Royal Australasian
College of Surgeons

NTASM ANNUAL REPORT

1 July 2016 to 30 June 2021

Royal Australasian College of Surgeons
Northern Territory Audit of Surgical Mortality

Royal Australasian College of Surgeons
Australian and New Zealand Audits of Surgical Mortality

ANZCA
FPM

NORTHERN TERRITORY GOVERNMENT

The Royal Australian and New Zealand College of Obstetricians and Gynaecologists
Excellence in Women's Health

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The information contained in this Annual Report has been prepared by the Royal Australasian College of Surgeons Northern Territory Audit of Surgical Mortality Management Committee.

The Northern Territory Audit of Surgical Mortality is a declared quality improvement committee under section 7 (1) of the Health Services (Quality Improvement) Act 1994 (gazetted 26 July 2005).

The Australian and New Zealand Audit of Surgical Mortality, including the Northern Territory Audit of Surgical Mortality, also has protection under the Commonwealth Qualified Privilege Scheme under Part VC of the Health Insurance Act 1973 (gazetted 2 May 2017).

Year Published: 2022

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NTASM Clinical Director's Report

I am very pleased to announce that the Northern Territory Audit of Surgical Mortality (NTASM) is progressing very well in every respect. Some examples include the ongoing collaboration with the Northern Territory (NT) Department of Health, which extended NTASM funding until June 2024. The NT Department of Health also provided NTASM with NT baseline data of all patients admitted for surgery and discharged home. This data is included in all NT annual reports and is compared with NTASM patients admitted during the same period as the baseline patients.

Obstetrics and Gynaecology (O&G) Fellows started participating in NTASM in 2012 and

anaesthetists in June 2016. Only 2 O&G cases have been reported to NTASM; 75 anaesthetic cases have been reported. Over this reporting period, NTASM was notified of 370 surgical deaths and 7.9% were excluded due to terminal care.

NTASM together with a respected NT surgeon published an article on alcohol use in patients included in NTASM compared with the rest of Australia. The author of the paper delivered the article to the NT Minister of Health, who has asked for recommendations to be made to the NT Department of Health supported by NT data.

Some issues have been identified in the NTASM data collection.

The NT has the lowest number of surgeons per population compared with all of Australia. The vascular and urology surgeons in Darwin also act as locum surgeons in Alice Springs.

The NT surgeons rely on locum surgeons and Specialist International Medical Graduate (SIMG) surgeons. Locum surgeons will be encouraged to self-report deaths as part of their orientation training when starting a roster in NT hospitals.

Previously, NTASM had recommended a full-time resident neurosurgeon in Darwin and an appointment resulted. During 2021, the Neurosurgery department reverted to just having locum surgeons, possibly due to COVID-19. NTASM recommends additional surgeons in the NT for the departments of Neurosurgery, Vascular Surgery and Urology.

Communication was highlighted as an issue in the 2020 NTASM Annual Report. NTASM sponsored a Safer Surgical Teamwork workshop on 25 September in Darwin. This was open to all surgeons, anaesthetists, intensivists and scrub nurses from all NT hospitals. The workshop was a success with 24 attendees. Alice Springs surgeons are requesting the same workshop be run at Alice Springs Hospital in 2022.

My sincere thanks to all surgeons and the Department of Health in NT and NTASM support staff for the continued participation and support of the NTASM project.

Dr John North
NTASM Clinical Director

NTASM Management Committee Chair's Report

Everyone believed that 2021 would be better than the previous year as we come to terms with the COVID-19 pandemic. Although we saw a glimmer of hope with vaccines, the impact of the pandemic is ongoing and continues to affect healthcare and service delivery to the community. Despite the monumental challenges such as staff shortages, constraints on the number of physical beds, reduction in theatre access and many more unprecedented disruptions, we are proud knowing that we have delivered a high-quality of surgical care to our patients in the Northern Territory comparable to other Australian facilities.

The data from this report clearly highlights the aspects that we have done well such as high presence of consultants in theatre (83.6%), high DVT prophylactic use (78.9%) and high percentage of cases with no clinical management issues (82.6%). However, it certainly points out the areas that we could have done better. The two major clinical management issues that were reported include delays to surgery and decision to operate. Although there may be compounding reasons that contribute to the issues described, we endeavour to reflect, learn and improve our performance. We are therefore thankful to the Northern Territory Government for funding and supporting NTASM, which enabled us to identify areas that warrant improvement.

Since the NTASM 2020 report highlighted communication as an issue, an NTASM-sponsored Safer Surgical Teamwork workshop was held for the first time in Darwin. The workshop was well received by the NT Health perioperative workforce, and we are looking forward to similar future workshops in the Northern Territory.

I would like to take this opportunity to thank Dr John North for his valuable guidance, the NTASM support staff for making the data collection and report possible and lastly, but not the least, my fellow colleagues for standing united while working as a team, facing the challenges together and overcoming all barriers to provide a safe and high-quality surgical service to the Territorians. Let us hope that 2022 will be better in every respect.

Dr Manimaran Sinnathamby
Director of General Surgery
Consultant General and Breast Surgeon
Royal Darwin Hospital
NTASM Management Committee Chair

Shortened forms

ACTASM	Australian Capital Territory Audit of Surgical Mortality
ANZASM	Australian and New Zealand Audit of Surgical Mortality
ANZCA	Australian and New Zealand College of Anaesthetists
ASA	American Society of Anesthesiologists
CI	confidence interval
CMI	clinical management issue
CVD	cardiovascular disease
DVT	deep vein thrombosis
FLA	first-line assessment
HDU	high dependency unit
ICD-10	International Classification of Diseases codes
ICU	intensive care unit
IQR	interquartile range
NT	Northern Territory
NTASM	Northern Territory Audit of Surgical Mortality
QASM	Queensland Audit of Surgical Mortality
QLD	Queensland
RR	risk ratio
RACS	Royal Australasian College of Surgeons
RANZCOG	Royal Australian and New Zealand College of Obstetricians and Gynaecologists
SCF	surgical case form
SLA	second-line assessment
TASM	Tasmanian Audit of Surgical Mortality
TED	thromboembolitic deterrent

Acknowledgements

We thank the following individuals and organisations for their contribution to NTASM:

- the NT government for funding NTASM
- the assessors for diligently completing their assessments
- the Chair, Dr Manimaran Sinnathamby, for his leadership and support
- the NTASM Management Committee for its wisdom and counsel
- the NTASM staff for systematically managing the process.

NTASM Management Committee members

Dr Manimaran Sinnathamby,
Chair, NTASM Steering Committee, RACS

Dr Mahiban Thomas,
Director of Surgical Services, Top End Health Service

Dr Lesley Barron,
surgeon, Alice Springs Hospital, RACS

Dr Richard Bradbury,
consultant general surgeon, Royal Darwin Hospital

Dr Mark Hamilton,
HOD Vascular Surgery, Top End Health Service/Central Australia Health Service

Dr John North,
Clinical Director, NTASM, RACS

NT Department of Health representative

Dr Sara Watson, Executive Director of Medical Services, Royal Darwin Hospital

Anaesthesia representative

Dr Phil Blum, Deputy Director,
Department of Anaesthesia, Top End Health Service and NT representative, ANZCA Mortality Subcommittee

Obstetrics and gynaecology representative

Dr Jason Sly, RANZCOG representative

ANZASM staff

Professor Guy Maddern,
Chair ANZASM Steering Committee

A/Professor Wendy Babidge,
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Dr John North,
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Jenny Allen,
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Kyrsty Webb,
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Trudy Dugan, Surgical Audit Officer, Royal Darwin Hospital

Francine Riessen, Health Information Manager, Darwin Private Hospital

Susan Sullivan, Data Integrity Officer, Alice Springs Hospital

Statistician

Professor Robert Ware, School of Medicine and Dentistry, Griffith University

NT Government Department of Corporate and Digital Development Data Services

Peta Archer, Senior Data Analyst

Kerry Gregory, Data Analyst

Ken Lin, Data Analyst

Executive summary

OVERVIEW

- The Northern Territory Audit of Surgical Mortality (NTASM) is an external, independent, peer-reviewed audit of care processes associated with surgical deaths in the Northern Territory (NT).
- A surgical death is one in which a surgeon was responsible for or had significant involvement in the patient's care, regardless of whether an operation was performed.
- The purpose of NTASM is to provide feedback to inform, educate, facilitate change and improve practice. Surgeons are encouraged to use NTASM feedback to self-reflect to improve their practice. Hospitals and policy makers are encouraged to use NTASM feedback to develop strategies to address clinical management areas needing improvement and staffing gaps in the NT surgical workforce.
- NTASM has qualified privilege protection under Commonwealth legislation.
- This report covers the period 1 July 2016 to 30 June 2021 (census date of 5 October 2021).

NORTHERN TERRITORY BASELINE DATA

- NTASM data are compared with NT baseline data in section 6 of this report.
- The NT baseline data include patients admitted to all NT public hospitals (by either a physician or a surgeon) in the relevant period who had an operation or surgical procedure that was performed by a surgeon and required a general anaesthetic.
- The NT baseline data are provided by the Northern Territory Government Department of Corporate and Digital Development Data Services (approval number DMSR 13143).

HOSPITALS

- All NT hospitals participate in NTASM.

SURGEONS

- All surgeons in the NT participate in NTASM.
- Locum surgeons are also encouraged to participate in NTASM.
- A consultant surgeon was present for 83.6% (427/511) of operations.

PATIENTS

- There were 428 patient deaths in the relevant period of which 370 (86.4%) were completed by the census date, forming the basis of this report.
- 58.4% of patients (216/370) were male.
- 87.0% of patients (322/370) had at least one comorbidity.
- Cardiovascular disease was the most frequently documented comorbidity (65.9%; 211/320) in patients with comorbidities.

ABORIGINAL AND TORRES STRAIT ISLANDER PEOPLE

- Aboriginal and Torres Strait Islander patients comprised 36.2% (134/370) of NTASM surgical deaths.
- Compared with non-Indigenous patients, NTASM Aboriginal and Torres Strait Islander patients were more likely to have cardiovascular disease, renal disease, diabetes, hepatic disease, be younger, experience more comorbidities and infections, and be transfer cases.

