Royal Australasian College of Surgeons

# SAASM ANNUAL REPORT 2022

(5-YEAR UPDATE 2017–2021)

Royal Australasian College of Surgeons
South Australian Audit of Surgical Mortality

**Acknowledgements**

South Australian Audit of Surgical Mortality
Royal Australasian College of Surgeons
24 King William Street
Kent Town SA 5067 Australia

Telephone: +61 8 8239 1144
Email: saasm@surgeons.org
Website: https://www.surgeons.org/SAASM

The information contained in this report has been prepared by the Royal Australasian College of Surgeons, South Australian Audit of Surgical Mortality Management Committee.

The South Australian Audit of Surgical Mortality is a declared quality assurance committee under the South Australian Health Care Act 2008, and is funded by the SA Department for Health and Wellbeing.

The Australian and New Zealand Audit of Surgical Mortality, including the South Australian Audit of Surgical Mortality, has protection under the Commonwealth Qualified Privilege scheme according to Part VC of the Health Insurance Act 1973 (gazetted 24 April 2022).

# Contents

# Figures



# Tables

# CHAIR'S REPORT

The South Australian Audit of Surgical Mortality (SAASM) report for the period 2017–2021 provides information regarding in-hospital patient mortality where surgical care was involved at a state level. Considering the data in this way allows for analysis of potential trends and issues in health care that would not be possible at an institutional or individual level. In particular, data on patient transfers and unplanned returns to theatre have been explored.

The timely completion of surgical case forms (SCFs) has improved in 2021, where the median number of days to completion was 51, compared to 57 days in 2020. The Australian and New Zealand Audit of Surgical Mortality (ANZASM), of which SAASM is a part, recommends that surgeons submit SCFs within 60 days of notification from SAASM. This is so feedback provided following evaluation of the case can be timely, and has the best possible opportunity for promoting self-reflection and subsequent improvement in surgical practice and patient outcomes. Surgeons are encouraged to take advantage of the self-reporting feature in the Fellows' Interface in order to pre-emptively address their cases while the events are fresh in mind and medical notes readily accessible. The audit remains a mandatory component of continuing professional development (CPD) for Fellows of the Royal Australasian College of Surgeons (RACS) and the Australian Orthopaedic Association (AOA).

Self-evaluation submitted by surgeons and feedback provided by assessors often result in differing perceptions and approaches to case management, contributing to the ongoing educational benefit of peer-review provided by SAASM. The opportunity for assessors to review the cases of their peers allows for reflection and improvement in their own personal practice.

I would like to thank my colleagues for their ongoing contributions to SAASM, which continue to underpin our high-quality audit.

**Tony Pohl FRACS**
Clinical Director
SA Audit of Surgical Mortality

# KEY POINTS

- Between 2017 and 2021 2,802 patient deaths were notified to SAASM, with 515 declared as terminal care admissions (excluded from further audit). Of these auditable cases, 94.8% of cases have been submitted while 91.9% have completed the audit process.
- SAASM cases were predominantly public, emergency patient admissions to public hospitals. The majority of patients were considered ASA 4 (based on the American Society of Anesthesiologists physical status classification system) and had a perceived risk of death of 'considerable'. Advanced age and cardiovascular disease were the most commonly reported comorbidities for this cohort.
- During this period 72.1% of patients underwent at least one procedure, while for the remainder of patients it was predominantly an active decision not to operate. 54.8% of those who were operated on were scheduled within the first 24 hours.
- Deep vein thrombosis (DVT) prophylaxis was used in 71.6% of patients through the 2017–2021 period, with heparin being the preferred anticoagulant. Assessors, on the whole, approved of the DVT prophylactic strategy employed by the surgeon, though it is worth noting that assessors were less willing to confirm DVT prophylactic strategies as appropriate with 19.4% of responses being 'unknown'.
- Infections were reported to be present in 34.4% of patients, with 68.5% of infections acquired after admission. These infections were predominately reported to be pneumonia or sepsis.
- Assessors identified clinical management issues (CMI) in 19.3% of cases and the majority of these were considered to be relatively minor. Delays in determining surgical diagnosis and implementing treatment, and incorrect/ inappropriate therapies, were the most common themes of CMIs.

# INTRODUCTION

The South Australian Audit of Surgical Mortality (SAASM) was launched in 2005 to support surgeons through the provision of an independent peer-review process for all in-hospital mortality associated with surgical care. As of 30 June 2022, SAASM has evaluated 7,830 cases since its inception, while 314 cases are still undergoing the audit process. A further 1,110 cases have been excluded from the full audit process due to being terminal care (palliative) admissions.

SAASM is funded by the South Australian (SA) Department for Health and Wellbeing and governed by the SAASM Management Committee. As a component of the Australian and New Zealand Audit of Surgical Mortality (ANZASM), SAASM enjoys Commonwealth Qualified Privilege as a declared quality assurance activity according to the *Health Insurance Act 1973 (Cth).* This protection has helped foster the engagement of surgeons, whether by submission of cases where they were involved in providing surgical care or by undertaking assessments and providing critical yet constructive feedback.

SAASM would like to acknowledge the constructive relationships held with SA hospitals and health professionals which continues to be fundamental to the services we can provide.

This report incorporates in-hospital surgery-related deaths that occurred between 1 January 2017 and 31 December 2021. The clinical and demographic characteristics of these cases are presented, as are the perspectives on case management of both treating surgeons and independent assessors. The objective of this report is to identify potential areas of improvement for the ongoing professional development of surgeons, as well as the systems and processes within which care is conducted.

# METHODS

## CASES

Following notification from public and private hospitals, SAASM evaluates all in-hospital surgical deaths that meet either of the following criteria:

- any patient admitted to hospital by a surgeon, regardless of whether a procedure took place
- any hospital admission where a procedure took place that was performed by a surgeon.

Terminal care admissions are excluded from the full audit process.

## COLLABORATIONS

The Royal Australasian College of Surgeons (RACS) has collaborations with the Australian and New Zealand College of Anaesthetists (ANZCA) and the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) for participation in SAASM. For cases involving gynaecological surgery, the treating surgeon is invited to participate in the audit and to voluntarily submit the case to SAASM. Similarly, Fellows from the Royal Australian and New Zealand College of Ophthalmologists (RANZCO) and the Royal Australasian College of Dental Surgeons (RACDS) are invited to participate in the audit on a voluntary basis. Participation in SAASM has been mandated by RACS and the Australian Orthopaedic Association (AOA) as part of their continuing professional development (CPD) programs.

## DATA COLLECTION

Following notification of a patient death, SAASM requests that the consultant surgeon responsible for the patient submit a surgical case form (SCF), which details the clinical, diagnostic and procedural data of the patient's final hospital admission. The SCF includes the opportunity to identify any CMIs perceived to have occurred during the course of patient care. It is also possible, at this point, for a consultant surgeon to declare a case a terminal care admission (i.e. the patient was palliated almost immediately upon admission, with no surgical intervention taking place). Terminal admissions are excluded from the full audit process.

SCFs are reviewed for clarity, de-identified and assigned for first-line assessment (FLA). Assessors provide initial feedback on the overall management of submitted cases and the level of care provided. They also indicate whether there is a need for further evaluation via second-line assessment (SLA), which includes medical note review. An SLA is generally requested because of specific questions arising from the FLA that require more considered evaluation. All assessors invited to evaluate submissions are surgeons from the same surgical specialty as the treating surgeon and are independent of the institution from which the case arose. All assessors are required to sign a declaration acknowledging the confidentiality of the process. SLAs allow for the provision of in-depth feedback to the consultant surgeon responsible for the case.

CMIs identified by surgeons or assessors as part of the audit process are classified as either:

- *Areas of consideration* – the clinician believes aspects of care could have been improved but recognises that this is debatable
- *Areas of concern* – the clinician believes that aspects of care should have been better
- *Adverse events* – an unintended injury caused by patient management rather than by the disease process that is sufficiently serious to lead to prolonged hospitalisation or temporary or permanent disability of the patient, or which contributes to or causes death.

The collection of SCF and FLA data is facilitated by the Fellows' Interface, a secure online platform to which surgeons have access. SLA data are entered by RACS staff using a bespoke administrative interface.

Where relevant, data are coded using READ code designations.[1] Data are stored securely and encrypted using Microsoft SQL Server 2017, with data subsets scrutinised for consistency on a monthly basis.

## DATA ANALYSIS

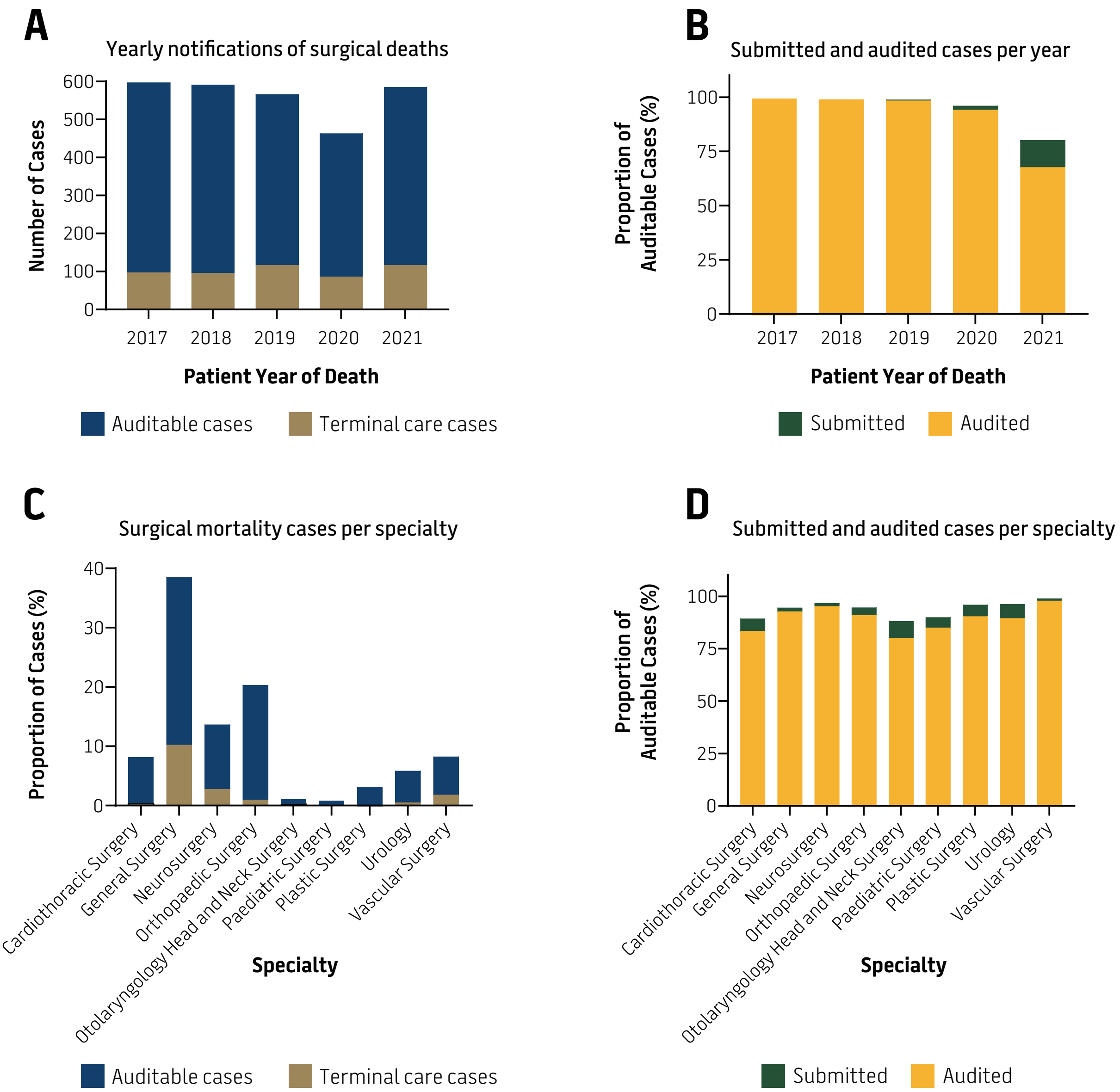
The scope of this report includes cases where the patient died as an in-patient during the period 1 January 2017 through 31 December 2021 (census date 30 June 2022). Data were analysed using R 4.2.1[2], RStudio 2022.02.0[3], GraphPad Prism 9.4.1 and Microsoft Excel 365. Statistical tests are introduced in the context within which they were applied. Categorical variables are expressed as counts and/or proportions. Continuous variables are expressed as means (± standard deviation) or medians (interquartile range [IQR]) depending on the normality of the distribution. Statistical significance was assumed at $p \leq 0.05$ (ns = non-significant). Analyses have been conducted using all available valid data points. Auditable cases include all cases notified to SAASM except those excluded due to being terminal care admissions and includes those cases still pending submission as of the census date.

# RESULTS

## CASE SUMMARY

During the period 2017–2021, there were 2,802 cases reported to SAASM. Those noted as terminal care (n = 515; 22.5% of cases) were excluded from the full audit process, leaving 2,287 auditable cases for analysis (Figure 1A). Most cases from this period have completed the audit process (90.2%). 19.9% of cases from 2021 are yet to be submitted and a further 12.3% of cases have not yet completed the audit process (Figure 1B). General Surgery accounted for the majority of cases (38.6%) (Figure 1C), while Vascular Surgery had the highest submission rate (98.9%) among all specialties (Figure 1D).

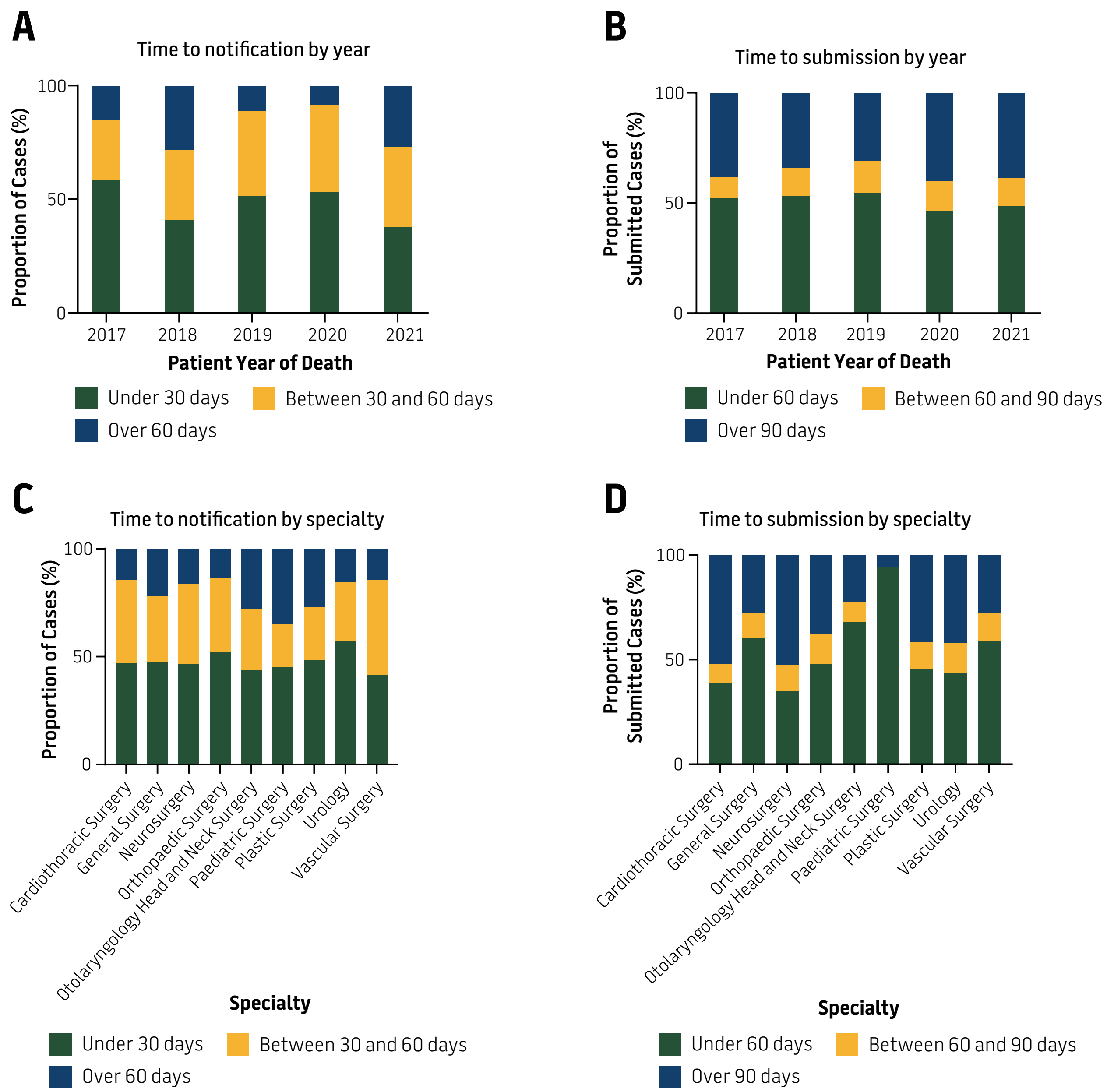
**Figure 1: Cases notified to SAASM and subsequent audit status, according to year and surgical specialty (2017–2021)**




**A:** Total number of cases notified to SAASM per year and proportion that were terminal care admissions
**B:** Proportion of cases submitted to SAASM per year that have completed the audit process
**C:** Distribution of auditable cases and terminal care admissions according to surgical specialty
**D:** Proportion of cases submitted that have completed the audit process according to surgical specialty

In 2021 there was a slight decrease in the proportion of cases notified to SAASM within 30 days (37.8%) compared to 2020 (53.1%) and 2019 (51.4%) (Figure 2A). SAASM recommends monthly notifications of death from partnered hospitals in order to allow for a more efficient process of providing feedback to the treating surgeon. The amount of time taken for surgeons to complete their cases has slightly improved since 2020 (46.3% submitted under 60 days), with 48.5% of cases submitted to SAASM in under 60 days in 2021 (the recommended ANZASM standard is for submission of SCFs within 60 days of surgeon notification) (Figure 2B). Of all the surgical specialties, neurosurgeons submitted the largest proportion of cases to SAASM outside of the recommended standard (64.9% of cases submitted after 60 days), followed by cardiothoracic surgeons (60.1% of cases submitted after 60 days) (Figure 2D).

