of deaths falling within WAASM criteria by month. The year 2015 is included to gain a full 5-year period of data to compare to surgical deaths in 2020.
Data included	All data collected between 2015 and 2020.
Data excluded	All ‘excluded error’ cases.
Figure 34: Surgical deaths by quarter, 2015–2020	
Definition	Counts of deaths falling within WAASM criteria by yearly quarter. The year 2015 is included to gain a full 5-year period of data to compare to surgical deaths in 2020.
Data included	All data collected between 2015 and 2020.
Data excluded	All ‘excluded error’ cases.
Figure 35: Emergency cases by major surgical specialty and year	
Definition	Counts of emergency admission cases by major surgical specialties and year. The year 2015 is included to gain a full 5-year period of data to compare to emergency admission cases in 2020.
Data included	All data collected between 2015 and 2020.
Data excluded	All ‘excluded error’, ‘surgical case pending’ and ‘excluded terminal care’ cases.
Figure 36: Elective cases by major surgical specialty and year	
Definition	Counts of elective admission cases by major surgical specialties and year. The year 2015 is included to gain5 a full five-year period of data to compare to elective admission cases in 2020.
Data included	All data collected between 2015 and 2020.
Data excluded	All ‘excluded error’, ‘surgical case pending’ and ‘excluded terminal care’ cases.

Appendix D.3 American Society of Anesthesiologists grade definitions

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