OPERATIONS

- 82.4% of patients (305/370) had at least one operation.
- 41.9% of patients (155/370) had more than one operation.

CLINICAL MANAGEMENT ISSUES

- Assessors considered that most patients (82.6%; 304/368) had no clinical management issues (CMIs) and 64 patients had CMIs (17.4%; 64/368).
- Of all the CMIs, 65.6% (42/64) were areas of consideration; 21.9% (14/64) were areas of concern and 12.5% (8/64) were adverse events.
- Of all the CMIs, 57.4% (35/61) were considered definitely or probably preventable.
- Of the areas of consideration, 57.1% (24/42) made no difference to the outcome.
- Of the areas of concern, 85.7% (12/14) may have contributed to the outcome.
- Of the adverse events, 62.5% (5/8) caused the death of the patient.

POSTOPERATIVE COMPLICATIONS

- 24.2% of patients had a postoperative complication (73/302) in the audit period (1 July 2016 to 30 June 2021).
- This figure is decreasing over time (20.3% of all operations in 2020–2021).

POSTOPERATIVE INTENSIVE CARE UNIT USE

- 18.3% (55/300) of patients had an unplanned postoperative admission to an intensive care unit (ICU).

INFECTION

- 35.1% of patients (129/368) had an infection.
- 54.7% of patients (70/128) acquired the infection before admission.
- Of the infections acquired during admission, pneumonia was the most prominent.

TRAUMA

- 22.8% of NTASM patients (84/369) had trauma.
- The most frequent causes of trauma were falls (54.8%; 46/84), road traffic accidents (23.8%; 20/84) or violence (16.7%; 14/84).

Recommendations

The following recommendations are derived from the responses documented in this report and from trends over time identified in previous Northern Territory Audit of Surgical Mortality (NTASM) reports. Surgeons, hospitals and policy makers are encouraged to consider these recommendations and advocate for change to optimise the surgical care provided to patients in the Northern Territory (NT).

1. INCREASE THE SURGICAL WORKFORCE IN THE NT

NTASM continues to recommend additional surgeons in the NT for the departments of Neurosurgery, Vascular Surgery and Urology.

The NT surgical workforce relies on locum surgeons. NTASM encourages NT surgeons to demonstrate to locum surgeons how to self-report deaths as part of the locum surgeon's orientation training when starting a roster in NT hospitals.

2. INCREASE PUBLIC EDUCATION ABOUT CARDIOVASCULAR DISEASE

Cardiovascular disease (CVD) continues to be the most frequently occurring comorbidity for all audit patients. Aboriginal and Torres Strait Islander patients are 20.0% more likely to have CVD documented as a comorbidity than are non-Indigenous patients.

Of the 16,263 patients in the NT baseline data, 2.5% had CVD recorded as a comorbidity. This is much lower than the 72.0% of NTASM patients who were inpatients in the same period and had CVD recorded as a comorbidity.

3. INCREASE HEALTH PROMOTION FOR ABORIGINAL AND TORRES STRAIT ISLANDER PEOPLE

In NTASM, Aboriginal and Torres Strait Islander patients are on average 16 years younger than non-Indigenous patients.

4. REFINE NTASM PROCESSES AND SYSTEMS

The Australian and New Zealand Audit of Surgical Mortality (ANZASM) with NTASM have already introduced changes to streamline audit processes or enhance reporting. Data fields are now mandatory to minimise the number of missing responses. Another change (implemented in July 2020) asks surgeons to declare, via a form submitted to NTASM, if they have changed practice following a preventable clinical management issue (CMI) with which they are associated. NTASM will publish findings when sufficient data have been collected to allow nonidentifiable and meaningful reporting of trends.

Approved improvements to the surgical case form (SCF) that will be implemented during 2022 include the addition of:

- alcohol as a co-factor that increased the risk of death
- smoking as co-factor that increased the risk of death, and
- fluid balance as an issue to include overload, dehydration or both.

Adopted recommendations

1. **The 2020 NTASM Annual Report recommended that the NT Steering Committee work with RACS and NT surgeons to improve communication with patients, their families and communities. This could be via a seminar that includes consumer representation.**

   NTASM sponsored a Safer Surgical Teamwork workshop on the 25 September 2021 in the Royal Darwin Hospital. This was open to all surgeons, anaesthetists, intensivists and scrub nurses from all NT hospitals. There were 24 attendees and the workshop was a success, with Alice Springs requesting the same workshop be run at Alice Springs Hospital in 2022.

   The NT Department of Health is encouraged to sponsor this course as an ongoing program.

2. **The 2020 NTASM Annual Report recommended that the NT Department of Health continue to educate the public about the risks of alcohol consumption, with a particular focus on women and Aboriginal and Torres Strait Islander people.**

   In 2021, NTASM together with a respected NT surgeon published an article on alcohol use in NTASM patients compared with the rest of Australia. On 26 November 2021, the author of the paper presented the article to the NT Minister of Health, Natasha Fyles, who has asked for recommendations to be made to the NT Department of Health supported by NT data. These recommendations will be developed in 2022.

3. **The NT Steering Committee should continue to petition for the inclusion of alcohol and other addictive substances as a comorbidity in the SCF.**

   In 2022, alcohol and smoking will be added to the SCF.

1 Introduction

KEY POINTS

- NTASM is an external, surgeon-led, peer-review audit of patient deaths that occurred under surgical care.
- This report is a review of all deaths notified during the period 1 July 2016 to 30 June 2021.
- This report is an analysis of the 370 cases that underwent the full peer-review audit process.

1.1 Background

Surgery in the Northern Territory (NT) is safe and well-regulated. Only a small proportion of surgical patients die. When a death does occur, it is reviewed by the consultant surgeon and by peer surgeon assessors. The Royal Australasian College of Surgeons (RACS) is responsible for facilitating this review process through the Northern Territory Audit of Surgical Mortality (NTASM), an external, independent, peer-reviewed audit of processes of care associated with surgery-related deaths in the NT. NTASM started in 2010 and is funded by the NT Government Department of Health.

NTASM is designed as a feedback mechanism for participating surgeons to encourage reflection on surgical care and practice following the death of a patient. Information submitted to NTASM by the consultant surgeon provides an opportunity to identify areas in which care could be improved. Surgical peers then review and assess the clinical management of each patient (including hospital systems and processes) and provide feedback for the consultant surgeon. The deidentified and aggregated results of these reviews are presented in this document.

NTASM provides feedback as follows:

- Surgeons receive electronic feedback on their cases from assessors.
- Surgeons receive an electronic copy of the NTASM Annual Report, which is also posted on the RACS website.
- Surgeons receive deidentified summaries of assessments in the *National Case Note Review Booklet,* which details a selection of deidentified patient cases across Australia.
- Hospitals participating in the audit receive clinical governance reports of aggregated deidentified data. These reports allow each hospital to compare their hospital with others across Australia.
- Surgeons can access online reports regarding their own audit data via the NTASM website.

Each self-assessment and peer-review assessment in the NTASM database provides valuable insights into current practice and shows opportunities for practice improvement. Ongoing refinements to NTASM audit processes enhance the quality and reliability of data captured by NTASM over time.

This report covers surgically related deaths that occurred from 1 July 2016 to 30 June 2021 (with a census date of 5 October 2021). Data analyses relate to the date of death rather than the notification date to NTASM. The nature of the audit process means that some patient cases reported during this period will still be undergoing review at the census date. These cases will be included in the next NTASM report. Please note that denominators in this report sometimes differ because not all questions are answered.

1.2 Objectives

The objectives of the audit are to:

- encourage and support surgeons to self-appraise their clinical care management
- encourage and support surgeons to appraise the clinical care management of their peers
- inform, educate, facilitate change and improve practice by providing feedback on surgical deaths in the NT.

1.3 Structure and governance

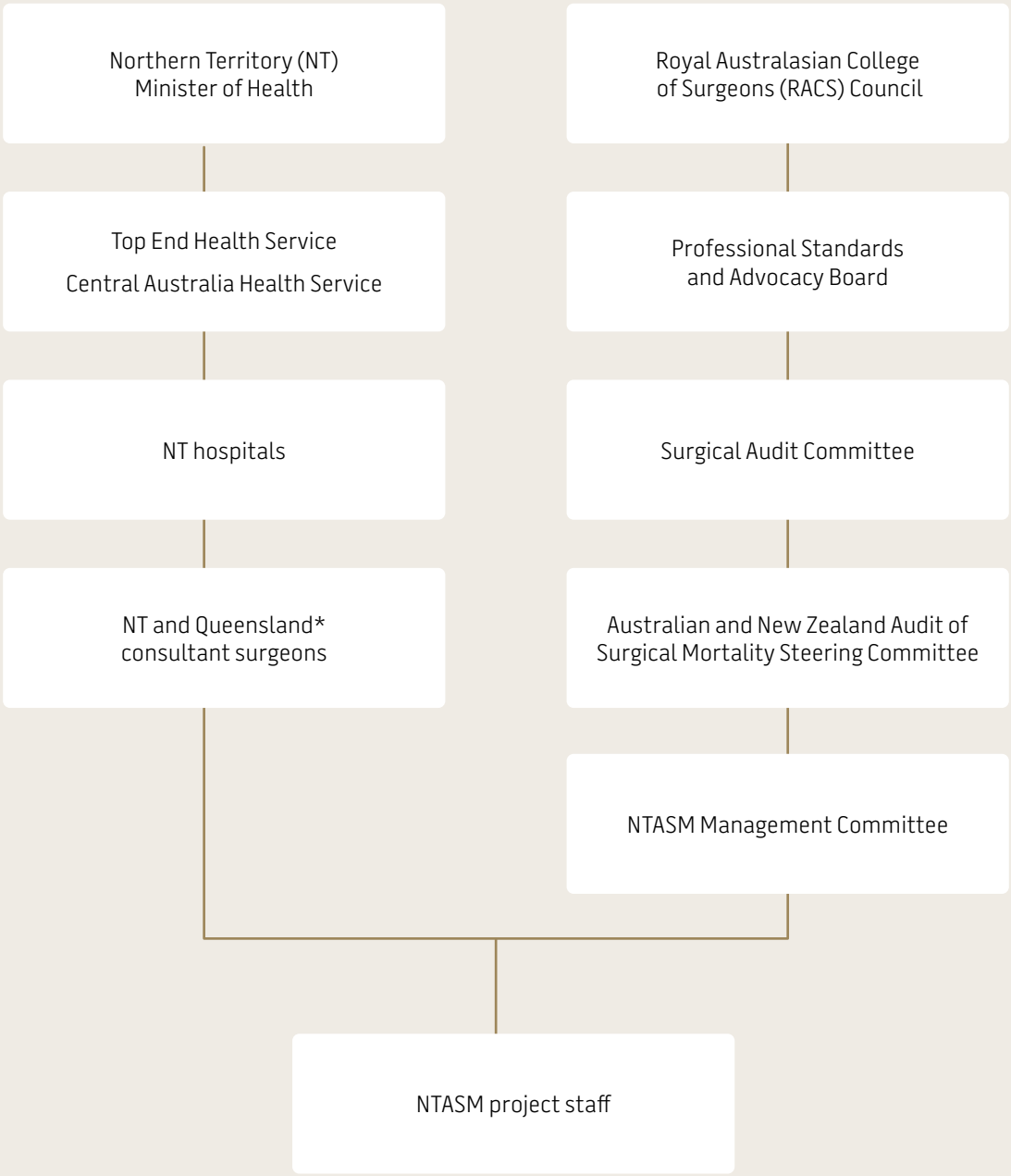
NTASM is overseen by The Australian and New Zealand Audit of Surgical Mortality (ANZASM). ANZASM is managed by Research, Audit and Academic Surgery, in the Fellowship Engagement portfolio of RACS. The NTASM governance structure is illustrated in Figure 1.