**Figure 2: Time between patient death and notification of SAASM, and notification of surgeon and case submission**




**A:** Time between patient death and notification of SAASM by the treating institution, according to the patient year of death
**B:** Time between the treating surgeon being notified by SAASM of a pending case and its eventual submission, according to the patient year of death
**C:** Time between patient death and notification of SAASM by the treating institution, according to surgical specialty
**D:** Time between the treating surgeon being notified by SAASM of a pending case and its eventual submission, according to surgical specialty
**Note:** all data are median, interquartile range (IQR)

Patient demographics for cases reported to SAASM have been summarised in Table 1. In 2021, most patients tended to be elderly (median 77, IQR 66-86), male (57.5%) and with cardiovascular disease (64%) as the most commonly reported comorbidity, along with age. These trends have remained relatively consistent over time. Overall, the majority of cases were public patients (73.9%) while presenting as emergency admissions (82.3%) to public hospitals (78.9%).

**Table 1: Patient demographics for SAASM cases by patient year of death**

| | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|
| Age (median years; IQR) | 77 (65–85) | 76 (64–85) | 79 (66–86) | 78 (67–85) | 77 (66–86) |
| Male:Female (%) | 56.5:43.5 | 59.4:40.6 | 53.9:46.1 | 53.7:46.3 | 57.5:42.5 |
| Aboriginal and/or Torres Strait Islander Descent (%) | | | | | |
| *Yes* | 2.2 | 2.2 | 2.9 | 3.2 | 1.7 |
| *No* | 97.0 | 95.6 | 95.3 | 92.8 | 77.4 |
| *Unknown* | 0.8 | 2.2 | 1.8 | 4.0 | 20.9 |
| Comorbidities[a] (%) | | | | | |
| *Advanced malignancy* | 21.5 | 27.5 | 23.2 | 24.3 | 27.9 |
| *Age* | 57.7 | 61.8 | 63.8 | 63.8 | 67.0 |
| *Cardiovascular* | 66.2 | 60.3 | 62.5 | 66.9 | 64.0 |
| *Diabetes* | 23.7 | 23.0 | 21.7 | 22.2 | 23.1 |
| *Hepatic* | 6.2 | 9.2 | 7.7 | 9.7 | 11.7 |
| *Neurological* | 21.0 | 19.9 | 24.0 | 24.3 | 22.2 |
| *Obesity* | 11.3 | 10.0 | 10.5 | 12.5 | 12.0 |
| *Other* | 24.1 | 23.2 | 21.9 | 28.0 | 19.5 |
| *Renal* | 25.0 | 25.9 | 29.1 | 33.7 | 27.6 |
| *Respiratory* | 31.6 | 30.6 | 35.5 | 35.0 | 34.8 |
| Patient Status (%) | | | | | |
| *Private* | 18.8 | 19.4 | 19.6 | 23.1 | 18.2 |
| *Public* | 80.4 | 78.8 | 77.5 | 71.0 | 60.5 |
| *Veteran* | 0.2 | 0.4 | 0.4 | 1.9 | 0.4 |
| *Unknown* | 0.6 | 1.4 | 2.4 | 4.0 | 20.9 |
| Admission Status (%) | | | | | |
| *Elective* | 9.0 | 14.5 | 14.0 | 11.4 | 11.1 |
| *Emergency* | 90.6 | 83.6 | 84.9 | 84.6 | 67.9 |
| *Unknown* | 0.4 | 1.8 | 1.1 | 4.0 | 20.9 |
| Hospital Status (%) | | | | | |
| *Private* | 14.4 | 14.9 | 15.6 | 18.6 | 12.8 |
| *Public* | 84.4 | 83.0 | 82.9 | 77.4 | 66.0 |
| *Co-Location* | 1.2 | 1.0 | 0.4 | 0.0 | 0.2 |
| *Unknown* | 0.0 | 1.0 | 1.1 | 4.0 | 20.9 |

| | | | | | |
|---|---|---|---|---|---|
| Hospital Type[b] (%) | | | | | |
| *Principal referral hospitals* | 65.9 | 65.5 | 63.9 | 63.3 | 65.2 |
| *Public acute group A hospitals* | 16.2 | 18.2 | 18.7 | 16.2 | 16.7 |
| *Public acute group B hospitals* | 2.8 | 1.8 | 1.6 | 1.1 | 1.3 |
| *Public acute group C hospitals* | 0.0 | 0.2 | 0.0 | 0.3 | 0.0 |
| *Private acute group A hospitals* | 7.2 | 6.7 | 7.3 | 12.2 | 9.8 |
| *Private acute group B hospitals* | 6.2 | 6.5 | 6.9 | 5.6 | 4.9 |
| *Private acute group C hospitals* | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 |
| *Children's hospitals* | 1.6 | 1.2 | 1.6 | 1.3 | 1.9 |
| Length of stay (median days; IQR) | 9 (3–19) | 9 (3–21) | 8 (3–19) | 9 (4–17) | 9 (4–19) |

Note: [a] Proportions are not mutually exclusive; [b] Hospital peer group designations according to AIHW classification4; 'Unknown' includes cases for which the information was not provided or for which the case is still pending submission; IQR = interquartile range.

The most frequent diagnoses for SAASM cases have been summarised in Table 2. Admission diagnoses were those conditions prompting initial admission; surgical diagnoses were the issues requiring surgical care; causes of death were as declared by the submitting surgeon. Diagnoses have been aggregated into parent groups (according to READ code designation[1]) for ease of summary.

The most common admission and surgical diagnoses for 2021 were 'other diseases of the intestines and peritoneum' (e.g. small bowel ischaemia), notably different to 'fracture of lower limb' (e.g. fractured neck of femur) reported for 2017–2020. The most reported cause of death for 2021 was 'other endocrine gland diseases' (e.g. diabetes mellitus), except for 2020 where 'other forms of heart disease' (e.g. heart failure) was reported.

**Table 2: The 5 most common diagnoses for SAASM cases**

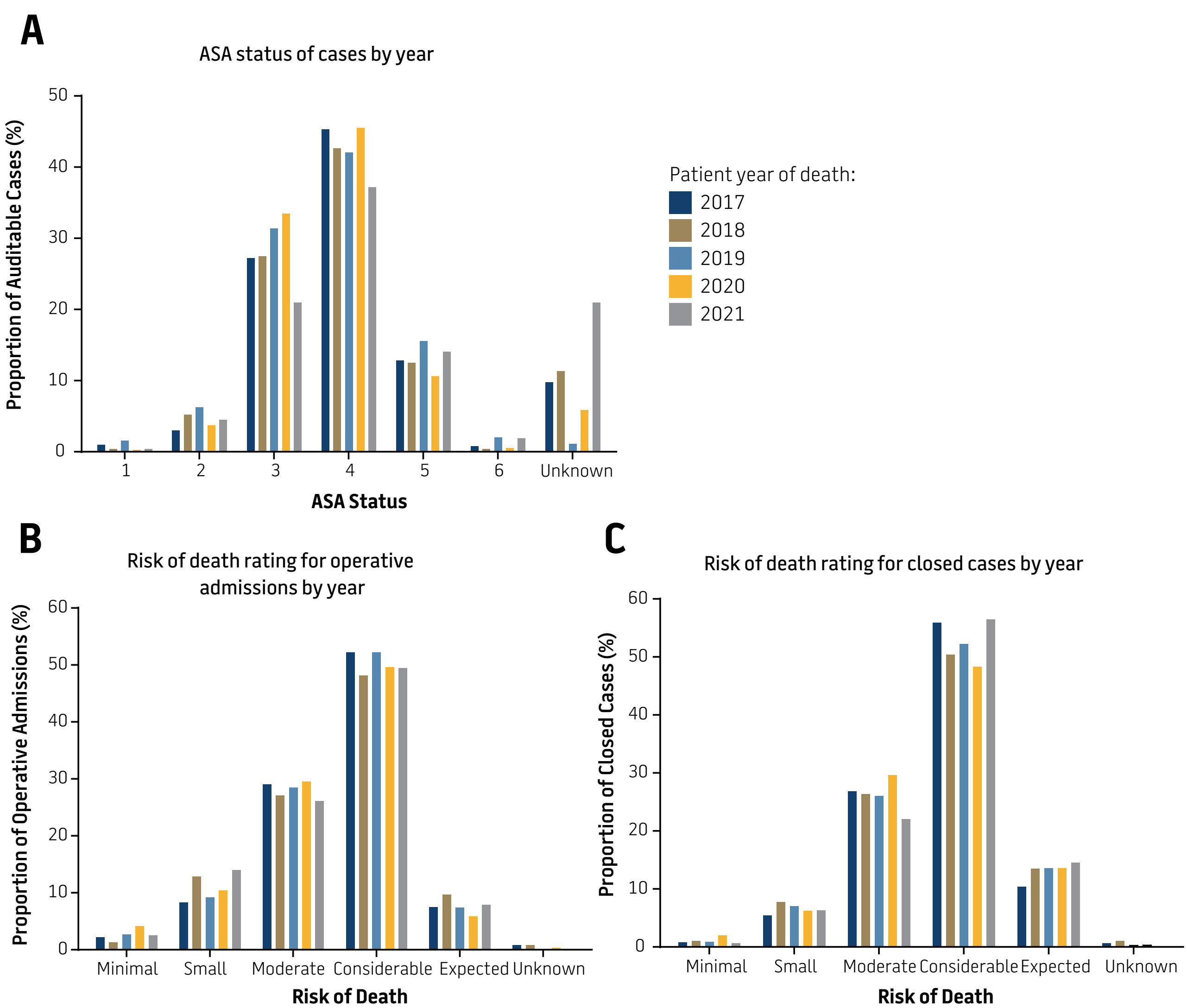
| | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|
| Admission Diagnoses | | | | | |
| **1** | Fracture of lower limb | Fracture of lower limb | Fracture of lower limb | Fracture of lower limb | Other diseases of the intestines and peritoneum |
| **2** | Liver, biliary, pancreas + gastrointestinal diseases NEC* | Other diseases of the intestines and peritoneum | Cerebrovascular disease | Other diseases of the intestines and peritoneum | Fracture of lower limb |
| **3** | Other diseases of the intestines and peritoneum | Cerebrovascular disease | Other diseases of the intestines and peritoneum | Liver, biliary, pancreas + gastrointestinal diseases NEC* | Cerebrovascular disease |
| **4** | Cerebrovascular disease | Malignant neoplasm of digestive organs and peritoneum | Arterial, arteriole and capillary disease | Other forms of heart disease | Liver, biliary, pancreas + gastrointestinal diseases NEC* |
| **5** | Arterial, arteriole and capillary disease | Arterial, arteriole and capillary disease | Intracranial injury excluding those with skull fracture | Malignant neoplasm of other and unspecified sites | Malignant neoplasm of digestive organs and peritoneum |
| Surgical Diagnoses | | | | | |
| **1** | Fracture of lower limb | Fracture of lower limb | Fracture of lower limb | Fracture of lower limb | Other diseases of the intestines and peritoneum |
| **2** | Other diseases of the intestines and peritoneum | Other diseases of the intestines and peritoneum | Cerebrovascular disease | Other diseases of the intestines and peritoneum | Fracture of lower limb |
| **3** | Cerebrovascular disease | Cerebrovascular disease | Other diseases of the intestines and peritoneum | Other forms of heart disease | Cerebrovascular disease |
| **4** | Liver, biliary, pancreas + gastrointestinal diseases NEC* | Malignant neoplasm of digestive organs and peritoneum | Arterial, arteriole and capillary disease | Arterial, arteriole and capillary disease | Liver, biliary, pancreas + gastrointestinal diseases NEC* |
| **5** | Malignant neoplasm of digestive organs and peritoneum | Other bacterial diseases | Intracranial injury excluding those with skull fracture | Carcinoma in situ | Noninfective enteritis and colitis |
| Cause of Death | | | | | |
| **1** | Other endocrine gland diseases | Other endocrine gland diseases | Other endocrine gland diseases | Other forms of heart disease | Other endocrine gland diseases |
| **2** | Other forms of heart disease | Other bacterial diseases | Cerebrovascular disease | Other endocrine gland diseases | Other forms of heart disease |
| **3** | Other bacterial diseases | Cerebrovascular disease | Other forms of heart disease | Other bacterial diseases | Other respiratory system diseases |
| **4** | Surgical and medical care complications NEC* | Other respiratory system diseases | Nephritis, nephrosis and nephrotic syndrome | Other respiratory system diseases | Other bacterial diseases |
| **5** | Cerebrovascular disease | Other forms of heart disease | Surgical and medical care complications NEC* | Pneumonia and influenza | Cause of morbidity and mortality unsure and ill-defined |

*Note: NEC = not elsewhere classified

## ASA SCORES AND RISK OF DEATH RATINGS

For the majority of cases, the reported ASA[5] score (American Society of Anesthesiologists physical status classification system), as specified by the treating surgeon, was 4 (a patient with severe systemic disease that is a constant threat to life) (Figure 3A). Risk of death is a rating given to the patient in both the surgical case form and all audit assessments. Figure 3B summarises risk of death ratings from treating surgeons for all operative cases, with risk of death rated as 'considerable' for 49.5% cases in 2021. Similarly, Figure 3C summarises data from assessors (for cases that have completed the audit process) with risk of death thought to be 'considerable' in 56.5% of cases.

**Figure 3: ASA and risk of death scores for SAASM cases**

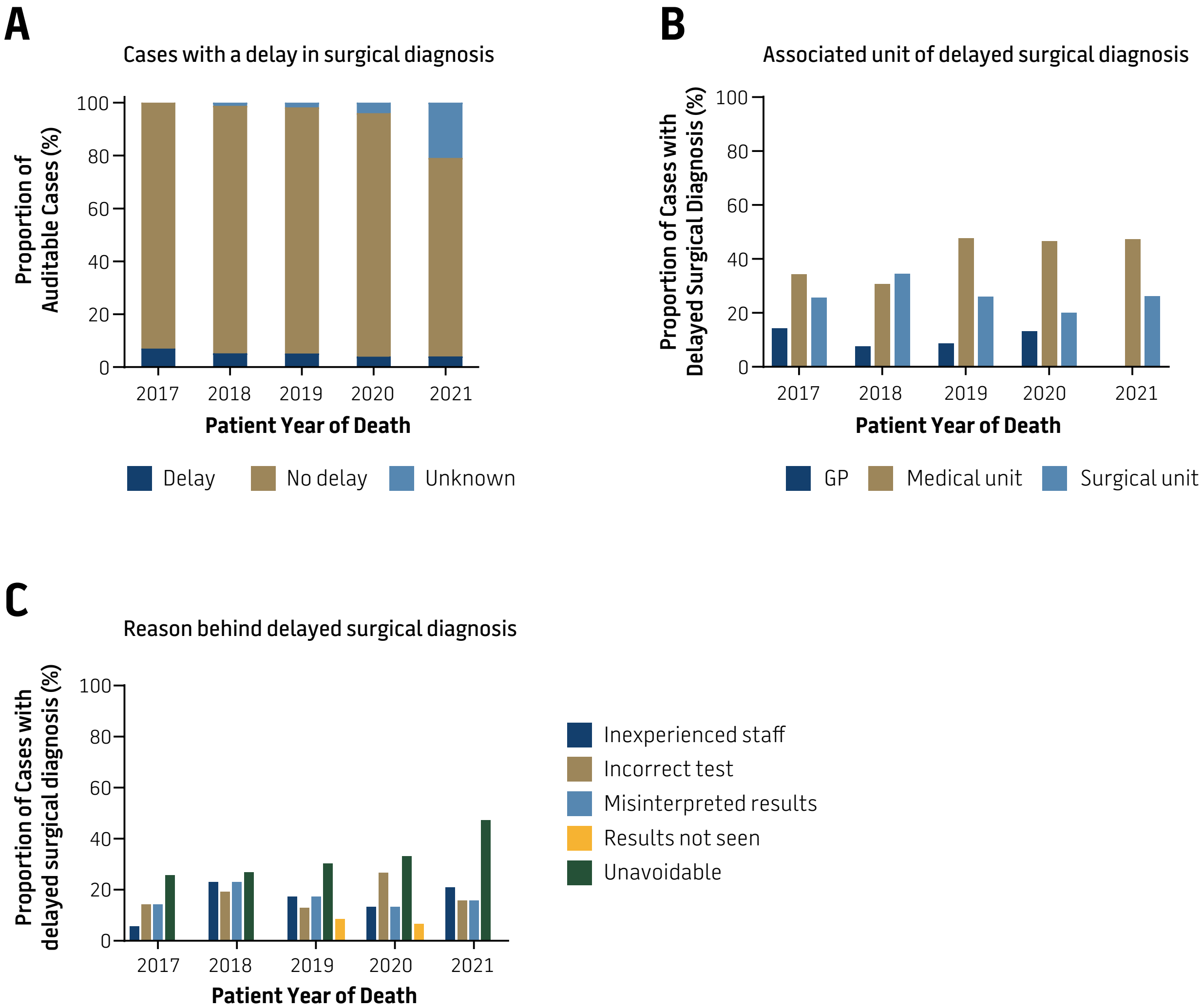



**A:** ASA score identified by treating surgeon as proportion of audited cases
**B:** Risk of death rating identified by treating surgeon as proportion of operative admissions
**C:** Risk of death rating identified by assessor as proportion of closed cases
**Note:**
ASA 1 = A normal healthy patient
ASA 2 = A patient with mild systemic disease
ASA 3 = A patient with severe systemic disease
ASA 4 = A patient with severe systemic disease that is a constant threat to life
ASA 5 = A moribund patient who is not expected to survive without the operation
ASA 6 = A declared brain-dead patient whose organs are being removed for donor purposes

## DELAYED PATIENT SURGICAL DIAGNOSIS

A delay in determining the surgical diagnosis may be reported by the treating surgeon when submitting the SCF, along with the health unit(s) primarily associated with the delay and the underlying cause. A delay in determining the surgical diagnosis was reported in 4.1% of cases in 2021, broadly consistent with previous years (Figure 4A). Of these delayed cases, 47.4% were primarily associated with the institutional medical unit (Figure 4B). While these delays were considered unavoidable for 47.4% of cases in 2021, there was a notable increase compared to 2020 (33.3%)(Figure 4C).