Participation by surgeons has been mandated as part of the RACS Continuing Professional Development (CPD) program since January 2010.

NTASM is a declared quality assurance committee under section 7 (1) of the Health Services (Quality Improvement) Act 1994 (gazetted 26 July 2005).

ANZASM , including NTASM, also has protection under the Commonwealth Qualified Privilege Scheme under Part VC of the Health Insurance Act 1973 (gazetted 2 May 2017).

Figure 1: NTASM governance structure



*Consultant surgeons from Queensland also undertake assessments for NTASM.
NTASM: Northern Territory Audit of Surgical Mortality

1.4 Methodology

The audit includes all deaths that occur in NT hospitals while a patient is under the care of a surgeon.

NTASM defines a surgical death as the death of a patient under the care of a surgeon, even if the patient did not have an operation.

NTASM includes all patient deaths that meet one of the following criteria:

- The patient was under the care of a surgeon (surgical admission) and may or may not have received an operation.
- The patient was under the care of a physician (medical admission) and subsequently underwent a surgical procedure.
- The patient's death was possibly or definitely related to anaesthesia during surgery or occurred within 48 hours of surgery.
- The patient was a gynaecology-related case.

NTASM excludes all patient deaths that meet the following criterion:

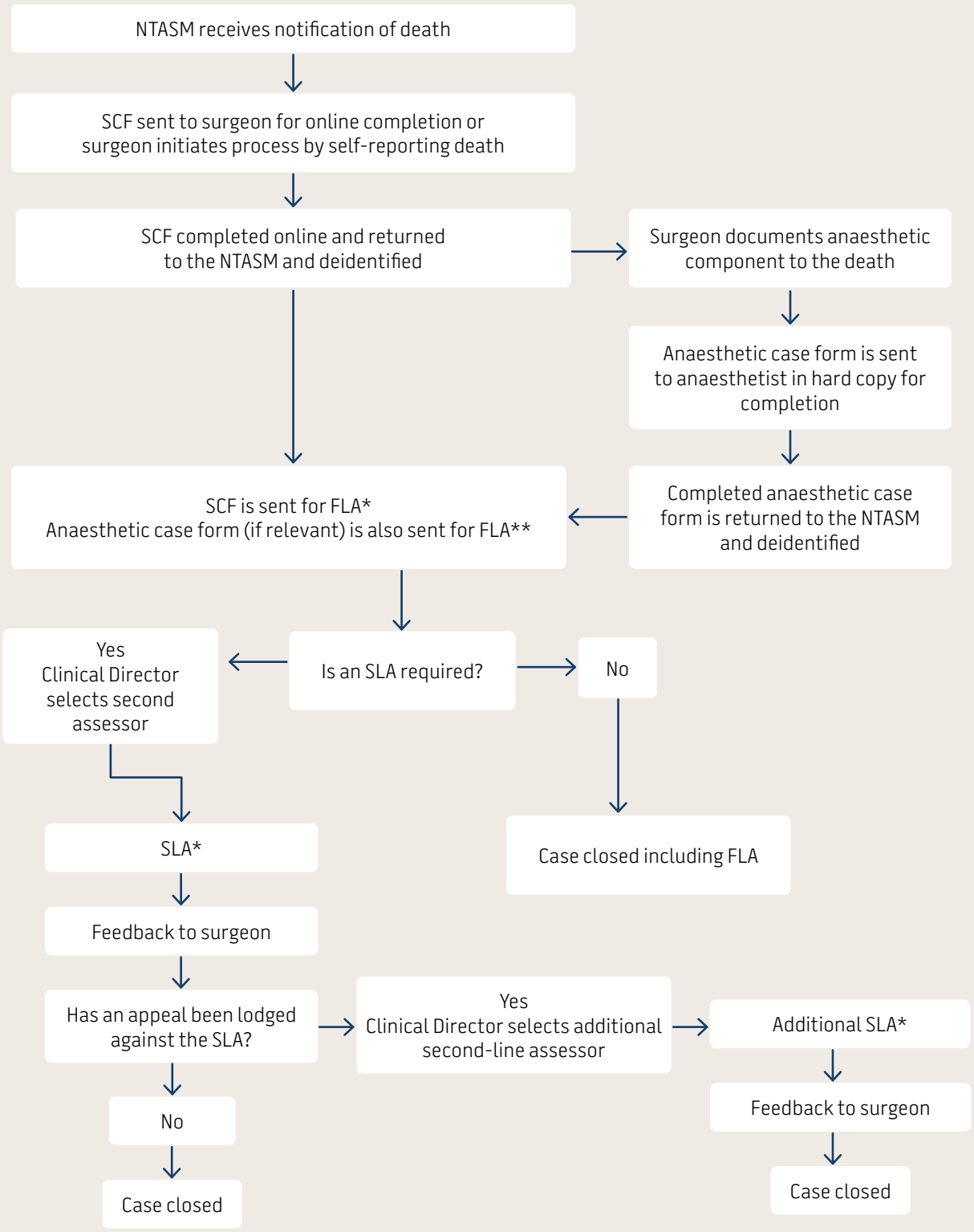
- The patient was deemed terminal upon admission and did not have an operation.

1.5 Audit process

The audit process combines surgeon self-reflection with peer-review of all surgical deaths in the NT to determine whether the death was a direct result of the disease process alone or whether aspects of patient management or hospital systems and processes may have contributed. Anaesthetists, obstetricians and gynaecologists may also participate in cases related to their specialties.

The audit process begins when a surgical or medical records department in an NT hospital notifies NTASM staff of a surgical death, or when a surgeon self-reports a surgical death. The overall audit process is coordinated by NTASM staff and is outlined in Figure 2.

Figure 2: NTASM audit process



*First- and second-line assessors for NTASM are peer surgeons from a different state
**Anaesthetists from Tasmania and the Australian Capital Territory perform assessments on NT cases.
NTASM = Northern Territory Audit of Surgical Mortality; SCF = surgical case form; FLA = first-line assessment; SLA = second-line assessment

1.6 Surgeon assessors

Surgeons participate in NTASM in the following capacities:

- as a surgeon who **self-assesses** the clinical management provided to the patient under review
- as a **peer assessor** who conducts a first-line assessment (FLA) or second-line assessment (SLA); first- and second-line assessors are surgical peers, sometimes from a different Australian state or territory (to the Northern Territory) to preserve anonymity and facilitate impartiality.

Surgeons and peer assessors (first- or second-line) review patient cases to identify any clinical management issues (CMIs), including hospital systems and processes, where care could have been better. Patients may have more than one CMI reported. This NTASM report includes only one CMI per patient—that reported by the highest-level assessor (i.e. the second-line assessor if an SLA is performed, otherwise the first-line assessor).

Surgeons and assessors provide a clinical judgement on one of the two possible outcomes:

1. The patient's death was a direct outcome of the disease process and clinical management had no impact on the outcome.
2. Aspects of clinical management may have contributed to the death of the patient.

If the latter, surgeons and assessors may identify CMIs that are classified as:

- **Area of consideration:** the assessor believes an area of care could have been improved or different but recognises that there may be debate about this.
- **Area of concern:** the assessor believes that an area of care should have been better.
- **adverse event:** the assessor identifies an unintended injury caused by medical management, rather than by the disease process, which is sufficiently serious to either:
  - lead to prolonged hospitalisation
  - lead to temporary or permanent impairment or disability of the patient at the time of discharge
  - contribute to, or cause, death.

Surgeons and assessors are asked to:	
• report the impact of the CMI on the outcome, using the following categories:	• made no difference to the death • may have contributed to the death • caused the death of a patient who would otherwise have been expected to survive
• give their opinion of whether the CMI was preventable, using the following categories:	• definitely • probably • probably not • definitely not
• indicate with whom the CMI was associated, using the following categories:	• audited surgical team • another clinical team • hospital

1.7 Obstetrician and gynaecologist assessors

Fellows of the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) began participating in NTASM in 2012. Obstetricians and gynaecologists voluntarily participate in the audit as first- or second-line assessors if the patient was a gynaecology-related case. The assessment process for obstetricians and gynaecologists is the same as for surgeons. These reviews are mostly of gynaecological cases.