**Figure 4: Reported delays in determining the main surgical diagnosis**

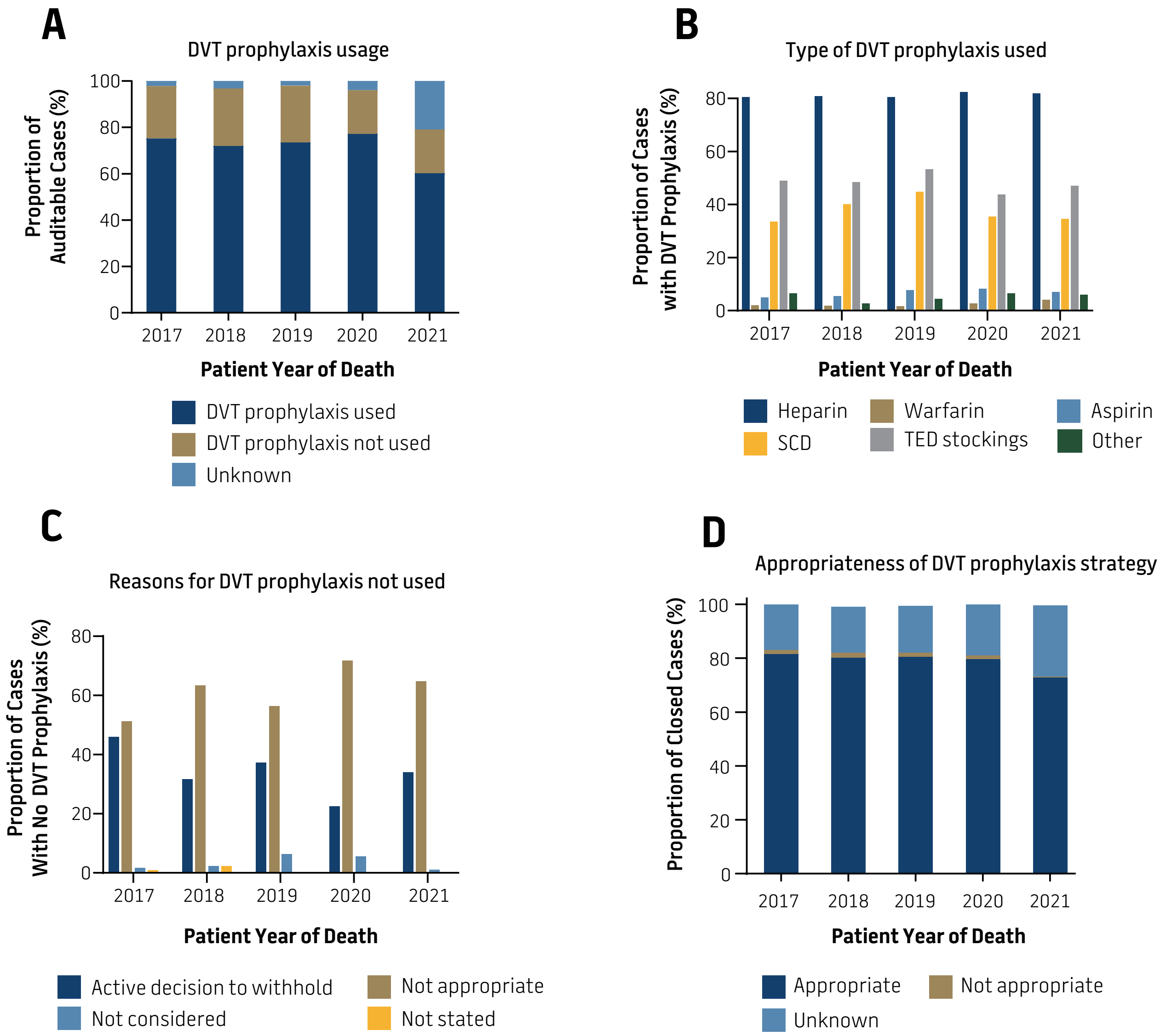



**A:** Proportion of cases per year where delays determining the surgical diagnosis were reported
**B:** Health units primarily responsible for the delay in diagnosis, according to treating surgeon (data not mutually exclusive)
**C:** Underlying causes of delay, according to treating surgeon (data not mutually exclusive)

## DEEP VEIN THROMBOSIS PROPHYLACTIC STRATEGIES

Deep vein thrombosis (DVT) prophylaxis was used in 60.3% of cases in 2021 (Figure 5A). (The relatively high proportion of cases for which the DVT prophylaxis strategy is unknown is due to unsubmitted data at the census date.) For those in whom DVT prophylaxis was employed in 2021, heparin was overwhelmingly the preferred form of prophylaxis (81.9% of cases), followed by the use of thromboembolic deterrent (TED) stockings (47.2%), and sequential compression devices (34.8%). This approach has remained consistent over time (Figure 5B). Non-use of DVT prophylaxis was substantially due to its use being considered inappropriate (64.8% of non-usage cases) and an active decision to withhold such treatment (34.1% of non-usage cases) for 2021 (Figure 5C). Following evaluation, assessors considered the DVT prophylactic strategy employed appropriate in most cases (72.9%), with active disapproval of the DVT prophylactic strategy being relatively rare (0.3%) for 2021 (Figure 5D), the lowest it has been in the 2017–2021 period. The proportion of cases for which assessors are unable to determine if the DVT prophylactic strategy was appropriate continues to remain concerningly high.

**Figure 5: DVT prophylaxis use among SAASM cases**

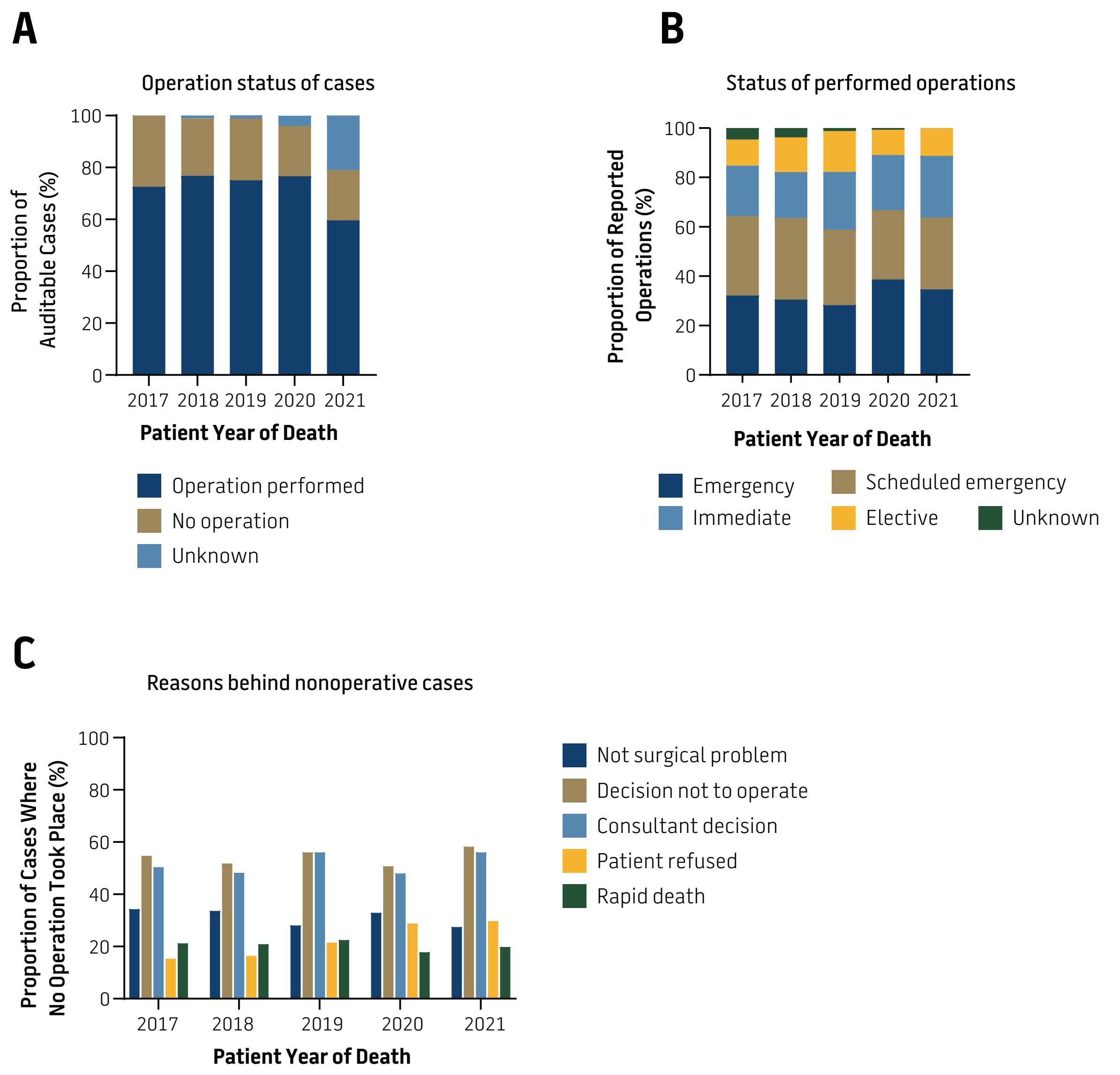



**A:** Proportion of cases per year in which DVT prophylaxis was used
**B:** Type of DVT prophylaxis used per year year (data not mutually exclusive)
**C:** Reasons given by treating surgeons per year why DVT prophylaxis was not used (data not mutually exclusive)
**D:** Assessor-determined appropriateness per year of DVT prophylaxis strategy

## PATIENT SURGICAL INTERVENTION AND ICU/HDU USAGE

Over half of the reported cases in 2021 (59.6%) underwent at least one surgical procedure during their admission (Figure 6A). Of these cases, 34.6% were considered to be an emergency operation while 29.1% were scheduled emergencies, following similar trends from 2017–2020 (Figure 6B). Among the cases that did not undergo a surgical procedure in 2021, an active decision not to operate was made in 58.2% of these nonoperative cases. Furthermore, in 29.7% of these nonoperative cases, the surgical procedure was refused by the patient (Figure 6C).

**Figure 6: Operative status of cases with urgency of operation and rationale for nonoperative cases**




**A:** Proportion of patients who underwent one or more operations during their last admission
**B:** Urgency of operation for patients who underwent one or more operations during their last admission (Emergency ≤24 hours postadmission, immediate ≤2 hours postadmission, scheduled emergency ≥24 hours postadmission, elective = agreed time prior to admission)
**C:** Rationale for nonoperative cases during their last admission (data not mutually exclusive)

## OPERATION TYPES, POSTOPERATIVE COMPLICATIONS AND ICU/HDU USAGE

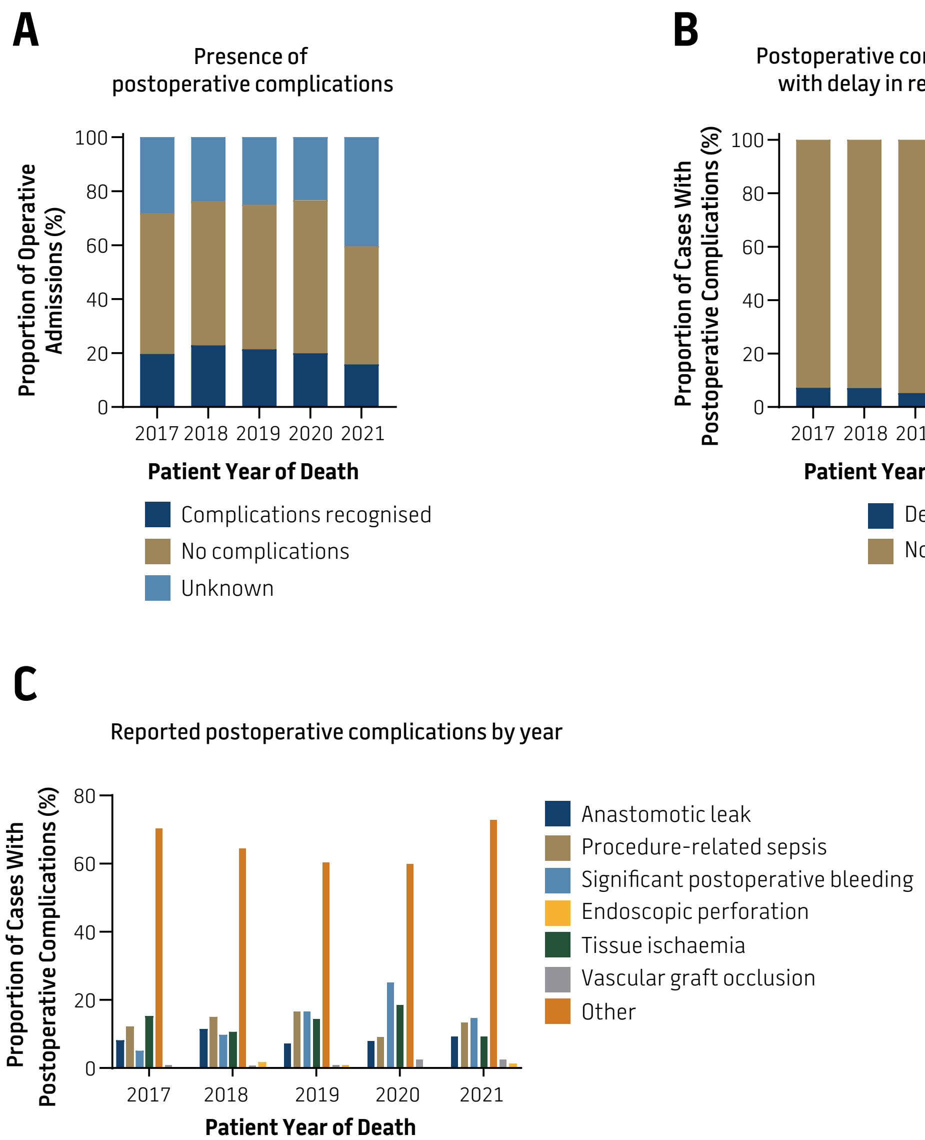
The most common types of operations for cases reported to SAASM are summarised in Table 3. Operations have been aggregated into parent groups (according to READ code designation[1]) for ease of summary. Similar to 2017–2019, the most common operation type for 2021 was 'soft tissue operations'.

**Table 3: The 5 most common operation types for SAASM cases**

| | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|
| Operation types | | | | | |
| **1** | Soft tissue operations | Soft tissue operations | Soft tissue operations | Other bone and joint operations | Soft tissue operations |
| **2** | Skin operations | Other bone and joint operations | Other bone and joint operations | Heart operations | Other bone and joint operations |
| **3** | Other bone and joint operations | Upper digestive tract operations | Artery and vein operations | Soft tissue operations | Lower digestive tract operations |
| **4** | Upper digestive tract operations | Artery and vein operations | Lower digestive tract operations | Lower digestive tract operations | Upper digestive tract operations |
| **5** | Lower digestive tract operations | Heart operations | Miscellaneous operations | Upper digestive tract operations | Artery and vein operations |

In 2021, postoperative complications were reported in 15.8% of cases (Figure 7A). Of those cases, a delay in recognising the complication was reported in 6.8% of cases, the second lowest in the 2017–2021 period (Figure 7B). The main postoperative complications noted in 2021 were other factors for 73.0% of cases, while significant postoperative bleeding and procedure-related sepsis occurred in 14.9% and 13.5% of cases, respectively (Figure 7C).

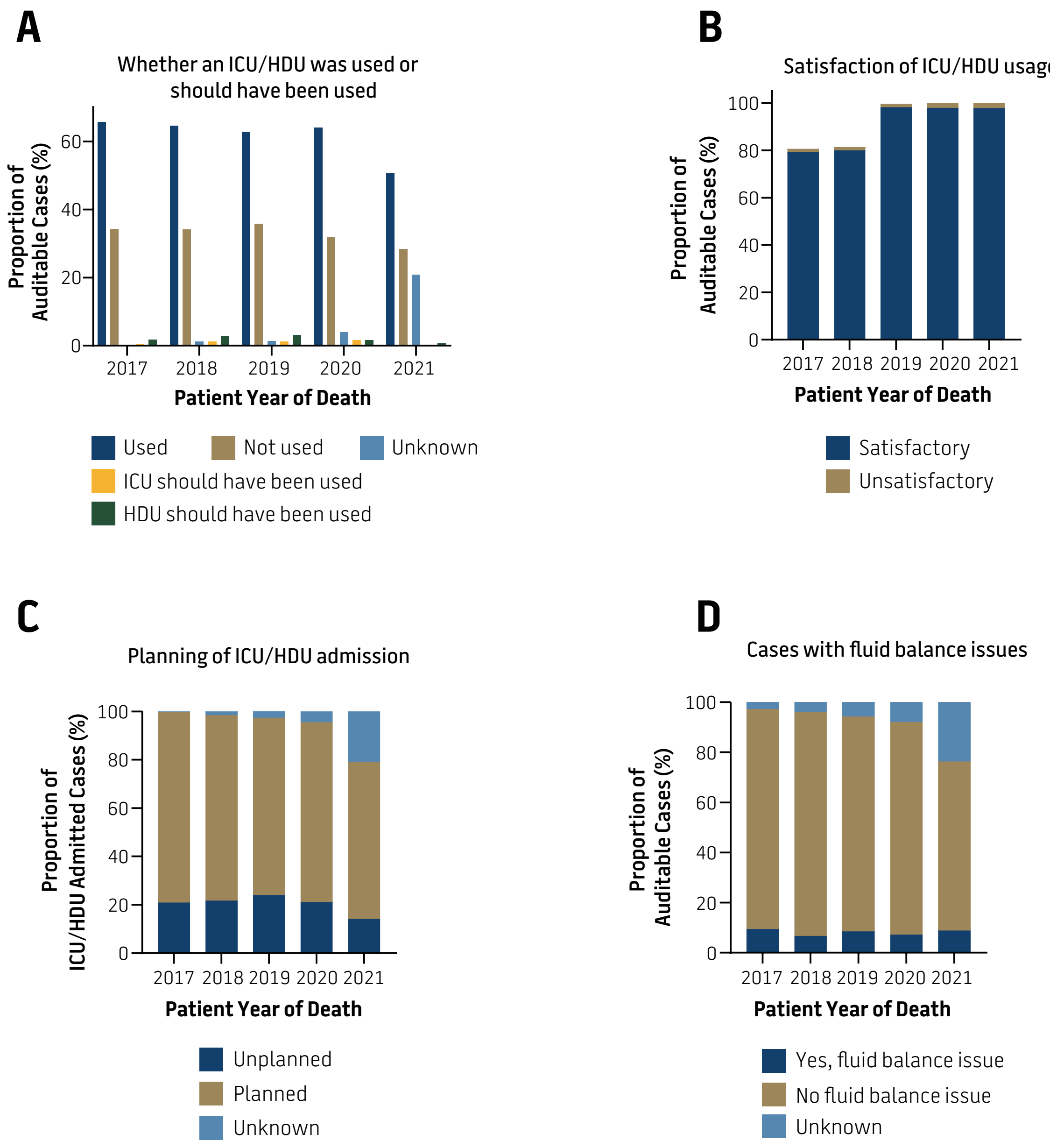
**Figure 7: Postoperative complications per year**




**A:** Proportion of operative admissions per year noted to have at least one complication
**B:** Proportion of operative admissions per year in which there was a delay in recognising postoperative complications
**C:** Types of reported postoperative complications per year (data not mutually exclusive)

An intensive care unit (ICU) or high dependency unit (HDU) was used in approximately half of cases (50.6%) for which an operation was performed in 2021 (Figure 8A). Of cases where an ICU/HDU was used, 97.9% were considered to be satisfactory usage, similar to previous years (Figure 8B). Unplanned admissions to ICU/HDU were lower in 2021 (14.1%), in comparison to 2020 (21.0%) and 2019 (24.1%) (Figure 8C). Fluid balance was reported as an issue in 8.8% of cases in 2021 (Figure 8D).

**Figure 8: ICU/HDU usage and patient fluid management**

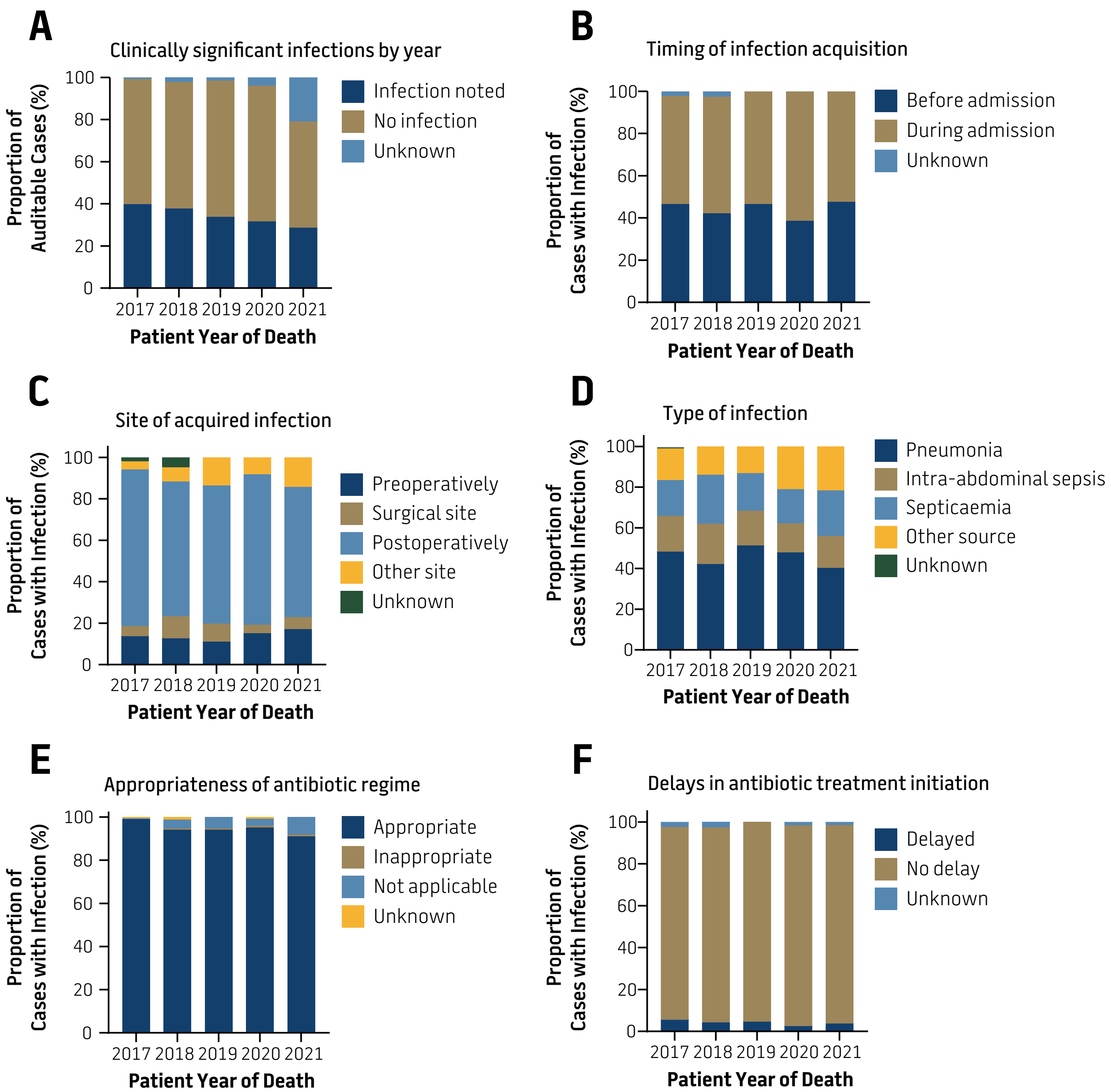



**A:** Proportion of cases per year in which ICU/HDU use was necessary
**B:** Proportion of cases per year in which ICU/HDU use was satisfactory
**C:** Proportion of cases per year with an unplanned admission to ICU/HDU
**D:** Proportion of cases per year in which fluid balance was an issue

## CLINICALLY SIGNIFICANT INFECTIONS

Clinically signification infections (CSI) are reported by the treating surgeon on the surgical case form and these data are presented in Figure 9. CSIs were reported in 28.6% of cases in 2021, which continues a trend towards less CSIs being reported since 2017 (Figure 9A). For those CSIs reported in 2021, 52.2% were acquired during admission (Figure 9B), with 62.9% of these having occurred postoperatively (Figure 9C). Pneumonia was the most common infection reported by treating surgeons (40.3%) followed by septicaemia (22.4%) and other sources (21.6%), with pneumonia at its lowest reported proportion in the 2017–2021 period (Figure 9D). The antibiotic regime administered to patients was considered appropriate by the treating surgeon in 91.0% of cases (Figure 9E), and a delay in administration of this treatment was only reported in 3.7% of CSI-related cases, the second lowest of the 2017–2021 period.

**Figure 9: Clinically significant infections among SAASM cases**

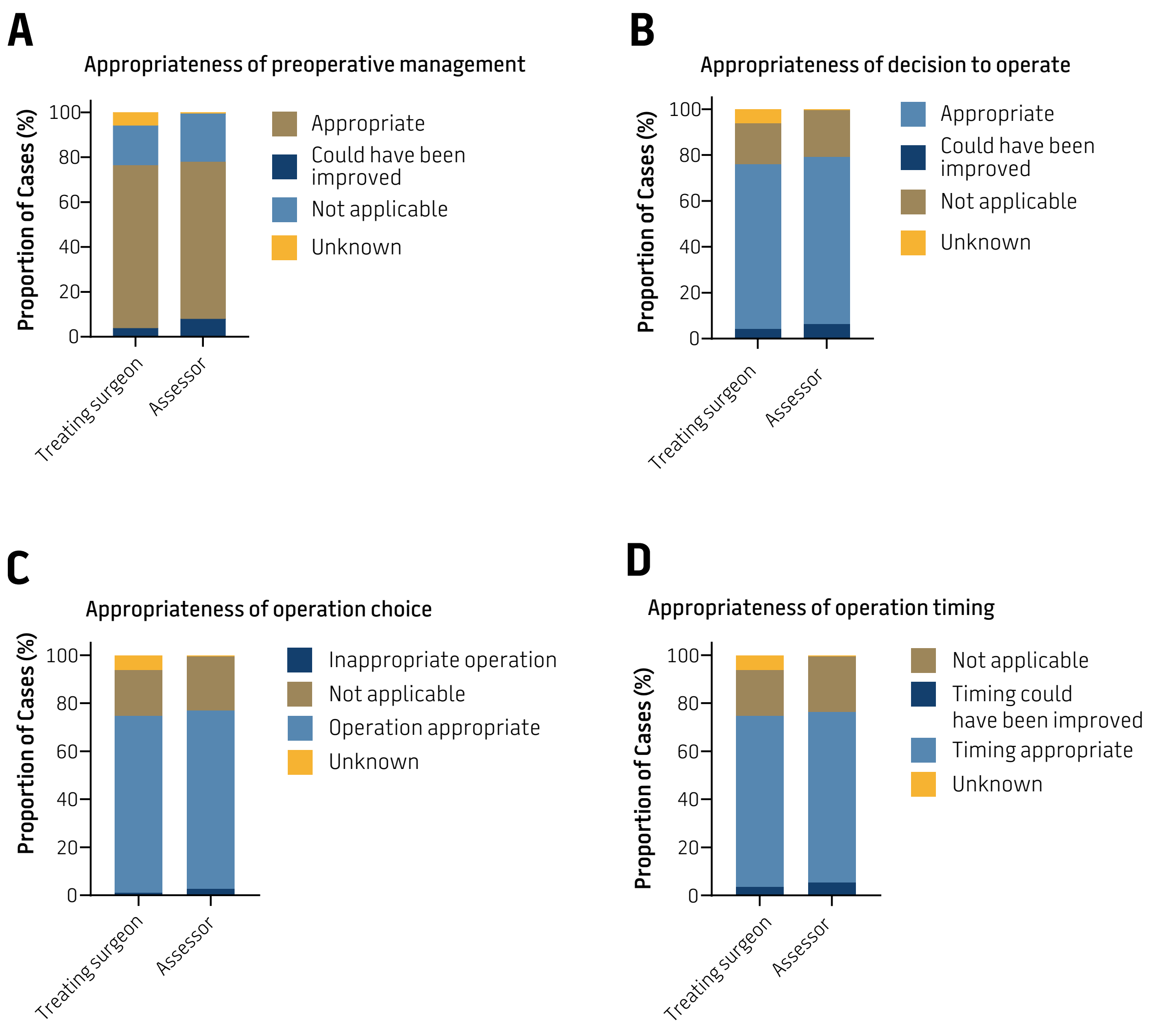



**A:** Proportion of patients per year where a clinically significant infection was reported by the treating surgeon
**B:** Admission period per year during which infection was acquired
**C:** Site of infection per year
**D:** Type of infection acquired per year
**E:** Treating surgeon assessment of appropriateness of antibiotic regime per year
**F:** Delay in initiation of antibiotic treatment per year

## OVERALL PATHWAY OF PATIENT CARE

An important aspect to the audit process is the opportunity for surgeons and assessors to indicate whether various parts of the overall pathway of care for a patient could have been improved. Factors influencing preoperative, intraoperative and postoperative care are considered, as well as the decision to operate, and timing and choice of operation (Figure 10 and Figure 11). An important feature of the audit process is the identification of potential areas for improvement following independent assessment not previously recognised by the treating surgeon. This is apparent in Figure 10A where treating surgeons recognised preoperative management could have been improved in 3.8% of cases, while in comparison, assessors were twice as likely to suggest this area for improvement (7.9% of cases). Similar observations were also seen regarding the appropriateness of decision to operate (Figure 10B), operation choice (Figure 10C) and operation timing (Figure 10D), with assessors more likely to report room for improvement than treating surgeons.