1.8 Anaesthetist assessors

Fellows of the Australian and New Zealand College of Anaesthetists (ANZCA) began participating in NTASM in August 2016. Anaesthetists voluntarily participate in the audit as first- or second-line assessors if a patient's death was related to anaesthesia during surgery. NT anaesthetists also perform anaesthetic peer assessments for the Australian Capital Territory Audit of Surgical Mortality (ACTASM) and the Tasmanian Audit of Surgical Mortality (TASM). TASM and ACTASM anaesthetists correspondingly assess NT anaesthetic cases.

1.9 Data management, storage and analysis

All data reported from NTASM are deidentified to preserve the confidentiality of the patient, surgeon and hospital. Data are encrypted and stored in a bespoke database. Transactions are time stamped and all changes to audit data are written to an archive table to provide a complete audit trail of each patient case. The database has an integrated workflow rules engine that enables NTASM staff to generate letters, reminders and management reports. NTASM staff routinely cross-check all data against the original SCF and the FLA and SLA forms. Data are cleaned using logic testing and manually reviewed before analysis.

1.10 Statistical analysis

Statistical analysis is performed using IBM SPSS Statistics (version 24.0). Graphs have been produced with Microsoft Office Excel (2010).

Numbers in parentheses (n) in the text represent the number of cases analysed. The total number of patients used in each analysis varies because not all data points in the original SCF were completed. The total numbers of cases (n) included in individual analyses are provided in all tables and figures throughout the report.

Continuous variables are summarised using medians and the interquartile range (IQR), indicating the values of the 25% and 75% percentiles of a given distribution. Reporting IQRs overcomes the problem of reporting the range (minimum, maximum), as extreme values do not overly influence the interpretation of the data.

Risk ratios (RRs) are calculated for variables that have a dichotomous outcome to assess the risk of an event in one group versus the risk of the event in the reference group. All RRs are reported with a 95% confidence interval (CI). RRs are interpreted as follows:

- RR > 1: if the patient has the characteristic of interest, they have an increased risk of that outcome than does the reference group.
- RR ≈ 1: no difference or little difference in risk (incidence in each group is the same).
- RR < 1: if the patient has the characteristic of interest, they have a reduced risk than does the reference group.

Qualitative responses are analysed by NTASM staff and classified into themes.

Comorbidities and diagnoses for NT baseline data are provided by the NT Government with International Classification of Diseases codes (ICD-10). To enable comparison with NTASM data, NTASM recodes the ICD-10 categories to match the categories in the SCF.

2 Audit participation

KEY POINTS

- In the NT, 100.0% (38/38) of surgeons participated in the audit.
- The SCF return rate at census date for participating surgeons was 97.9%.
- 100% of all public and private hospitals currently participate in NTASM

2.1 Audit numbers

During the audit period 1 July 2016 to 30 June 2021, NTASM received 428 notifications of deaths associated with surgical care and NTASM excluded 10.5% (45/428) of these reported deaths (Table 1). These did not meet the inclusion criteria and were either incorrectly attributed to surgery 2.6% (11/428) or the patients were admitted for terminal care 7.9% (34/428).

Of the 383 included cases, surgeons completed 97.9% (375/383). A total of 96.6% (370/383) of the included cases had had the peer-review audit process completed by the census date (5 October 2021). The clinical information from these deaths provides the patient profiles described in this report and is the denominator in all analyses pertaining to outcomes from the audit, unless stated otherwise.

The remaining 3.4% (13/383) of cases are not included in this report for the following reasons:

- The SCF has not been completed by the surgeon (n = 8).
- The case had not completed the full peer-review audit process at the census date (n = 5).

Table 1: NTASM cases at census date, 2016–2021 (n = 370)

Notifications reported	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021	Total
	88	106	95	76	63	**428**
Excluded: error	4 (4.5%)	3 (2.8%)	2 (2.1%)	0 (0.0%)	2 (2.1%)	**11 (2.6%)**
Excluded: terminal care	6 (6.8%)	7 (6.6%)	4 (4.2%)	10 (7.6%)	7 (11.1%)	**34 (7.9%)**
Notifications included	78 (88.6%)	96 (90.6%)	89 (94.6%)	66 (86.8%)	54 (85.7%)	**383 (89.5%)**
Surgical case pending	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	8 (14.8%)	**8 (2.1%)**
Review process incomplete	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (9.3%)	**5 (1.3%)**
Review process complete	78 (100%)	96 (100%)	89 (100%)	66 (100%)	41 (75.9%)	**370 (96.6%)**

Reference: Appendix data table 1 and Appendix data table 2

Since 2018–2019, there has been a decrease in the number of deaths notified to NTASM. In 2019–2020 this could be due to COVID-19 impacting on the number of patients admitted to hospital. In 2020–2021, 3 deaths were reported to NTASM after the census date (5 October 2021), due to staffing issues.

2.2 Hospitals

All public and private hospitals certified to provide surgical services in the Northern Territory participate in NTASM. These hospitals notified NTASM of 428 patient surgical deaths by the 2021 census date (5 October 2021). The NTASM review process was completed for 370 patients, which are the basis of this report.

Surgical deaths were observed to occur predominantly in public hospitals, with a small fraction in private and co-located hospitals (Table 2). According to the Australian Institute of Health and Welfare, many interventions occur for acute overnight separations in the public sector in the NT, with no data provided for the private sector.(1) A separation is a completed episode of care for an admitted patient (Appendix 3: Definitions).(2)

Table 2: Hospital type for all reviewed surgical deaths, 2016–2021 (n = 370)

Hospital type	NTASM patients	% of total deaths
Public	357	96.5
Private	11	3.0
Co-located	2	0.5

2.3 Obstetrician and gynaecologist participation

Fellows of RANZCOG began participating in NTASM in 2012. Obstetricians and gynaecologists voluntarily participate in the audit if the patient's death was gynaecology-related.

In total there were 6 participating obstetricians and gynaecologists. Only 2 gynaecology cases were reported to NTASM. Because this number is so small these cases will be included in the total cases reported and not discussed as gynaecology cases.

2.4 Anaesthetist participation

Fellows of ANZCA began participating in NTASM in August 2016. Anaesthetists voluntarily participate in the audit if a patient's death was possibly or definitely related to anaesthesia during surgery or occurred within 48 hours of surgery. Anaesthetist participation is dependent on the surgeon noting an anaesthetic-related death in the SCF or anaesthetists self-notifying NTASM of cases in which they are involved (Figure 2).

In total there were 34 participating anaesthetists, 7 of whom were general practitioner (GP) anaesthetists.

2.5 Surgeon participation

Surgeons participate in NTASM as consultant surgeons (responsible for the case under review), peer-review surgeons providing FLAs or SLAs, locums or Specialist International Medical Graduates.

As of 30 November 2021, 32 consultant surgeons in the NT from 9 specialities were participating in the audit (Table 3). The NT relies extensively on locum surgeons and SIMGs. Currently, 5 locum surgeons and 3 SIMGs are participating in NTASM.

Previously, NTASM had recommended a full-time resident neurosurgeon and this position was appointed. During 2021, due to COVID-19, the Neurosurgery department reverted to having only locum surgeons. The vascular and urology surgeons in Darwin also act as a locum surgeon in Alice Springs. Additionally, there is a urology SIMG present in Darwin. NTASM recommends a full-time-equivalent position for both Vascular Surgery and Urology in Alice Springs.

Table 3: NT surgeons participating by surgical specialty as of November 2021

Surgical specialty	Surgeons participating*
General	19
Orthopaedic	4
Otolaryngology Head and Neck	2
Plastic and Reconstructive	2
Ophthalmology	2
Vascular	1
Urology	1
Neurosurgery	0
Oral and Maxillofacial	1
Total	**32**

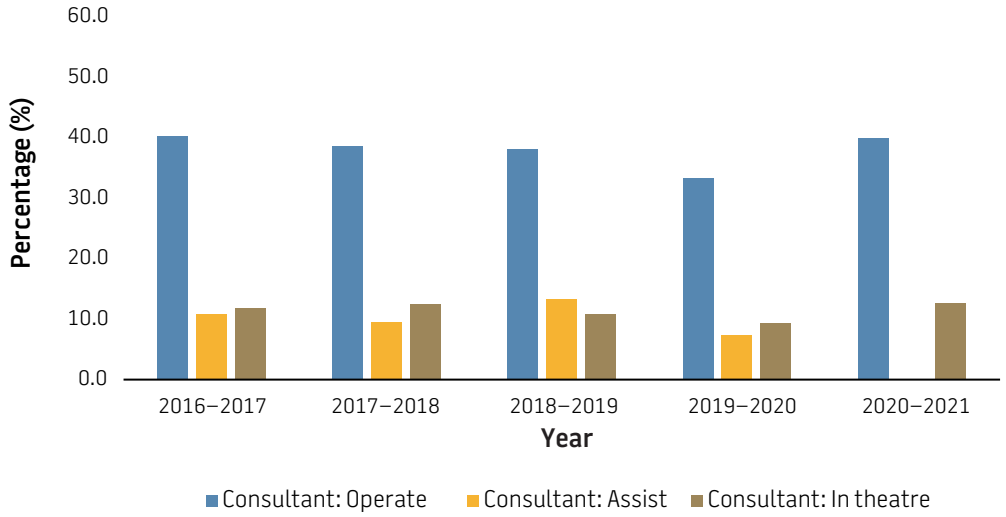
*Excluded from this table are surgeons who are no longer operating (n = 1), have left practice (n = 1), are locum (n = 5) or are Specialist International Medical Graduate surgeons (n = 3) in the NT.

2.5.1 Surgeon presence in theatre

Consultant surgeons may be in theatre to perform, assist with or supervise an operation. A total of 511 operations were performed. The presence of consultant surgeons, in any capacity (i.e. performing, assisting with or supervising the operation) is 83.6% (427/511) in the NT.

Consultants performed 59.5% of all operations (304/511), assisted in 11.0% (56/511) or were in theatre in an unspecified capacity for 13.1% of operations (67/511) (Figure 3).

Figure 3: Operations conducted with a consultant surgeon present in theatre, 2016-2021 (n=511)



Consultant in theatre = surgeon may have performed, assisted with or supervised the operation (not specified).
Reference: Appendix data table 3

2.5.2 Surgeon completion of surgical case forms

The audit relies on surgeons returning completed SCFs, which are sent to surgeons on the same day that the death notification is received. Most SCFs were completed by the census date (98.1%; 420/428), with only 8 still in progress (1.9%). NTASM is an ongoing process, so some cases were under assessment at the time of reporting. Only surgical deaths that have completed the audit review process and have a status of 'reviewed' were included in the analysis for this report. Cases under assessment will be included in the next reporting period.

2.5.3 Surgeon views in retrospect

Within the SCF, surgeons are asked to consider whether—in retrospect—they would have done anything differently in terms of patient management. (No answer was provided for 8 patients [2.2%; 8/370].)

- For 80.0% (296/370) of patients, the surgeon would **not** have changed the patient's management.
- For 17.8% (66/370) of patients, the surgeon would have done something differently.

The areas of care identified by surgeons for improvement covered all aspects of patient management. Sample comments are provided in Appendix 1.

2.5.4 Surgeon communication

The SCF asks surgeons to indicate if the case involved a communication issue. Surgeons indicated communication was an issue in 7.6% (28/367) of cases, not an issue in 91.3% (335/367) of cases and unknown in the remaining cases. The SCF does not capture information about the source (e.g. patient, patient's family or community, member of the clinical team) or nature (e.g. patient cognitive impairment, family unwilling to discuss palliative care) of the communication issue.

Surgeons' reports of communication issues have remained low over the 10-year reporting period of the audit (Table 4). Nevertheless, the NT Steering Committee has identified communication as a future area of focus for surgeons.

Table 4: Number of communication issues reported by consultant surgeons (n = 367*)

Communication reported	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021	Total
Communication issue	10	3	9	5	1	28
No communication issue	62	93	80	60	40	335
Unknown	3	0	0	1	0	4
Total	**75**	**96**	**89**	**66**	**41**	**367**

*Data missing n = 3 (0.8%)

Feedback from a Safer Surgical Teamwork (SST) workshop at Royal Darwin Hospital (25.09.2021):

Thanks again for organising the SST, for the surgically keen Juniors that attended the session (although only 3 of us), just wanted to say that it was a very valuable course to do. Definitely surprised at the content and delivery of it.

I want to strongly advocate for holding the course at least 1-time a year in Darwin to increase awareness of current surgeons (those who may have not attended) and upcoming surgical RMO/Registrars as a part of the surgical unit education at RDH.

3 Results: all patients

KEY POINTS

- 428 patients' deaths were notified between July 2016 and June 2021.
- The review process was completed for 370 patients (86.4% of reported cases).
- Most patients had an emergency admission (91.6%; 339/370).
- 2 obstetrics and gynaecology patients' deaths were reported.
- 75 anaesthetic cases were reported.

3.1 Notified and peer-reviewed cases

NTASM was informed of 428 notifications of deaths associated with surgical care (between July 2016 and June 2021). NTASM excluded 10.5% (45/428) of these reported deaths as they were either incorrectly attributed to surgery (2.6%; 11/428) or the patients were admitted for terminal care (7.9%; 34/428).

Of the 383 included deaths, surgeons completed 97.9% (375/383) of the included cases. Of the included cases, 96.6% (370/383) had completed the peer-review audit process by the census date (5 October 2021). The clinical information from these 370 deaths provides the patient profiles described in this report and is the denominator in all analyses pertaining to outcomes from the audit, unless stated otherwise.

Assessors completed 370 FLAs and 38 SLAs during 2016–2021. Most cases were closed after FLA (89.7%; 332/370). The percentage of cases sent to second-line assessors was 10.3% (38/370). Insufficient information contained in 2.7% of the SCFs (9/370) was the reason the first-line assessor progressed the case to SLA. Hospitals are notified of the number of cases allocated for SLA due to insufficient information in their annual hospital report.

3.2 Anaesthetic review

Since participation started in 2016, there have been 75 anaesthetic cases reported to NTASM and 1 case was excluded. Of these cases, 78.4% (58/74) have been reviewed, 6.8% (5/74) are under review and 14.9% (11/74) are pending submission.

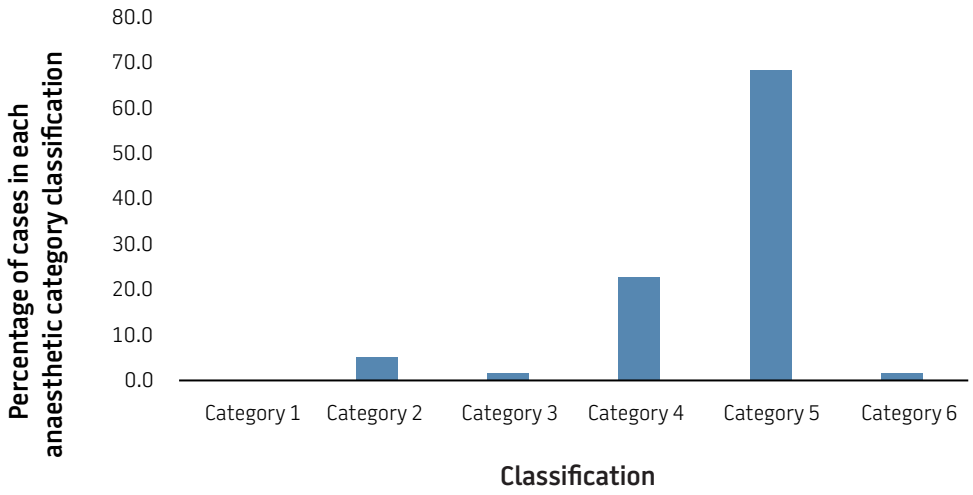
The median age of anaesthetic patients was 66.5 years (IQR 51–77). The most frequently occurring age (mode) across the 5-year NTASM reporting period was 77 years.

The majority of assessors reported no area of concern or for consideration (77.6%; 45/58). In a smaller proportion of cases, assessors reported an area of concern or consideration that made no difference to the outcome (12.1%; 7/58) or an area of concern which contributed to death (10.3%; 6/58).

Only 5.2% (3/58) of anaesthetic cases had an SLA. These SLAs were all requested due to a lack of information on both the anaesthetic and SCF.

Assessors deemed that nearly all cases (91%; 52/58) were not attributed to anaesthesia (Category 4 and Category 5). There were no Category 1 cases reported. Assessor classified more than two-thirds of cases (68.4%; 39/57) as Category 5 cases where death was inevitable and would have occurred irrespective of anaesthesia or surgical procedures (Figure 4).

Figure 4: Anaesthesia Category Classification (n = 57*)



*missing data n = 1
Category 1: Where it is reasonably certain that death was caused by the anaesthesia or other factors under the control of the anaesthetist.
Category 2: Where there is some doubt whether death was entirely attributable to the anaesthesia or other factors under the control of the anaesthetist.
Category 3: Where it is reasonably certain that death was caused by both surgical and anaesthetic factors.
Category 4: Where the administration of anaesthesia is not contributory to death and surgical or other factors are implicated.
Category 5: Inevitable death, which would have occurred irrespective of anaesthesia or surgical procedures.
Category 6: Incidental death which could not reasonably be expected to have been foreseen by those looking after the patient, was not related to the indication for surgery and was not due to factors under the control of the anaesthetist or surgeon.
Reference: Appendix data table 4.

3.3 Surgical Specialties of reviewed NTASM cases

During 2016–2021, 67.6% (250/370) of NTASM cases were managed in General Surgery, 11.6% (43/370) in Orthopaedic Surgery and 9.2% in Neurosurgery (34/370) (Table 5).

Table 5: Surgical specialties of reviewed NTASM cases

Surgical specialty	Reviewed NTASM cases, 2016–2021 (n = 370)	
	n	(%)
General Surgery	250	67.6
Orthopaedic Surgery	43	11.6
Neurosurgery	34	9.2
Vascular Surgery	17	4.6
Urology	10	2.7
Otolaryngology Head and Neck	7	1.9
Other*	9	2.4

*Other includes specialties with fewer than 5 surgical deaths (i.e. Plastic Surgery, Ophthalmology, Obstetrics & Gynaecology and Oral/Maxillofacial)

3.4 Patient admissions

Most patients had an emergency admission (91.6%; 339/370). Only a small percentage of patients had an elective admission (8.4%; 31/370).

3.5 Patient length of stay

The median length of stay (LOS) in hospital for the episode in which the death occurred was 13 days (IQR 4–27 days). Not all patients had an operation. LOS was longer for patients with an operation than without. Patients who had an operation had a median LOS of 17 days (IQR 5–28 days), compared with 5 days (IQR 2–10.5 days) for patients who did not have an operation.

3.6 Patient transfers

A total of 73 patients (20.2%; 73/362) were transferred between hospitals. Transfer distances ranged from less than 1 km to 3,030 km. Transfers of less than 1 km were usually between the co-located Darwin Private Hospital and Royal Darwin Hospital. The mean distance was 561.4 km (standard deviation [SD] 527.4) and the median distance was 400 km (IQR 300–800).