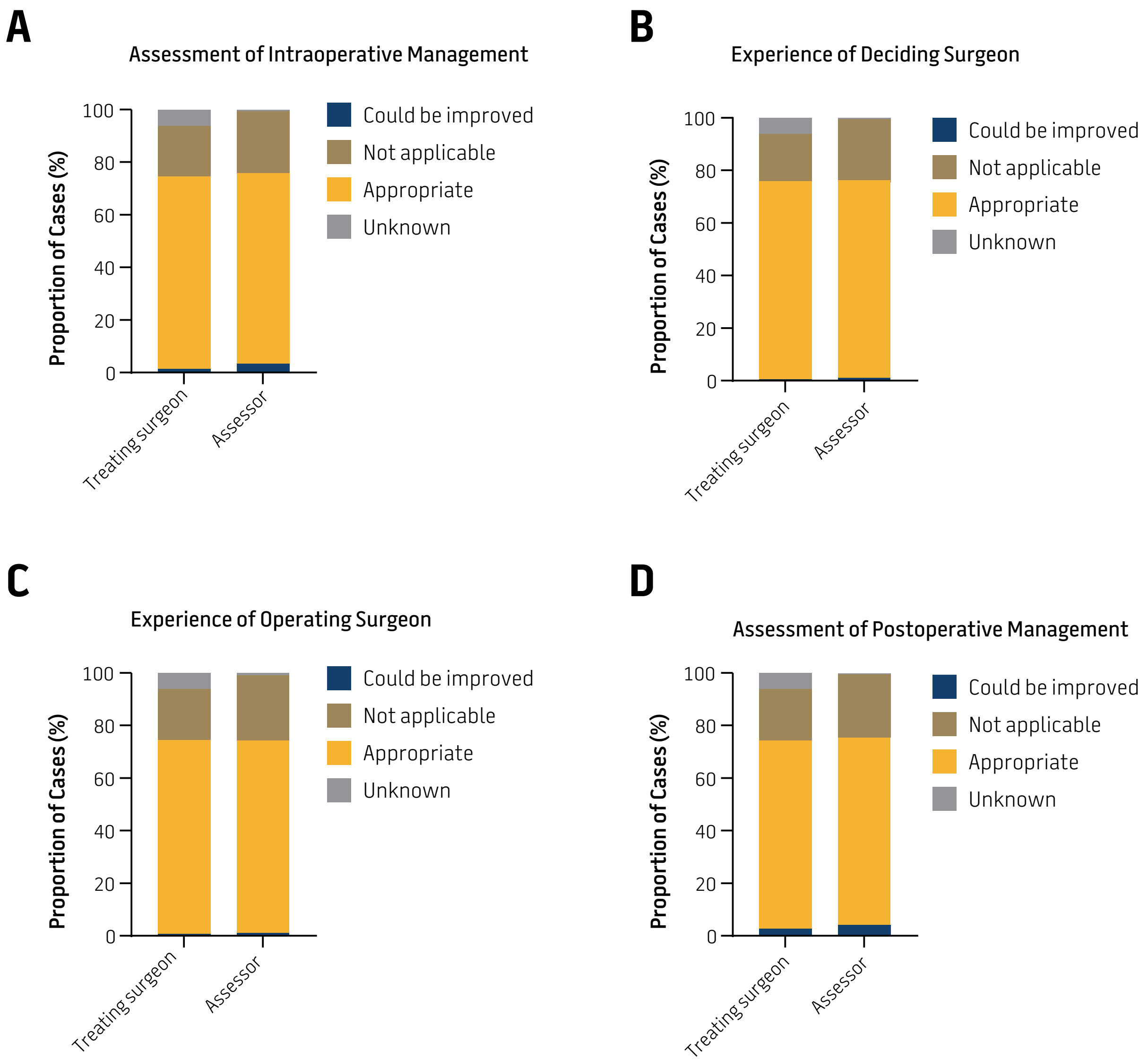
**Figure 10: Evaluation of the preoperative patient management pathway (2017–2021)**




**A:** Proportion of cases where preoperative management could be improved
**B:** Proportion of cases where the decision to operate could be improved
**C:** Proportion of cases where the choice of operation could be improved
**D:** Proportion of cases where the timing of operation(s) could be improved

The trend of assessors being more critical than treating surgeons was also apparent for intraoperative management (Figure 11A), the experience of deciding surgeons (Figure 11B) and operating surgeons (Figure 11C), and postoperative management (Figure 11D).

**Figure 11: Evaluation of the intraoperative patient management pathway (2017–2021)**

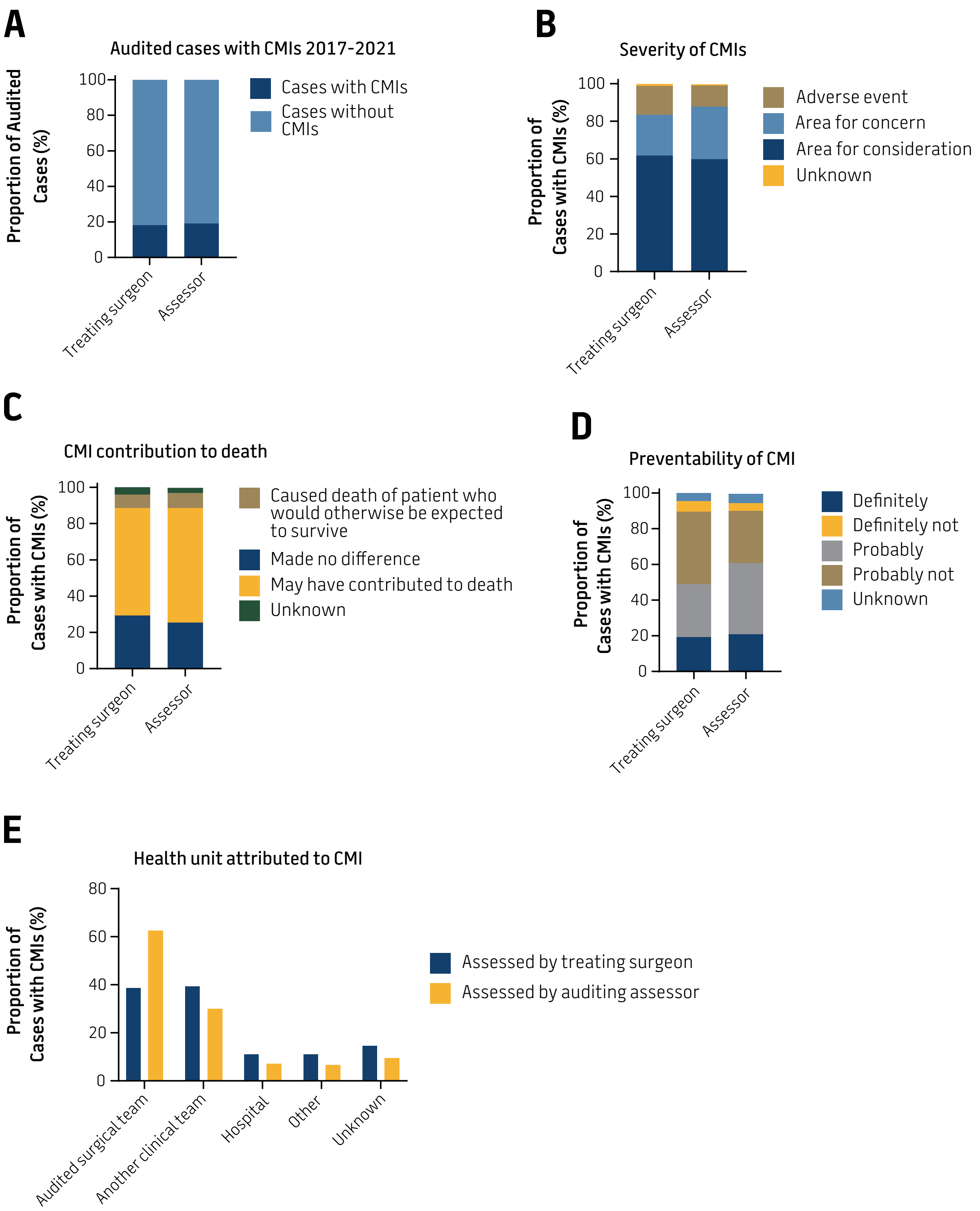



**A:** Proportion of cases where intraoperative management could be improved
**B:** Proportion of cases where the experience of the surgeon deciding to operate could be improved
**C:** Proportion of cases where the experience of the operating surgeon could be improved
**D:** Proportion of cases where postoperative management could be improved

## CLINICAL MANAGEMENT ISSUES

The overall surgical management of a case is also evaluated with respect to whether distinct CMIs were identified by surgeons and/or assessors. In the period 2017–2021, treating surgeons identified 417 CMIs from 18.1% of audited cases (387 cases), while assessors identified 580 CMIs from 19.2% (409 cases) of audited cases (Figure 12A). The severity of the CMIs were determined as predominately areas for consideration by treating surgeons and assessors, however, assessors did determine a slightly larger proportion as areas for concern (28.1%) compared to treating surgeons (21.5%) (Figure 12B). Whether the CMI was thought to contribute to death displayed similar patterns between treating surgeons and assessors (Figure 12C). Treating surgeons classified a majority of CMIs as probably not preventable (40.5%) followed by probably preventable (29.5%). By contrast, assessors classified 39.8% of CMIs as probably preventable followed by 29.1% as probably not preventable (Figure 12D). The audited surgical team was attributed to the CMI by treating surgeons in 38.6% of cases, markedly less than what was attributed by assessors (62.6%) (Figure 12E).

**Figure 12: CMI classifications as identified by treating surgeons and assessors**




**A:** Proportion of cases where at least one CMI was reported by surgeons or assessors
**B:** Severity of CMIs reported. (Areas of 'consideration' are considered minor, areas of 'concern' are of moderate severity and 'adverse events' are issues where the patient may have survived, had they not occurred.)
**C:** Extent to which the CMI was thought to have contributed to patient demise
**D:** Extent to which the CMI was considered potentially preventable
**E:** Health unit to which the CMI was primarily attributable (not mutually exclusive)

The more frequently reported CMIs have been summarised in Table 4. CMIs have been aggregated into parent groups (according to READ code designation[1]) for ease of summary. The most common CMIs for the overall cohort in 2021 were delays and incorrect or inappropriate therapy.

**Table 4: The 5 most common CMIs as identified by treating surgeons and assessors**

| | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|
| CMIs (surgeon-identified) | | | | | |
| 1 | Delays | Incorrect/ inappropriate therapy | Incorrect/ inappropriate therapy | Delays | Delays |
| 2 | Incorrect/ inappropriate therapy | Delays | Delays | Incorrect/ inappropriate therapy | Incorrect/ inappropriate therapy |
| 3 | Communication failures | General complications of treatment | Open surgery, organ-related technical | Assessment problems | Communication failures |
| 4 | Assessment problems | Communication failures | Communication failures | Diagnosis-related complications | Drug-related complications |
| 5 | Anaesthesia-related complications | Problems due to failure to use facilities | General complications of treatment | General complications of treatment | Laparoscopic surgery, organ-related technical |
| CMIs (assessor-identified) | | | | | |
| 1 | Incorrect/ inappropriate therapy | Incorrect/ inappropriate therapy | Incorrect/ inappropriate therapy | Incorrect/ inappropriate therapy | Incorrect/ inappropriate therapy |
| 2 | Delays | Delays | Delays | Delays | Delays |
| 3 | Assessment problems | Communication failures | Assessment problems | Assessment problems | Assessment problems |
| 4 | Communication failures | Assessment problems | Communication failures | Diagnosis-related complications | Diagnosis-related complications |
| 5 | General complications of treatment | Open surgery, organ-related technical | Diagnosis-related complications | Open surgery, organ-related technical | Communication failures |

The dataset was investigated to identify those clinical factors that seemed to be strongly associated with the presence of CMIs (as identified by assessors). Basic analysis ($\chi^2$ test for categorical variables, Mann-Whitney U test for continuous variables) was used to identify those factors which individually showed differences in the prevalence of CMIs. These are listed in Table 5 (Univariate Correlates).

The factors identified by basic analysis were then compared with each other in a complex multivariate model in order to identify those variables contributing most strongly to the presence of CMIs in the overall cohort. These data are also listed in Table 5 (Multivariate Correlates). The directions of these relationships have been summarised in Figure 13.

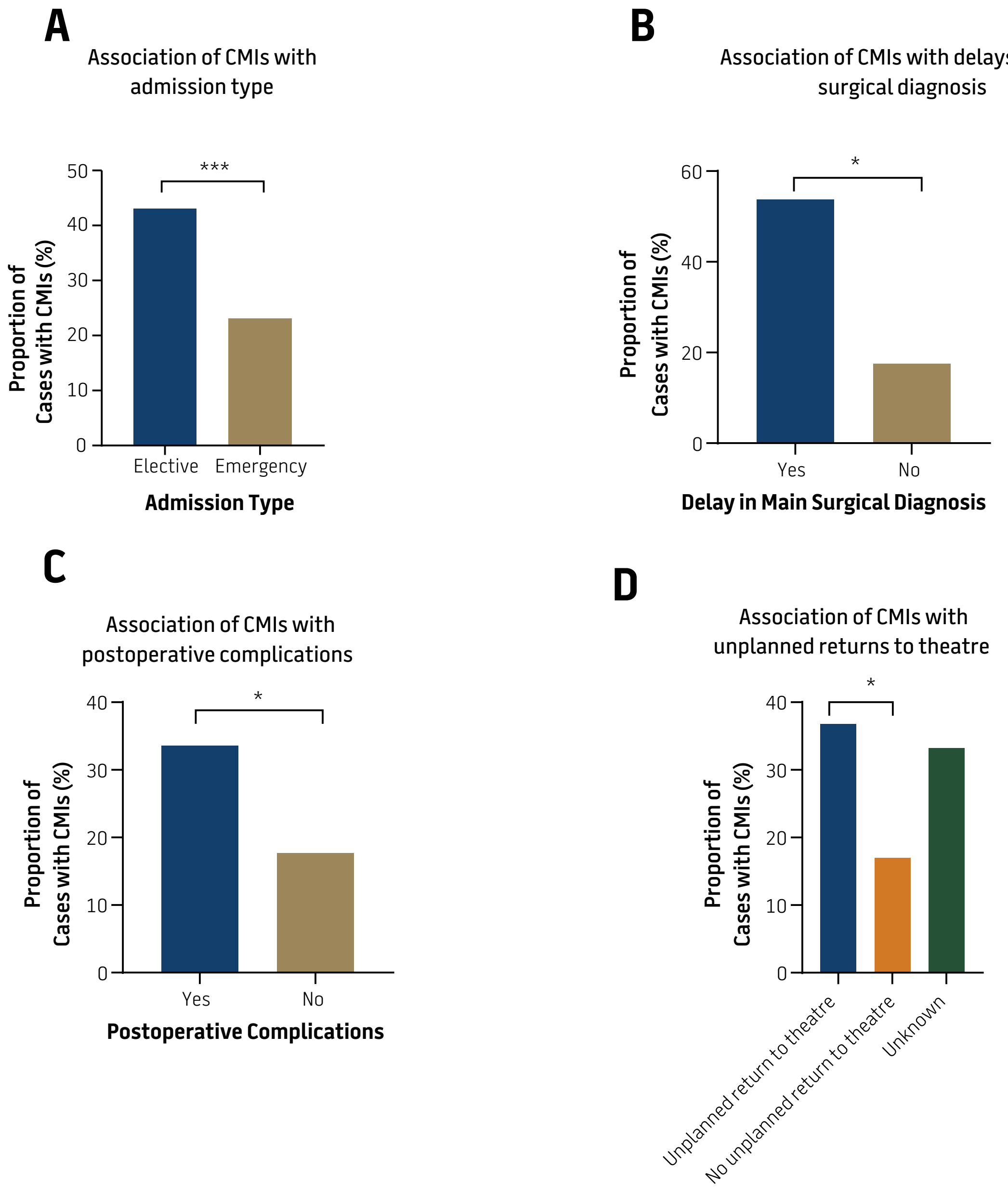
**Table 5: Correlates of the presence of assessor-identified CMIs**

| Univariate Correlates | p |
|---|---|
| Specialty | <0.001 |
| Admission type | <0.001 |
| ASA status | <0.05 |
| Patient transferred | <0.001 |
| Delay in surgical diagnosis | <0.001 |
| Operative admission | <0.001 |
| Risk of death (identified by surgeon) | <0.01 |
| Postoperative complications | <0.001 |
| DVT prophylaxis status | <0.001 |
| Unplanned return to theatre | <0.001 |
| Unplanned ICU/HDU admission | <0.001 |
| Unplanned readmission | <0.01 |
| Fluid balance issues | <0.05 |
| Treatment in ICU/HDU | <0.001 |
| Age | <0.001 |
| Length of stay | <0.001 |
| **Multivariate Correlates** | **p** |
| Admission type (elective) | <0.001 |
| Delay in surgical diagnosis | <0.001 |
| Postoperative complications | <0.05 |
| Unplanned return to theatre | <0.05 |
| Treatment in ICU/HDU | 0.058 |
| Length of stay | 0.066 |

Note: p≤0.05 indicates that the result has a 5% chance or less of occurring randomly.

Elective admissions, cases where a delay in determining the surgical diagnosis was reported, cases where postoperative complications occurred, and cases where there was an unplanned return to theatre, were all proportionately more likely to have CMIs present (Figure 13). Trends were observed towards CMIs more likely to be present in patients that were admitted to ICU/HDU, and in patients with extended lengths of stay, but these relationships did not achieve statistical significance.

**Figure 13: Multivariate correlates of the emergence of CMIs as identified by assessors in SAASM cases**

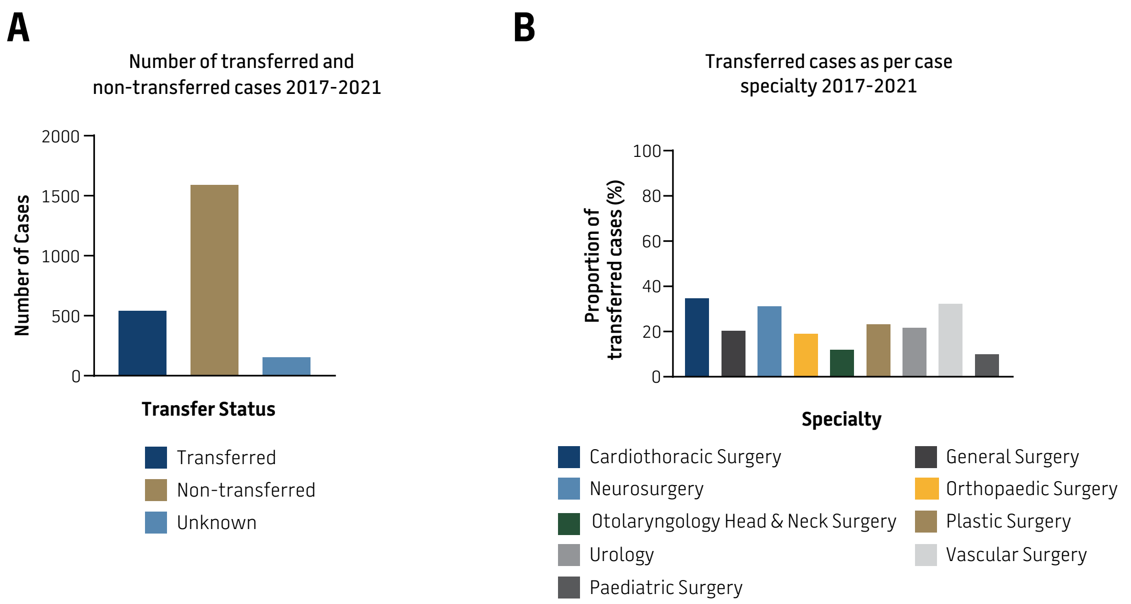



**A:** Proportion of elective versus emergency admission cases with CMIs present
**B:** Proportion of cases with CMIs where a delay in determining the main surgical diagnosis was reported
**C:** Proportion of cases with CMIs where postoperative complications were reported
**D:** Proportion of cases with CMIs where an unplanned return to theatre was reported
Note: *=p<0.05, **=p<0.01, ***=p<0.001

## PATIENT TRANSFERS

South Australian hospitals experience high levels of patient transfers between hospitals, with 542 (out of 2,287) cases from 2017–2021 being transferred (Figure 14A). Cardiothoracic Surgery, Vascular Surgery, and Neurosurgery, respectively, were the specialties with the largest proportion of their cases transferred (Figure 14B).

**Figure 14: Number of transferred patients and the proportion of cases from each specialty to be transferred**




**A:** Number of transferred and non-transferred cases
**B:** Proportion of transferred cases per surgical specialty

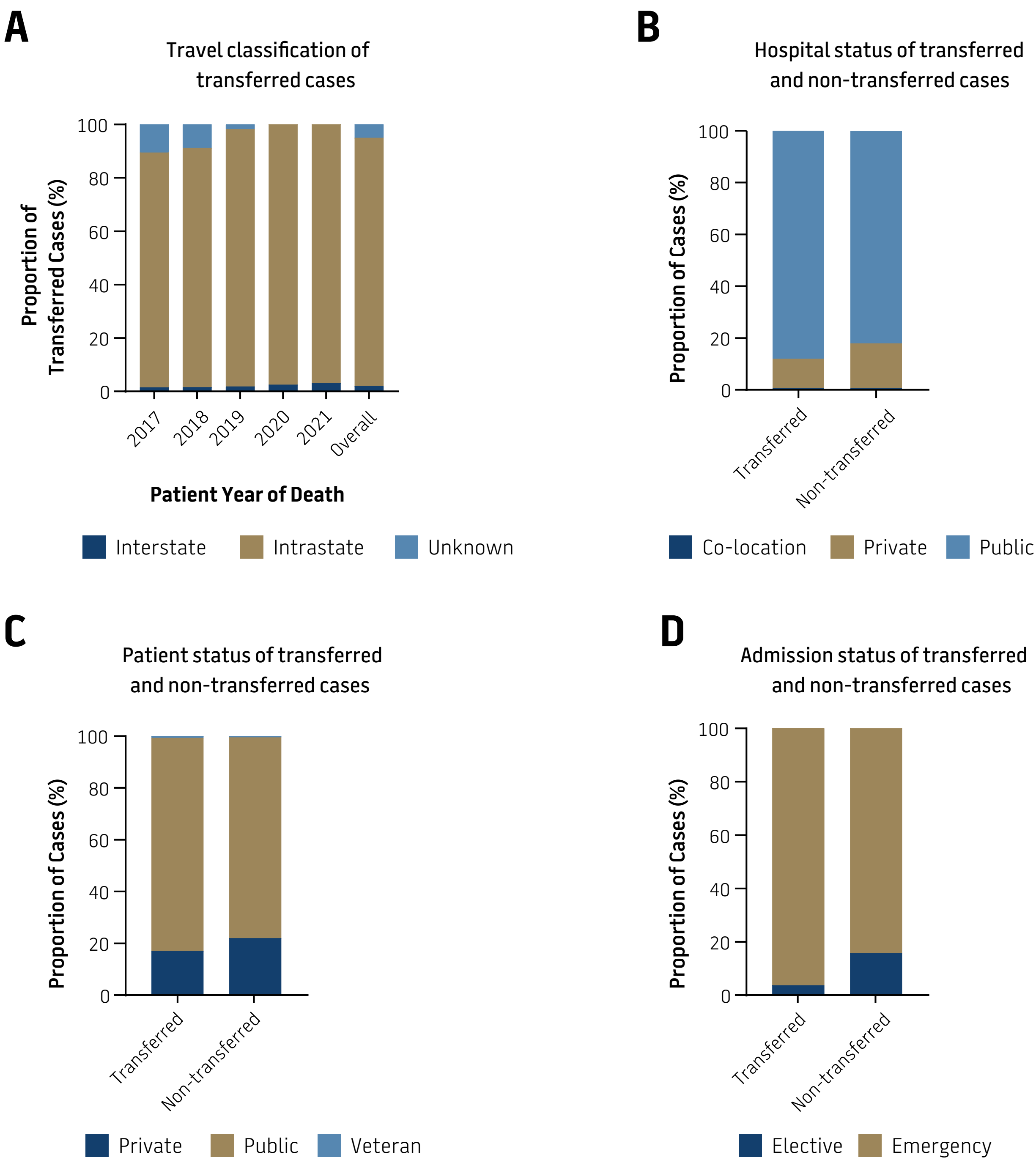
The demographics of transferred versus non-transferred patients have been summarised in Table 6. Transferred patients were much more likely to be public, emergency admissions to public (Principal Referral) hospitals than their non-transferred counterparts. They were also more likely to be male, of Aboriginal and/or Torres Strait Islander descent, and have shorter lengths of stay.

**Table 6: Patient demographics of transferred and non-transferred SAASM cases**

| | Transferred Patients | Non-transferred Patients | p |
|---|---|---|---|
| Age (median years;IQR) | 75 (62–84) | 78 (66–86) | <0.001 |
| Male:Female (%:%) | 62.4:37.6 | 54.6:45.4 | <0.01 |
| Aboriginal and/or Torres Strait Islander Descent (%) | 6.5 | 1.2 | <0.001 |
| Patient Status (%) | | | 0.051 |
| *Private* | 17.1 | 22 | |
| *Public* | 82.2 | 77.4 | |
| *Veteran* | 0.7 | 0.6 | |
| Admission Status (%) | | | <0.001 |
| *Elective* | 3.7 | 15.7 | |
| *Emergency* | 96.3 | 84.3 | |
| Hospital Status (%) | | | <0.01 |
| *Private* | 11.3 | 17.4 | |
| *Public* | 88 | 82 | |
| *Co-Location* | 0.7 | 0.6 | |
| Hospital Type (%) | | | <0.001 |
| *Principal referral hospitals* | 74 | 62.3 | |
| *Public acute group A hospitals* | 13.5 | 18.5 | |
| *Public acute group B hospitals* | 0.7 | 2.1 | |
| *Public acute group C hospitals* | 0 | 0.1 | |
| *Private acute group A hospitals* | 4.6 | 9.6 | |
| *Private acute group B hospitals* | 5.9 | 6 | |
| *Private acute group C hospitals* | 0 | 0 | |
| *Children's hospitals* | 1.3 | 1.4 | |
| Length of stay (median days;IQR) | 7 (3–17) | 9 (4–20) | <0.001 |

Most transfers were predominately from intrastate hospitals, with 98.6% of all transferred SAASM cases in 2021 from intrastate hospitals (Figure 15A). For the majority of cases, the patients were transferred to public hospitals (Figure 15B), while patients were also predominately public (Figure 15C), and a larger proportion were emergency admissions (with comparison to non-transferred cases, Figure 15D).

**Figure 15: Demographics of transferred SAASM cases compared to non-transferred cases**




**A:** Proportion of transferred cases per year from interstate and intrastate hospitals
**B:** Hospital status of transferred and non-transferred cases
**C:** Patient status of transferred and non-transferred patients
**D:** Admission status of transferred and non-transferred cases

Table 7 lists the most common diagnoses on admission to hospital, diagnoses requiring surgical intervention, and causes of death according to the treating surgeon for transferred and non-transferred patients. The most common admission and surgical diagnosis for both transferred and non-transferred patients was fracture of lower limb (e.g. neck of femur fracture), followed by diseases of the intestines and peritoneum (e.g. small bowel ischaemia) and cerebrovascular disease (e.g. stroke). Similarly, the most common cause of death was endocrine gland diseases (e.g. diabetes mellitus) followed by heart disease (e.g. myocardial ischaemia) for both transferred and non-transferred patients.

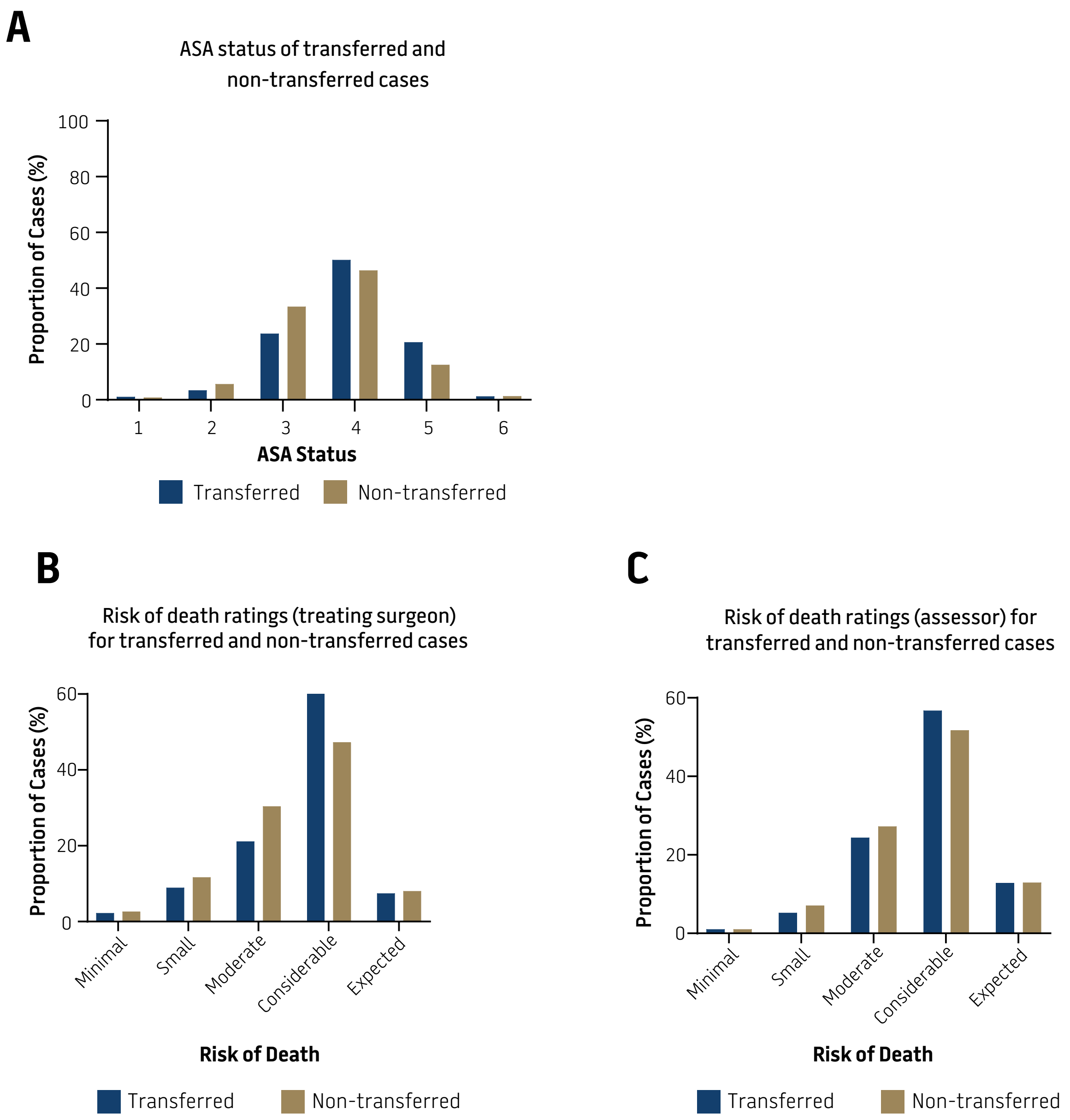
**Table 7: The 5 most common diagnoses for transferred and non-transferred SAASM cases**

| | Transferred | Non-transferred |
|---|---|---|
| Admission Diagnoses | | |
| **1** | Fracture of lower limb | Fracture of lower limb |
| **2** | Other diseases of the intestines and peritoneum | Other diseases of the intestines and peritoneum |
| **3** | Cerebrovascular disease | Cerebrovascular disease |
| **4** | Arterial, arteriole and capillary disease | Liver, biliary, pancreas + gastrointestinal diseases NEC* |
| **5** | Other bacterial diseases | Arterial, arteriole and capillary disease |
| Surgical Diagnoses | | |
| **1** | Fracture of lower limb | Fracture of lower limb |
| **2** | Other diseases of the intestines and peritoneum | Other diseases of the intestines and peritoneum |
| **3** | Cerebrovascular disease | Cerebrovascular disease |
| **4** | Arterial, arteriole and capillary disease | Liver, biliary, pancreas + gastrointestinal diseases NEC* |
| **5** | Other bacterial diseases | Malignant neoplasm of digestive organs and peritoneum |
| Cause of Death | | |
| **1** | Other endocrine gland diseases | Other endocrine gland diseases |
| **2** | Other forms of heart disease | Other forms of heart disease |
| **3** | Other bacterial diseases | Other respiratory system diseases |
| **4** | Cerebrovascular disease | Other bacterial diseases |
| **5** | Surgical and medical care complications NEC* | Cerebrovascular disease |

*Note: NEC = not elsewhere classified

The most common ASA status for transferred patients was 4 (a patient with severe systemic disease that is a constant threat to life), similar to non-transferred patients (Figure 16A). According to treating surgeons and assessors, the most common risk of death rating was 'considerable' for both transferred and non-transferred patients (Figure 16B and Figure 16C).

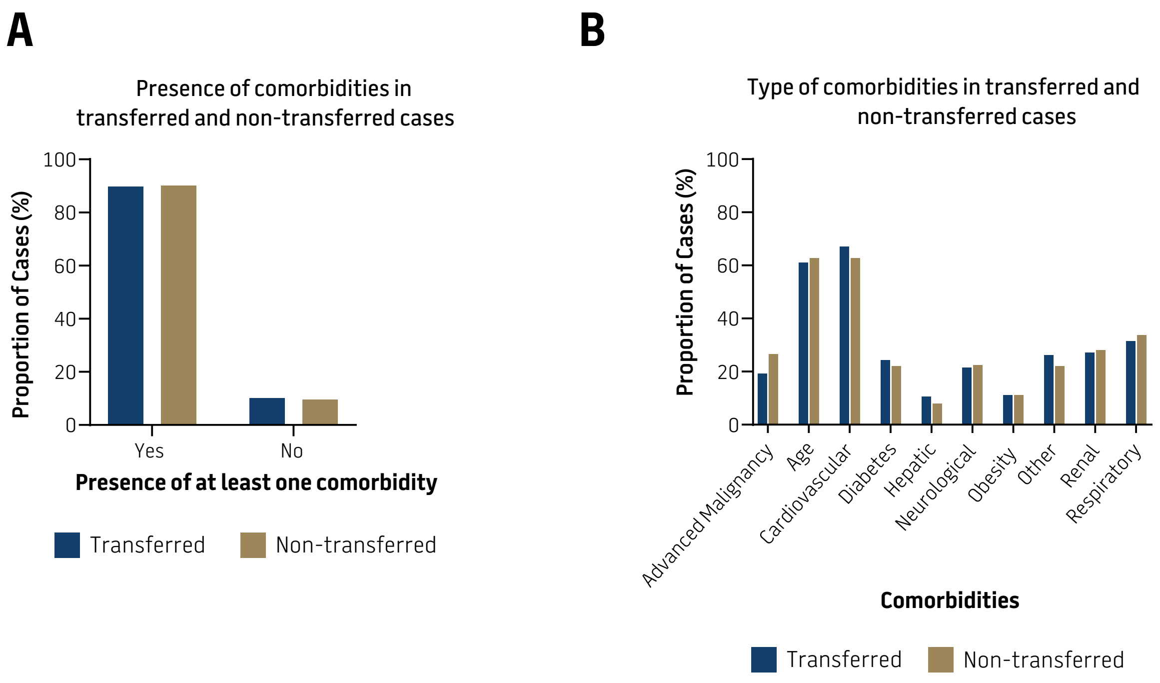
**Figure 16: ASA and risk of death scores for SAASM cases with transferred patients**




**A:** Proportion of transferred and non-transferred cases according to ASA status
**B:** Proportion of transferred and non-transferred cases according to risk of death as identified by treating surgeon
**C:** Proportion of transferred and non-transferred cases according to risk of death as identified by assessor
**Note:**
ASA 1 = A normal healthy patient
ASA 2 = A patient with mild systemic disease
ASA 3 = A patient with severe systemic disease
ASA 4 = A patient with severe systemic disease that is a constant threat to life
ASA 5 = A moribund patient who is not expected to survive without the operation
ASA 6 = A declared brain-dead patient whose organs are being removed for donor purposes

The proportion of cases with at least one comorbidity reported was very similar between transferred and non-transferred patients (Figure 17).