3.7 Patient demographics

3.7.1 Patient age

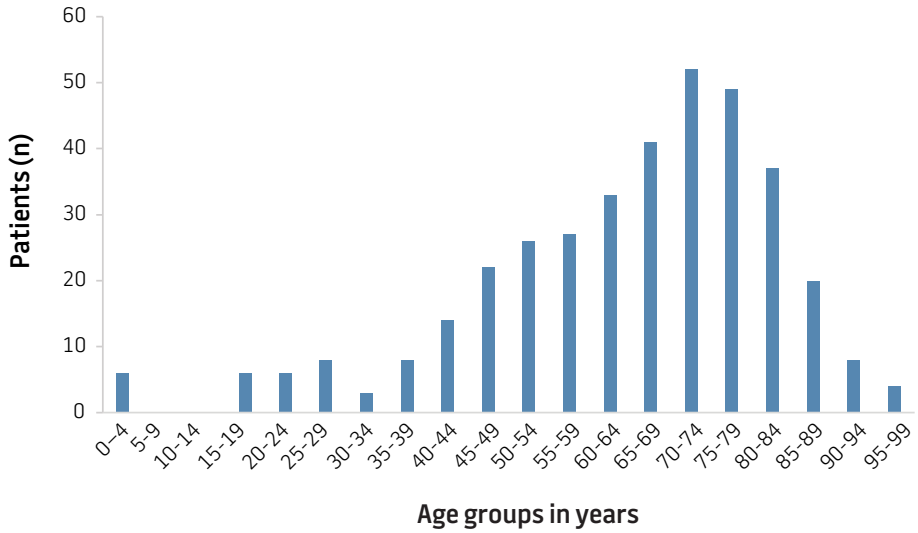
Overall, patients included in NTASM are elderly patients. The median age of surgical patients who died was 67 years (IQR 50–78; n=370). The most frequently occurring age (mode) across the 5-year NTASM reporting period was 78 years (Table 6 and Figure 5).

Table 6: Age distribution of NTASM patients, 2016–2021.

Age statistics	Age, in years, of NTASM patients (n = 370)
Mean ±SD	63.7 (19.0)
Median (IQR)	67 (53–78)
Mode	78
Minimum	0
Maximum	99

Source: Notification of death form

Figure 5: Age of NTASM patients, 2016–2021 (n = 370)



Reference: Appendix data table 5

Median patient age has varied little over the last 5 years of the audit. In 2016–2017, the median patient age was 66 years (IQR 49–73; n=78), and in 2020–2021 the median patient age was 69 years (IQR 54–78; n=41).

3.7.2 Patient sex

More males than females died during surgical admissions in NT hospitals, both in the 5-year reporting period of 2016–2021 and the most recent reporting period of 2020–2021 (Table 7).

Table 7: Sex ratio of NTASM patients by year, 2016–2021 (n = 370)

Year	Male		Female	
	Patients (n)	% of total	Patients (n)	% of total
2016–2017 (n=78)	50	64.1	28	35.9
2017–2018 (n=96)	51	53.1	45	46.9
2018–2019 (n=89)	53	59.6	36	40.4
2019–2020 (n=66)	35	53.0	31	47.0
2020–2021 (n=41)	27	65.9	14	34.1
Total (n=370)	**216**	**58.4**	**154**	**41.6**

Source: Notification of death form

3.7.3 Patients with comorbidities

Surgeons recorded all known comorbidities (coexisting medical conditions that threaten life). Nearly all patients had at least one comorbidity (87.0%; 322/370) (Table 8).

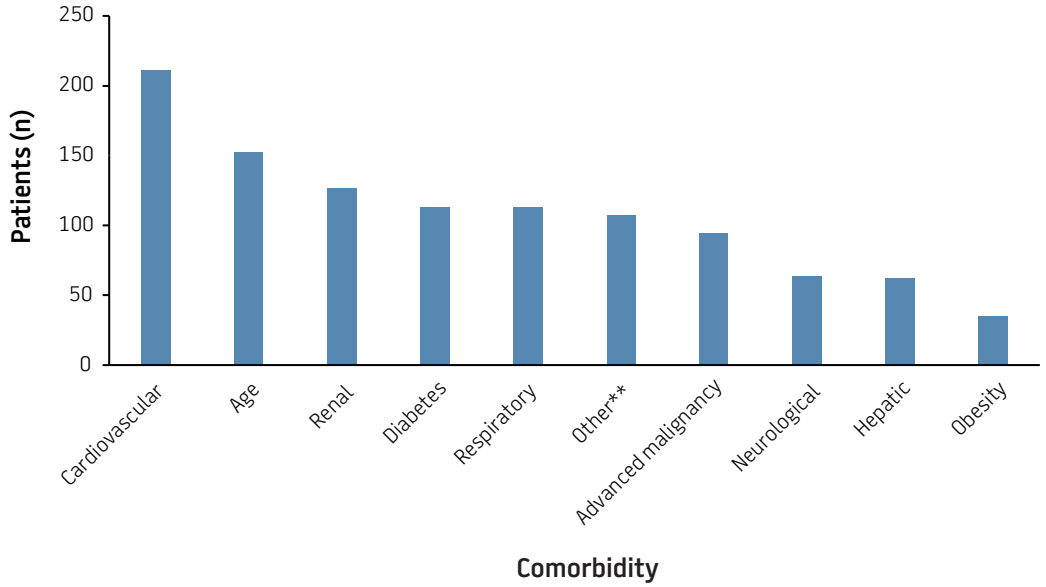
Table 8: Comorbidity status of NTASM patients, 2016–2021 (n =370)

Comorbidity status	Patients (n)	% of total
Comorbidities present	322	87.0
No comorbidities present	48	13.0

Source: Surgical case form

Surgeons did not report the type of comorbidity for 2 patients. Of the patients with comorbidities, only 15.5% had 1 comorbidity (50/322) and 83.9% (270/322) had multiple comorbidities. The median number of comorbidities was 3 (IQR 2–4), with a minimum of 1 and a maximum of 8. Cardiovascular disease (65.9%) was the most frequently reported comorbidity (Figure 6).

Figure 6: Types of comorbidities, 2016–21 (n = 368*)



*Data missing for n=2 (0.01%).
**Other includes alcohol abuse, anticoagulation therapy, arthritis/osteoporosis, dementia/Alzheimer's disease, cerebral palsy, hyperthyroidism, malignancy, malnutrition/cachexia, peripheral vascular disease, smoking, ischaemic heart disease.
Reference: Appendix data table 6

3.8 Patients treated in intensive care

Planned or unplanned admission to an intensive care unit (ICU) can occur at any time during a patient's hospital stay regardless of whether the patient has an operation or not. Surgeons record whether the patient was admitted to ICU.

More than half of all NTASM patients were treated in intensive care (66.4%; 245/369). Fewer patients who did not have an operation were treated in ICU (63.1%; 41/65) compared to those patients who had an operation (67.1%; 204/304), although this difference is not statistically significant (RR 0.94; 95% CI 0.77–1.15).

Unplanned admission to ICU increases the risk of in-hospital mortality in very elderly patients (80 years and older).(3) At least 50.0% of the risk of in-hospital death in patients 80 years or older is attributable to a combination of unplanned ICU admission, comorbidity (≥1 comorbid condition), acute renal failure and respiratory failure.(3) More than half of the NTASM patients who died were 60 years or older (65.9%; 244/370) and 19.2% of these patients had an unplanned treatment in intensive care (46/240). Less than a quarter of NTASM patients were 80 years or older (18.6%; 69/370) and 11.6% of these patients had an unplanned treatment in intensive care (8/69).

3.9 Patients with deep vein thrombosis prophylaxis

Deep vein thrombosis (DVT) prophylaxis is given to most patients regardless of whether they have an operation. Surgeons document any DVT prophylaxis used and comment on its appropriateness.

The percentage of cases given DVT prophylaxis was 78.9% (292/363); 19.6% (71/363) did not receive DVT prophylaxis (data missing n=7/370 cases [1.9%]).

Surgeons stated that they did not use DVT prophylaxis in the following situations:

- use not appropriate—67.2% of patients (45/67)
- active decision to withhold—26.9% of patients (18/67)
- usage not considered—6.0% of patients (4/67).

Many surgeons gave additional reasons for not giving DVT prophylaxis. The most frequently cited reasons were that the patient was:

- actively bleeding
- coagulopathic
- already anticoagulated
- being palliated.

Some patients receive more than one DVT prophylaxis agent. Surgeons provided 473 uses of DVT prophylactic agents to 286 patients. The most frequently used DVT prophylaxis was heparin, in any form (Table 9).

Table 9: Distribution of DVT prophylaxis provided to all NTASM patients, 2016–2021 (n = 286*)

Type of DVT prophylaxis	Patients	% of all prophylactic agents
Heparin—in any form	222	46.9
TED stockings	130	27.5
Sequential compression device	86	18.2
Aspirin	20	4.2
Other**	13	2.7
Warfarin	2	0.4

473 uses of DVT prophylactic agent for 286 patients.
*missing data n = 84
**Other includes: apixaban, enoxaparin/Clexane and rivaroxaban/Xarelto, dual antiplatelet therapy, calf compressors, IVC filter already inserted.
TED = thromboembolitic deterrent

4 Results: patients with operations

In this report, the term ***operation*** encompasses both operations and procedures (i.e. an operation may refer to a relevant radiological or endoscopic procedure).

Most NTASM patients admitted under the care of a surgeon had a surgical operation (82.4%; 305/370). Although this is a surgical audit, 17.6% (65/370) of patients did not have an operation.

Surgeons performed a total of 511 operations; consultant surgeons performed 59.5% (304/511) of these operations. More than half of the operations were the only operation for that patient (58.1%; 215/370).

The most frequently performed operations across 2016–2021, representing 58.1% (297/511) of all operations, are presented in Table 10.