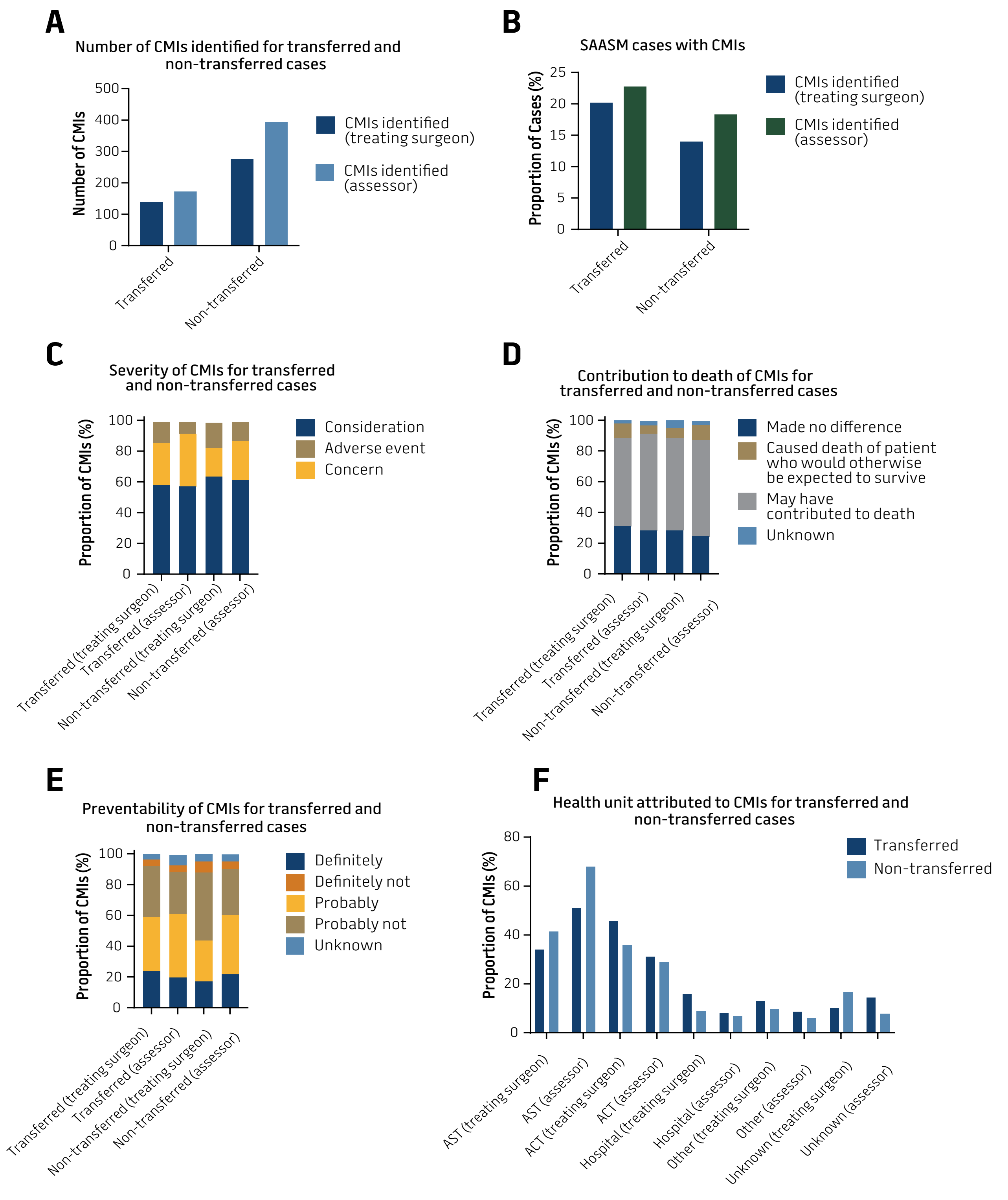
**Figure 17: Presence of comorbidities among transferred and non-transferred patients**




**A:** Proportion of transferred and non-transferred cases with at least one comorbidity
**B:** Comorbidities present among transferred and non-transferred patients (not mutually exclusive)

While fewer CMIs overall (Figure 18A) were reported in transferred cases by both treating surgeons (138 CMIs identified in transferred cases vs 275 in non-transferred cases) and assessors (173 CMIs identified in transferred cases vs 393 in non-transferred cases), a larger proportion of transferred cases were reported having CMIs present when compared to non-transferred cases (Figure 18B). Most CMIs identified in transferred cases were areas of consideration, however, in both transferred and non-transferred CMIs, assessors graded larger proportions as areas for concern (though less as adverse events) compared to treating surgeons (Figure 18C). In transferred cases, both treating surgeons and assessors displayed relative concordance when rating the preventability of identified CMIs, though this was not the case when considering non-transferred patients (Figure 18E). Treating surgeons mostly indicated that CMIs were attributable to another clinical team for transferred cases (in comparison to the audited surgical team for non-transferred cases), whereas assessors indicated that CMIs were predominately attributable to the audited surgical team for both cohorts (Figure 18F).

**Figure 18: CMI classifications in transferred patients as identified by treating surgeons and assessors**




**A:** Number of CMIs identified by treating surgeons and assessors for transferred and non-transferred cases
**B:** Proportion of cases where CMIs were reported in transferred and non-transferred cases
**C:** Severity of CMIs in transferred and non-transferred cases
**D:** CMI contribution to the death of transferred and non-transferred patients
**E:** Preventability of CMIs in transferred and non-transferred patients
**F:** Health unit attributed to CMIs in transferred and non-transferred patients, AST = audited surgical team, ACT = another clinical team

The most frequently reported CMIs for transferred and non-transferred cases are listed in Table 8. The most commonly identified CMIs by the treating surgeon and assessor for transferred cases were delays (e.g. delay to operation) and incorrect/inappropriate therapy (e.g. postoperative care unsatisfactory), of which the inverse was true for non-transferred cases. Interestingly, the third most common CMI for transferred cases was communication failures.

**Table 8: The 5 most common CMIs for SAASM cases (transferred vs non-transferred patients)**

| | Transferred | Non-transferred |
|---|---|---|
| Clinical Management Issues (Surgeon-identified) | | |
| **1** | Delays | Incorrect/inappropriate therapy |
| **2** | Incorrect/inappropriate therapy | Delays |
| **3** | Communication failures | General complications of treatment |
| **4** | Transfer problems | Assessment problems |
| **5** | Open surgery, organ-related technical | Communication failures |
| Clinical Management Issues (Assessor-identified) | | |
| **1** | Delays | Incorrect/inappropriate therapy |
| **2** | Incorrect/inappropriate therapy | Delays |
| **3** | Communication failures | Assessment problems |
| **4** | Diagnosis-related complications | Open surgery, organ-related technical |
| **5** | General complications of treatment | Communication failures |

Table 9 lists the most common operation types for transferred and non-transferred patients. The most common operation types for transferred patients were 'other bone and joint operations' (e.g. joint operations) followed by 'soft tissue operations' (e.g. primary hernia repair), while the inverse was true for non-transferred patients.

**Table 9: The 5 most common operation types for SAASM cases (transferred vs non-transferred patients)**

| | Transferred | Non-transferred |
|---|---|---|
| | Operation type | |
| **1** | Other bone and joint operations | Soft tissue operations |
| **2** | Soft tissue operations | Other bone and joint operations |
| **3** | Heart operations | Upper digestive tract operations |
| **4** | Upper digestive tract operations | Heart operations |
| **5** | Urinary operations | Lower digestive tract operations |

The cohort of transferred patients (note Table 5, patient transfer status was a univariate factor associated with the presence of CMIs) was investigated to identify clinical factors that seemed to be strongly associated with the presence of CMIs (as identified by assessors). Basic analysis ($\chi^2$ test for categorical variables, Mann-Whitney U test for continuous variables) was used to identify factors which individually showed differences in prevalence with the presence of CMIs. These are summarised in Table 10.

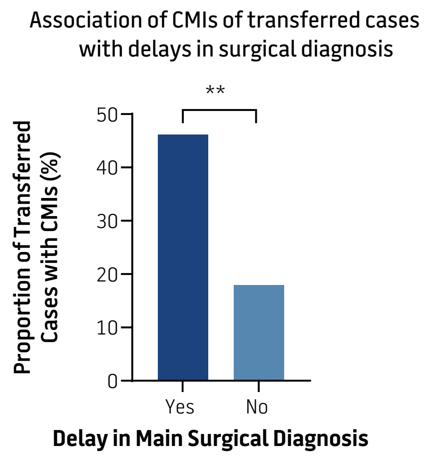
The factors identified were then compared with each other in a complex multivariate model to identify those variables contributing most strongly to the presence of CMIs in the transferred patient cohort. These data are also listed in Table 10 (Multivariate Correlates). Delay in determining the surgical diagnosis was most strongly associated with the presence of CMIs (as identified by assessors). This is also shown in Figure 19.

**Table 10: Correlates of the presence of assessor-identified CMIs for transferred patients**

| Univariate Correlates | p |
|---|---|
| Specialty | 0.07 |
| Delay in determining surgical diagnosis | <0.05 |
| Unplanned readmission | <0.05 |
| Fluid balance issues | <0.05 |
| Age | <0.05 |
| Length of stay | <0.05 |
| **Multivariate Correlates** | **p** |
| Delay in determining surgical diagnosis | <0.01 |

Note: p≤0.05 indicates that the result has a 5% chance or less of occurring randomly.

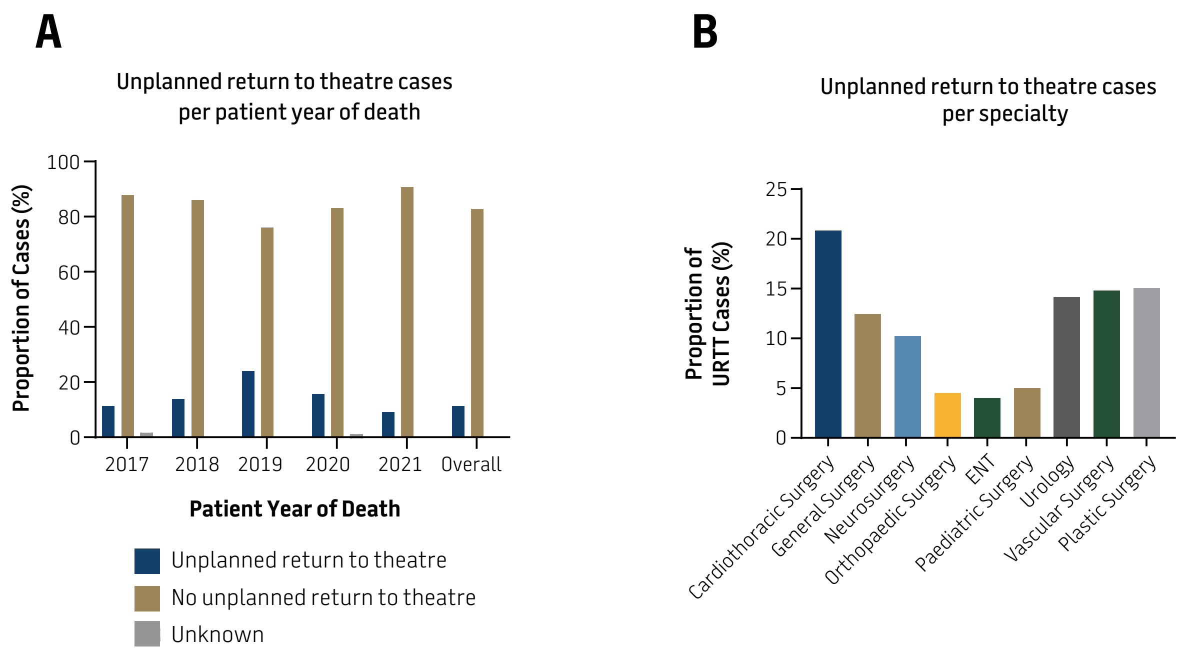
**Figure 19: Multivariate correlation of CMIs in transferred cases as identified by assessors in SAASM cases**




## UNPLANNED RETURN TO THEATRE

Unplanned returns to theatre pose a challenge for healthcare systems: they place the patient under additional physiological stress, they may interrupt patient flow through hospitals, and may be indicative of inadequate planning for and management of surgical patients. Overall, an unplanned return to theatre (URTT) during the course of patient care was reported in 11.5% (262 cases) of SAASM cases, with 2021 the lowest period at 9.1% (Figure 20A). Cardiothoracic Surgery has experienced the highest rate of URTT at 20.9% of their respective cases (Figure 20B).

**Figure 20: SAASM cases with unplanned returns to theatre**




**A** Proportion of cases per year with unplanned return to theatre.
**B:** Proportion of cases with unplanned return to theatre based on surgical specialty.
**Note:** ENT Surgery = Otolaryngology Head and Neck Surgery

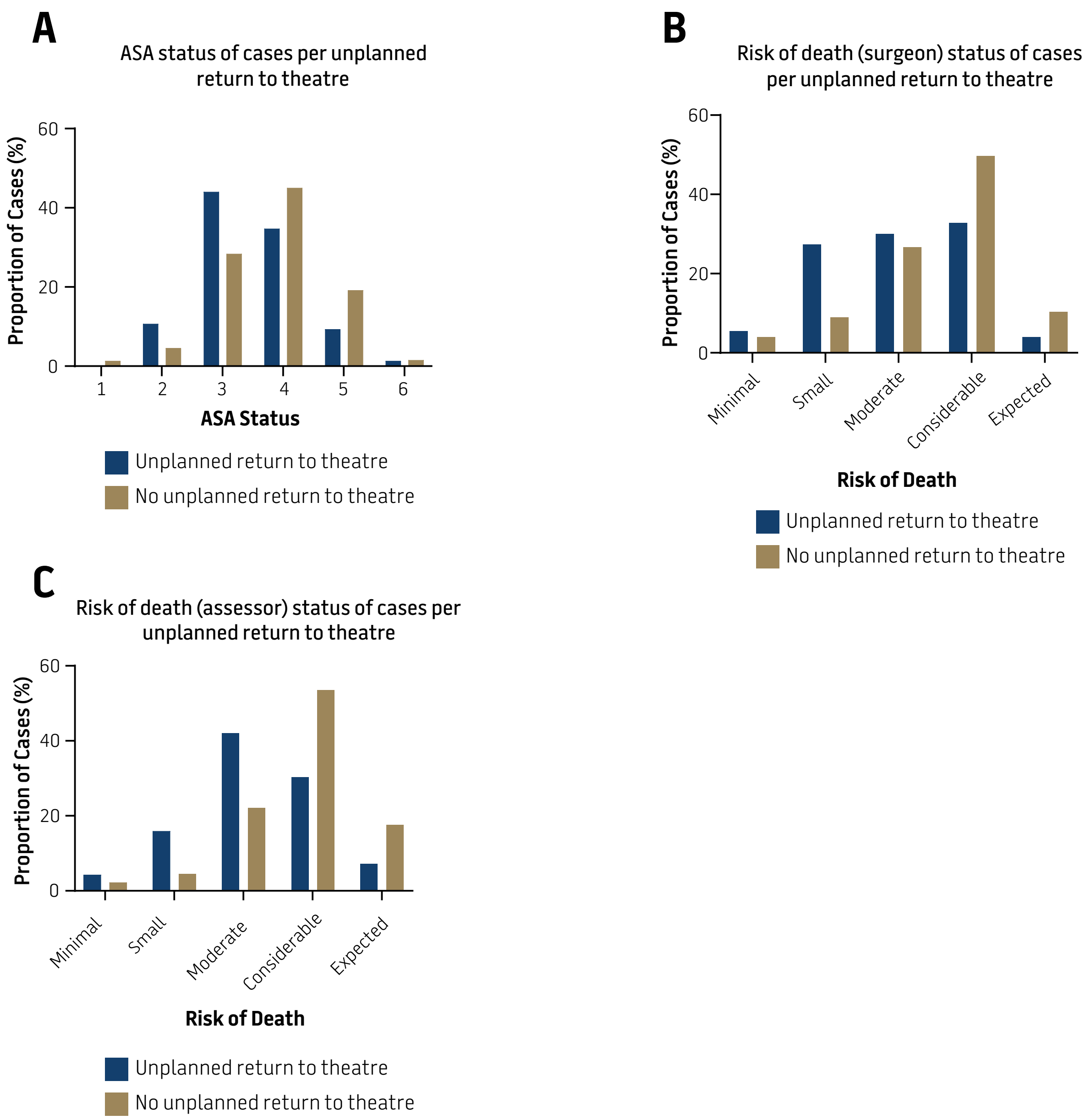
Table 11 summarises the demographics for cases where a URTT occurred. URTT cases were significantly younger and had longer lengths of stay in comparison to non-URTT cases. URTT cases were also proportionately more likely to be elective admissions.