Table 10: Most frequently performed operations, 2016–2021 (n = 511)

Operation type	Patients (n)	% of total operations
Debridement of muscle NEC	48	9.4
Debridement of skin NEC	44	8.6
Reopening of laparotomy site	39	7.6
Exploratory laparotomy	33	6.5
Diagnostic gastroscopy NEC	31	6.1
Burr hole(s) for ventricular external drainage	24	4.7
Irrigation of peritoneal cavity	20	3.9
Change of dressing	15	2.9
Dressing of wound	12	2.3
Open insertion of feeding tube into stomach	11	2.2
Prosthetic cemented hemiarthroplasty of hip	10	2.0
Primary open reduction and internal fixation of a proximal femoral fracture with a screw/nail device alone	10	2.0

NEC = not elsewhere classified
Source: Surgical case form

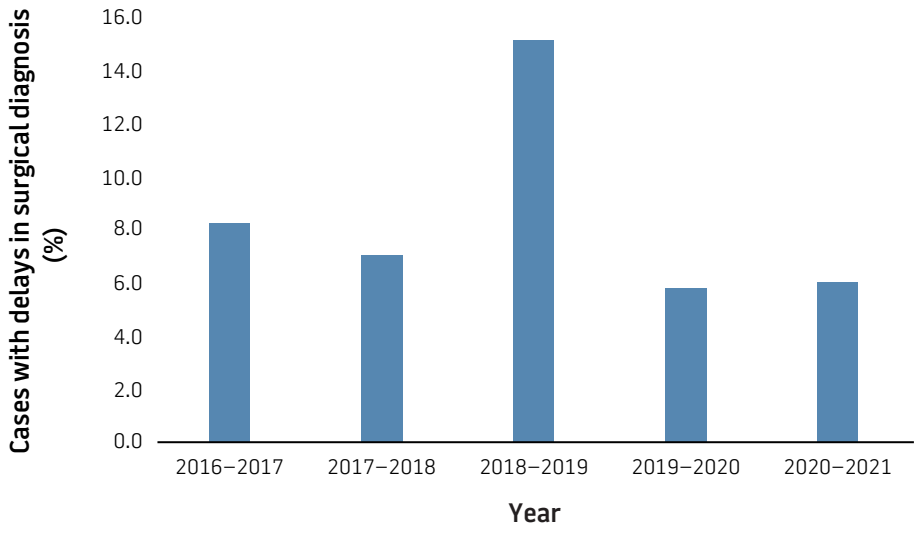
4.1 Patients with delays in surgical diagnosis

Delays in surgical diagnoses are associated with higher mortality rates in surgical patients.(4,5) The percentage of NTASM patients with delay recorded varies slightly across years but is trending downwards in 2020–2021 (Figure 7).

Across 2016–2021, 27 patients had a delayed surgical diagnosis (reported for 8.9% [27/304] of patients who had an operation). Almost half of the surgeons (44.4%; 12/27) who reported delays in diagnoses for a patient provided no further details regarding the cause of the delay. The causes of the delays can be associated with more than one department. Most of the delays were associated with surgical departments (33.3%; 9/27), medical departments (22.2%; 6/27) and with GPs (18.5%; 5/27).

Nearly half of the delays were due to unavoidable factors (44.4%; 12/27), and those associated due to the wrong test being done, results not seen, misinterpretation of results or inexperience of staff are too few to report.

Figure 7: Delays in surgical diagnoses in NTASM patients, 2016–2021 (n=304*)



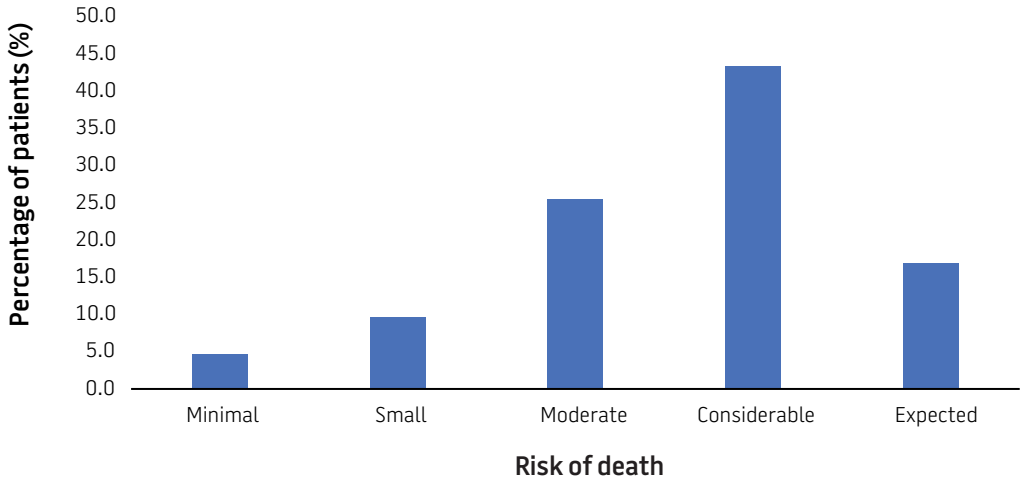
*missing data n = 1 (>0.3%)
Reference: Appendix data table 7

4.2 Patients with preoperative risk of death

Surgeons assessed each patient's risk of death prior to surgery (reported for 99.0% [302/305] of patients who had an operation). Risk of death, while subjective, reflects the complexity of the procedure in the context of the patient's presentation, estimated physiological reserve and American Society of Anesthesiologists (ASA) class. Surgeons assessed 68.9% of patients (208/302) as having a moderate or considerable risk of death prior to surgery.

Death was expected for 16.9% of patients (51/302) who underwent at least one operation (Figure 8). There was no difference between surgeons' assessments of risk of death for the most complex patients (moderate, considerable or expected) over the audit period (1 July 2016 to 30 June 2021).

Figure 8: Surgeon-assessed risk of death for NTASM patients, 2016–2021 (n = 302*)



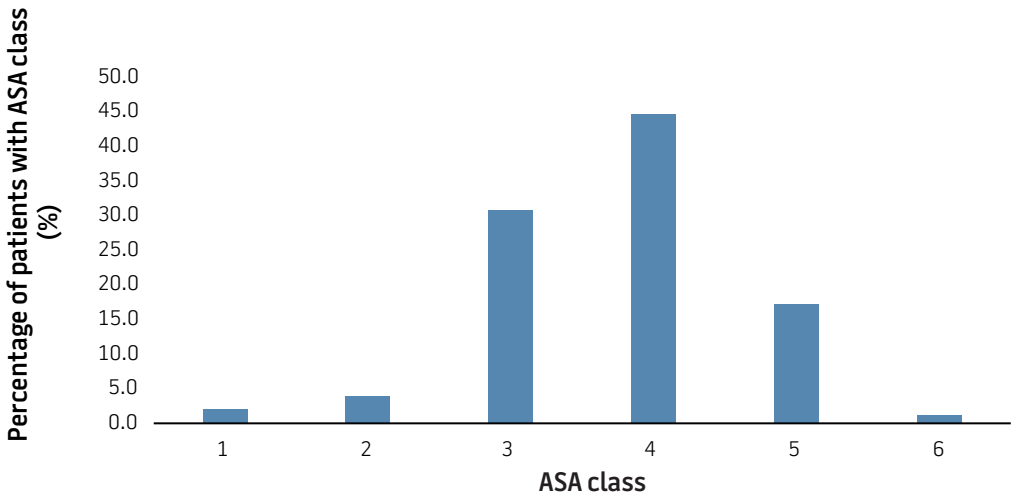
*Missing data n = 3 patients (1.0%)
Reference: Appendix data table 8

4.3 American Society of Anaesthesiologists class

Anaesthetists use the American Society of Anesthesiologists (ASA) physical status classification system to assess preoperative risk, based on the patient's comorbidities and other factors.(6) Classification levels range from class 1 (normal, healthy patient) to class 6 (declared brain-dead patient). NTASM surgeons record ASA class for all patients regardless of whether or not they receive an operation.

The median ASA class for patients who had an operation was 4 (IQR 3–4), with 63.2% (179/285) at class 4 or higher. This implies severe systemic disease that is a constant threat to life (Figure 9). Surgeons did not report ASA class for 20 patients who had an operation (20/305; 6.6%).

Figure 9: ASA class recorded for NTASM patients, 2016–2021 (n = 285*)



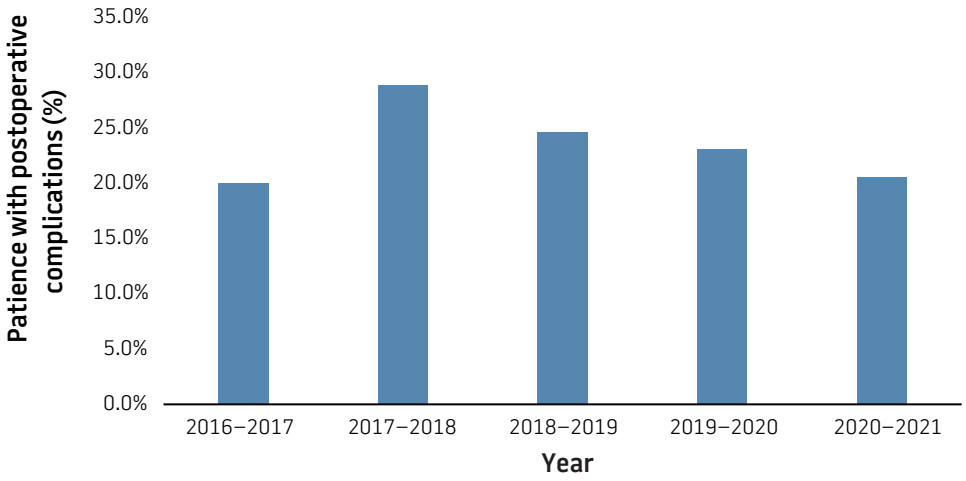
ASA class 1 = a normal healthy patient; ASA class 2 = a patient with mild systemic disease; ASA class 3 = a patient with moderate systemic disease; ASA class 4 = a patient with severe systemic disease that is a constant threat to life; ASA class 5 = a moribund patient unlikely to survive 24 hours, who is not expected to survive without an operation; ASA class 6 = a patient declared brain-dead whose organs are being removed for donor purposes.
*Missing data n = 20 patients (6.6%)
Reference: Appendix data table 9

4.4 Patients with postoperative complications

Surgeons did not report postoperative complications for all patients who had an operation. Postoperative complications occurred in 24.2% of patients (73/302) during 2016–2021. The frequency of postoperative complications is decreasing over time, from 28.9% of all operations in 2017–2018 to 20.3% of all operations in 2020–2021 (Figure 10).