**Table 11: Patient demographics for unplanned return to theatre**

| | Unplanned Return to Theatre | No Unplanned Return to Theatre | p |
|---|---|---|---|
| Age (median years;IQR) | 73 (61–80) | 78 (66–86) | <0.001 |
| Male:Female (%:%) | 59.2:40.8 | 55.7:44.3 | 0.18 |
| Aboriginal and/or Torres Strait Islander Descent (%) | 2.7 | 2.5 | <0.001 |
| Patient Status (%) | | | 0.19 |
| *Private* | 25.6 | 20.3 | |
| *Public* | 74.4 | 79 | |
| *Veteran* | 0 | 0.7 | |
| Admission Status (%) | | | <0.001 |
| *Elective* | 31.7 | 10.2 | |
| *Emergency* | 68.3 | 89.8 | |
| Hospital Status (%) | | | 0.07 |
| *Private* | 21.4 | 15.3 | |
| *Public* | 78.6 | 84 | |
| *Co-Location* | 0 | 0.7 | |
| Hospital Type (%) | | | 0.1 |
| *Principal referral hospitals* | 67.9 | 64.7 | |
| *Public acute group A hospitals* | 12.2 | 18 | |
| *Public acute group B hospitals* | 0 | 2 | |
| *Public acute group C hospitals* | 0 | 0.1 | |
| *Private acute group A hospitals* | 8.8 | 8.3 | |
| *Private acute group B hospitals* | 10.3 | 5.4 | |
| *Private acute group C hospitals* | 0 | 0.1 | |
| *Children's hospitals* | 0.8 | 1.4 | |
| Length of stay (median days;IQR) | 16 (8–31) | 8 (3–17) | <0.001 |

An ASA score of 3 (a patient with severe systemic disease) was most commonly noted for URTT cases, differing from non-URTT cases with an ASA score of 4 as the most common (Figure 21A). The risk of death was noted (by the treating surgeon) to be considerable in a larger proportion of URTT cases (32.9%), however, this is closely followed by moderate at 30.1% and small at 27.4% (Figure 21B). Interestingly, a different pattern is present in the risk of death ratings as noted by assessors, with a larger proportion deemed moderate (42.0%), next followed by considerable at 30.4% (Figure 21C).

**Figure 21: ASA and risk of death scores for patients with unplanned returns to theatre**




**A:** ASA status of cases with an unplanned return to theatre
**B:** Risk of death scores for patients returned to theatre as identified by treating surgeon
**C:** Risk of death scores for patients returned to theatre as identified by assessor
**Note:**
ASA 1 = A normal healthy patient
ASA 2 = A patient with mild systemic disease
ASA 3 = A patient with severe systemic disease
ASA 4 = A patient with severe systemic disease that is a constant threat to life
ASA 5 = A moribund patient who is not expected to survive without the operation
ASA 6 = A declared brain-dead patient whose organs are being removed for donor purposes

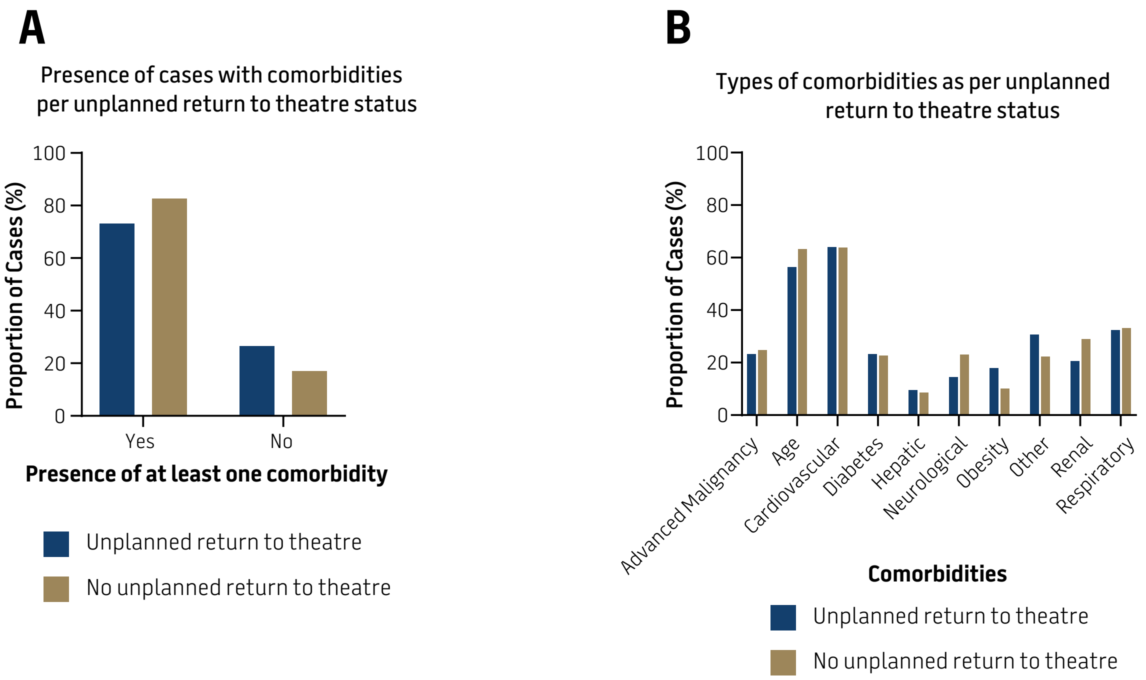
Table 12 shows the most common admission diagnosis, surgical diagnosis and causes of death for URTT and non-URTT cases. Interestingly, while the top 2 admission and surgical diagnosis were different between URTT and non-URTT cases, the top three cases of death for both cohorts were the same.

**Table 12: The 5 most common diagnoses for SAASM cases that underwent an unplanned return to theatre**

| | Unplanned Return to Theatre | No Unplanned Return to Theatre |
|---|---|---|
| Admission Diagnoses | | |
| **1** | Arterial, arteriole and capillary disease | Other diseases of the intestines and peritoneum |
| **2** | Carcinoma in situ | Cerebrovascular disease |
| **3** | Other diseases of the intestines and peritoneum | Fracture of lower limb |
| **4** | Cerebrovascular disease | Intracranial injury excluding those with skull fracture |
| **5** | Malignant neoplasm of digestive organs and peritoneum | Other bacterial diseases |
| Surgical Diagnoses | | |
| **1** | Arterial, arteriole and capillary disease | Other diseases of the intestines and peritoneum |
| **2** | Carcinoma in situ | Fracture of lower limb |
| **3** | Cerebrovascular disease | Cerebrovascular disease |
| **4** | Intracranial injury excluding those with skull fracture | Intracranial injury excluding those with skull fracture |
| **5** | Other diseases of the intestines and peritoneum | Arterial, arteriole and capillary disease |
| Cause of Death | | |
| **1** | Other endocrine gland diseases | Other endocrine gland diseases |
| **2** | Other bacterial diseases | Other bacterial diseases |
| **3** | Cerebrovascular disease | Cerebrovascular disease |
| **4** | Nephritis, nephrosis and nephrotic syndrome | Other respiratory system diseases |
| **5** | Other diseases of the intestines and peritoneum | Other forms of heart disease |

Of the cases that had an unplanned return to theatre, 73.3% had at least one comorbidity, compared to 82.8% for those that did not have an unplanned return to theatre (Figure 22A). Of these comorbidities, for both cohorts, cardiovascular disease and age were the most prominently reported.

**Figure 22: Comorbidities for patients with unplanned return to theatre**




**A:** Proportion of cases with unplanned return to theatre with at least one comorbidity
**B:** Types of comorbidities present in patients who had unplanned returns to theatre

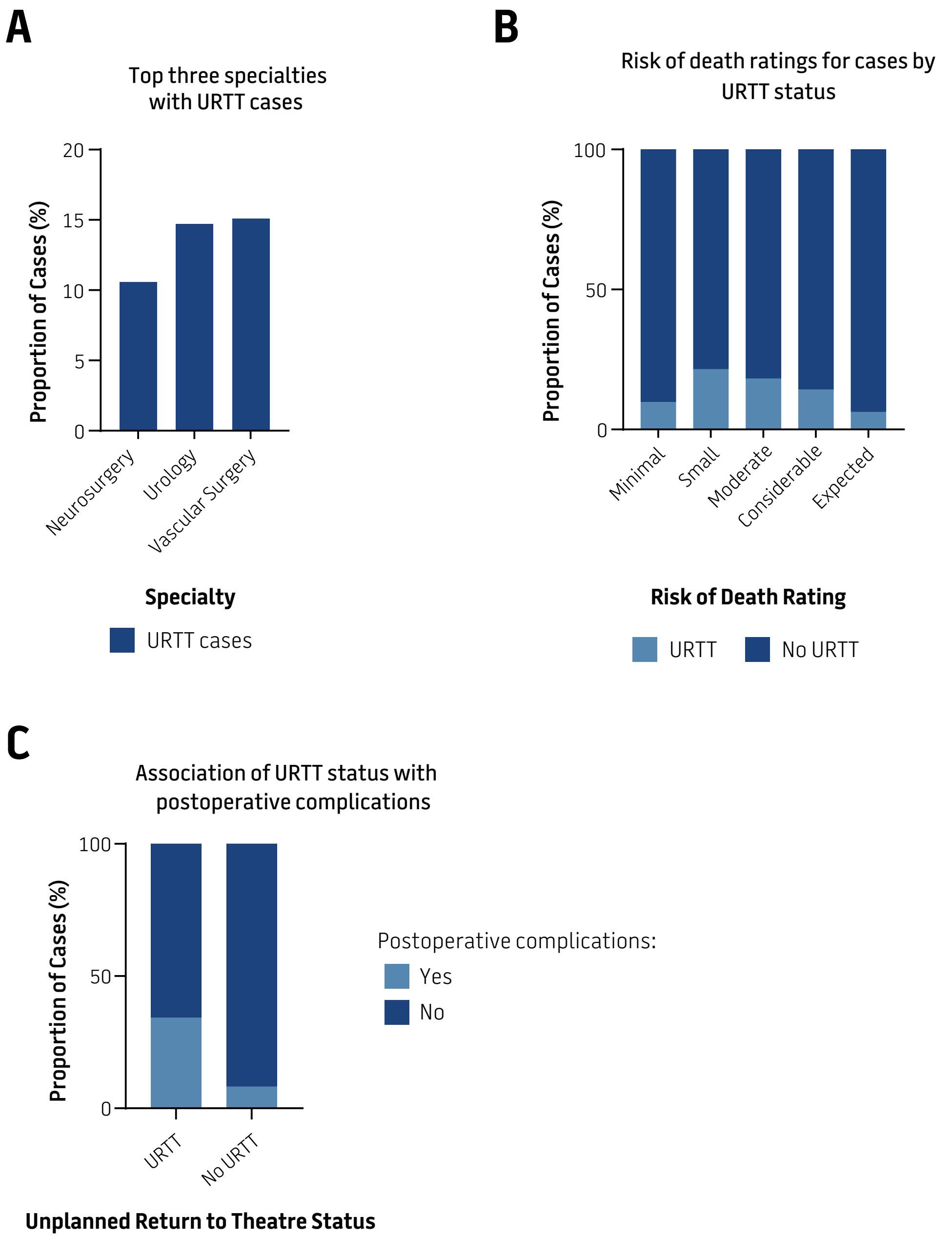
The cohort of patients with URTT (note Table 5, URTT was a univariate factor associated with the presence of CMIs) was investigated to identify clinical factors that seemed to be strongly associated with the presence of URTTs. Basic analysis ($\chi^2$ test for categorical variables, Mann-Whitney U test for continuous variables) was used to identify factors which individually showed differences in the prevalence of URTTs. These are summarised in Table 13.

**Table 13: Correlates of assessor-identified CMIs in patients who had unplanned returns to theatre**

| Univariate Correlates | p |
|---|---|
| Specialty | <0.001 |
| Aboriginal and/or Torres Strait Islander Descent | <0.001 |
| Admission status | <0.001 |
| ASA | 0.06 |
| Patient transferred | 0.06 |
| Operative admission | <0.001 |
| Risk of death (identified by treating surgeon) | <0.001 |
| Postoperative complications | <0.001 |
| Unplanned admission to ICU | <0.001 |
| Unplanned readmission | <0.001 |
| Fluid balance issues | <0.001 |
| Treatment in ICU/HDU | <0.001 |
| Age | <0.001 |
| Length of stay | <0.001 |
| **Multivariate Correlates** | **p** |
| Specialty | |
| Neurosurgery | <0.05 |
| Urology | <0.05 |
| Vascular Surgery | <0.001 |
| Risk of death (identified by treating surgeon) | |
| Small | <0.05 |
| Postoperative complications | <0.001 |
| Unplanned admission to ICU | 0.06 |

The factors identified by basic analysis were then compared with each other in a complex multivariate model in order to identify those variables contributing most strongly to clinical determinants in the URTT patient cohort. These data are also listed in Table 13 (Multivariate Correlates). The surgical specialties with the highest proportions of URTT were Neurosurgery, Urology and Vascular Surgery (Figure 23A). Patients with a small perceived risk of death and the presence of postoperative complications were also associated with URTT (Figure 23B and Figure 23C), while unplanned admission to ICU trended towards significance.

**Figure 23: Clinical determinants significantly associated with unplanned returns to theatre**




**A:** Proportion of cases that had unplanned returns to theatre
**B:** Risk of death scores for cases with unplanned returns to theatre
**C:** Proportion of cases with unplanned returns to theatre that also had postoperative complications

# DISCUSSION

The current report summarises data on patient in-hospital mortality where surgical care was involved for the period 2017–2021. SAASM cases were more likely to be public, emergency admissions to public hospitals. Patients were more likely to be elderly and male, with cardiovascular disease the most commonly reported comorbidity. The number of cases reported to SAASM over time continues to remain relatively consistent (Figure 1).

Evaluation of the overall management of these patients reflects the acute nature of the presentations. Proportionately, emergency presentations were much less likely to be associated with CMIs than elective presentations. Delays in determining the surgical diagnosis were also significantly associated with the emergence of CMIs in these cases. Delays in surgical diagnosis were reported for less than 5% of cases. These delays were primarily attributed to inexperienced staff from institutional medical units and were considered largely unavoidable. Nonetheless these data highlight the importance of appropriate consultant involvement in these cases.

Given the high burden of transferred cases that SA manages, these data were also investigated for the potential effect of transferred status on the quality of patient care. The SAASM data shows that transferred patients were much more likely to be emergency cases involving public hospital admissions. Despite their emergency status, the proportion of cases with reported CMIs present was higher among cases where patient transfer was reported. When investigating the potential causes of this, the single strongest factor identified was a reported delay in determining the main surgical diagnosis, which was reflected in the most common type of CMI reported by both surgeons and assessors (delays). Our data is unable to determine the root cause of these delays, though we note that recent seminars presented by SAASM have focused on the importance of effective communication between health professionals (including junior to consultant), clinical departments and health institutions.

Unplanned returns to theatre among this dataset were also explored, given the additional burden it imposes upon health systems. Our data confirmed this, with patients who had URTT experiencing much longer duration in hospital (median 16 days [IQR 8–31] vs median 8 days [IQR 3–17]) than those with no URTT ($p < 0.05$). From the clinical data we sought to identify whether there were particular factors that increased the likelihood of a URTT. Some of the variables identified by this analysis likely correlate by circumstance – the presence of postoperative complications and unplanned admissions to ICU logically associate with URTT, as does a patient with a small perceived risk of death. However, the surgical specialties that were associated with URTT after multivariate analysis require further exploration in order to understand this phenomenon.

Notifications of patient deaths are received promptly from SA hospitals, enabling timely submission of cases by surgeons. The median time taken for submission of cases – 55 days (IQR 13–127) – aligns with the ANZASM recommendation for submission of SCFs within 2 months of surgeon notification, though it is worth noting that there are still cases outstanding from 2021 and earlier. Surgeons are encouraged to address this backlog so the cases can be evaluated and feedback disseminated.

It is pleasing to note the constructive engagement SAASM enjoys with the SA surgical community. Efforts in recent years to foster increased interstate interaction have been positively received. More cases from SA are being sent interstate to ensure independent assessment and more SA surgeons are being invited to evaluate interstate cases. There is a clear benefit to participating in SAASM, whether through submission of cases and being receptive to feedback, or by providing constructive yet critical evaluation of patient care undertaken by another surgeon. Participation in SAASM remains a mandated activity of CPD programs for both RACS and the AOA.

It is hoped that the data summarised in this report benefit surgeons during the course of their practice and health systems seeking to achieve the best possible outcomes for patients.

# REFERENCES

1. Benson T. The history of the Read Codes: the inaugural James Read Memorial Lecture 2011. Inform Prim Care. 2011;19(3):173-82.

2. R Development Core Team. R: A language and environment for statistical computing. 4.2.1 ed. Vienna, Austria: R Foundation for Statistical Computing; 2022.

3. R Studio Team. RStudio: Integrated Development Environment for R. 2022.2.0.443 ed. Massachusetts, U.S.: RStudio, PBC; 2022.

4. AIHW. Australian hospital peer groups. Canberra: Australian Institute of Health and Welfare; 2015.

5. Mayhew D, Mendonca V, Murthy BVS. A review of ASA physical status – historical perspectives and modern developments. Anaesthesia. 2019;74(3):373-9.

Royal Australasian
College of Surgeons

Royal Australasian College of Surgeons
South Australian Audit
of Surgical Mortality