There was a delay in recognising postoperative complications in 9.6% (7/73) of patients who had a complication.

Figure 10: NTASM patients with postoperative complications, 2016–2021 (n = 302*)



*Missing data n = 3 patients (1.0%)
Reference: Appendix data table 10

Surgeons did not report the type of complication for all patients who had a complication. The most frequently recorded complications were:

- significant postoperative bleeding—20.2% (17/70)
- procedure-related sepsis—11.9% (10/70)
- tissue ischaemia—8.3% (7/70)

Of the patients who had operations, the most frequently occurring postoperative complication group was significant postoperative bleeding. Postoperative complications are listed by frequency in Table 11. Some of the patients who died had several complications.

Table 11: Postoperative complications in NTASM patients, 2016–2021 (n = 70*)		
Postoperative complication	**Patients (n)**	**% of patients with complication**
Significant postoperative bleeding	17	20.2
Procedure-related sepsis	10	11.9
Tissue ischaemia	7	8.3
Anastomotic leaks	3	3.6
Endoscopic perforation	2	2.4
Vascular graft occlusion	2	2.4
Other	43	51.2

Source: Surgical case form
*Missing data n = 3 patients (4.1%)

4.5 Patients with an unplanned return to theatre

Unplanned returns to theatre are strong predictors of death.(7) On average, 20.1% (61/303) of patients who died after an operation had had an unplanned return to theatre (Table 12). The percentage of patients who had an unplanned return to theatre has decreased since 2016.

Table 12: Unplanned returns to theatre, 2016–2021 (n = 303*)			
Year	**Operated patients (n)**	**Unplanned returns to theatre (n)**	**% of total**
2016–2017*	60	14	23.3
2017–2018*	83	15	18.1
2018–2019	73	12	16.4
2019–2020	53	15	28.3
2020–2021	34	5	14.7
Total 2016–2021	**303**	**61**	**20.1**

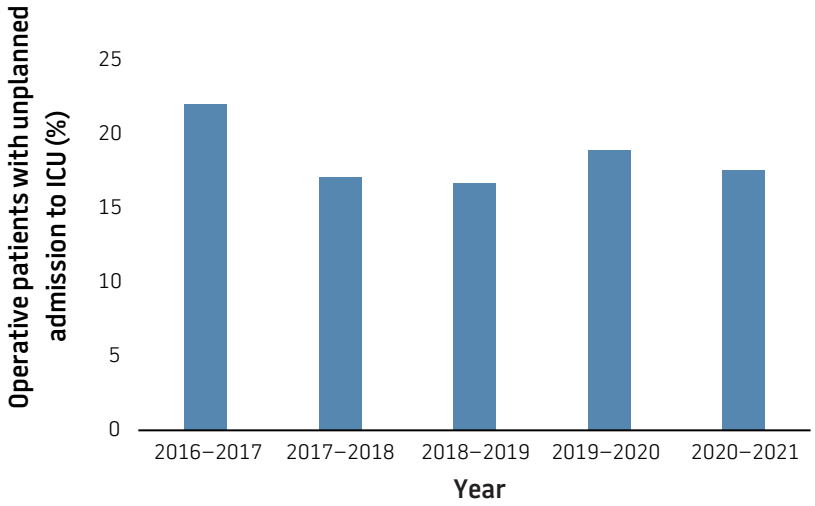
*missing data n = 2
Source: Surgical case form

4.6 Patients with postoperative unplanned admission to an intensive care unit

Postoperative admission to an intensive care unit (ICU) should be planned during preoperative assessments.

Of the patients who had an operation, 18.3% (55/300) required an unplanned admission to ICU (Figure 11). The rate of postoperative unplanned ICU admissions remained steady across the years.

Figure 11: Operative NTASM patients with unplanned admission to ICU, 2016–2021 (n = 300*)



*Missing data n = 5 (1.6%)
Reference: Appendix data table 11

4.7 Operative patients with deep vein thrombosis prophylaxis

The percentage of patients who had an operation and were given DVT prophylaxis was 80.3% (241/300); 19.7% (59/300) did not receive DVT prophylaxis (data missing n=5/305 cases [1.6%]).

Surgeons stated that they did not use DVT prophylaxis in the following situations:

- usage not appropriate—65.5% of patients (36/55)
- active decision to withhold—29.1% of patients (16/55)
- usage not considered—5.5% of patients (3/55).

Surgeons provided DVT prophylactic agent on 396 occasions for 235 operative patients. The most frequently used DVT prophylaxis was heparin, in any form (Table 13).

Table 13: Distribution of DVT prophylaxis provided to NTASM patients who had an operation, 2016–2021 (n = 235*)

Type of DVT prophylaxis	Patients	% of all prophylactic agents
Heparin—in any form	186	47.0
TED stockings	106	26.8
Sequential compression device	75	18.9
Aspirin	16	4.0
Other**	12	3.0
Warfarin	1	0.3

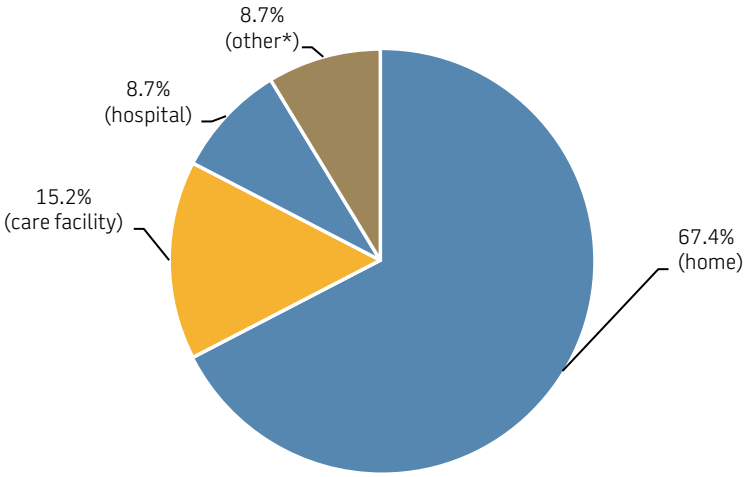
396 uses of DVT prophylactic agent for 235 patients
TED = thromboembolitic deterrent
*missing data n = 70
**Other includes: apixaban, enoxaparin/Clexane, rivaroxaban/Xarelto, dual antiplatelet therapy, calf compressors, IVC filter already inserted.

5 Results: trauma

Surgeons are asked to document whether patients were admitted as a result of trauma and if the trauma was related to a fall, road traffic accident, violence or other cause.

More than one-fifth of patients (22.8%; 84/369) were admitted to hospital because of trauma. The most frequent causes of trauma were falls (54.8%; 46/84), road traffic accidents (23.8%; 20/84) or violence (16.7%; 14/84). Over 90.0% of falls occurred at a private home, care facility or hospital. Other fall locations were places of sport, recreation, farming or work (Figure 12).

Figure 12: Patient location at time of fall that caused trauma, 2016–2021 (n = 46)



*Other includes sport/recreation/farm/work
Reference: Appendix data table 12

Of all road traffic accidents, 90.0% involved either a motor vehicle (14/20) or a motorcycle (4/20). Pedestrians were involved in traffic accidents but are too few to report (Appendix data table 13).

Self-inflicted (50.0%; 7/14) and public violence (35.7%; 5/14) were the main causes of trauma related to violence.

6 Results: infections

Surgeons are asked to document whether patients died with a clinically significant infection still present at the time of death. Surgeons are also asked to document if the infections were present at the time of admission or if they developed during the hospital admission.

More than a third of NTASM patients (35.1%;129/368) had a clinically significant infection present at the time of their death. More patients acquired the infection before their admission to hospital (54.7%; 70/128) than during their admission (45.3%; 58/128).

Of the patients who acquired the infection during admission; 60.3% (35/58) acquired the infection postoperatively. Surgical site infections occurred in 13.8% (8/58) of patients and other invasive site infections occurred in 10.3% (6/58) of patients.

Pneumonia was the most frequent type of infection that was acquired during the admission (30.2%; 39/129). The other types of infections that were acquired were of similar proportions (Table 14).

Table 14: Infection type in NTASM patients who acquired a clinically significant infection during admission, 2016–2021 (n = 129)

Type of infection	n (%)
Pneumonia	39 (30.2)
Intra-abdominal sepsis	27 (20.9)
Septicaemia	30 (23.3)
Other source (not specified)	33 (25.6)

In half of the cases, the infective organism was identified (52.4%; 66/126). These included:

Bacteria

- Group A *Streptococcus* (n= 16)
- *Escherichia coli* (n = 14)
- *Staphylococcus aureus* (n = 14)
- *Pseudomonas species* (n = 8)
- *Methicillin-resistant Staphylococcus aureus* (n = 3)
- *Klebsiella species* (n = 2)

Viruses

- Influenza A (n = 1)
- *Cytomegalovirus* (n = 1)

Yeast

- *Candida albicans/Candida species* (n = 7)
- *Cryptococcus species* (n = 1)

7 Aboriginal and Torres Strait Islander patients

KEY POINTS

- There was no difference in the presence of comorbidities between Aboriginal and Torres Strait Islander patients and non-Indigenous patients.
- Aboriginal and Torres Strait Islander patients admitted under General Surgeons were 10% more likely to have an operation than non-Indigenous patients.
- There was no difference between the care provided to Aboriginal and Torres Strait Islander patients and that provided to non-Indigenous patients.
- CMIs did not occur in 85.0% of NTASM Aboriginal and Torres Strait Islander patients.

In Australia, Aboriginal and Torres Strait Islander people experience poorer health outcomes compared with non-Indigenous people. RACS 2020 *Indigenous health position paper* reaffirms the RACS commitment to improving health outcomes for Aboriginal and Torres Strait Islander people.(8)

Aboriginal and Torres Strait Islander people have higher rates of disease (cardiovascular disease, diabetes and chronic kidney disease), hospitalisation and death than do non-Indigenous people. These rates are increased at a younger age than in non-Indigenous patients.(9)

Adult Aboriginal and Torres Strait Islander people are more likely to have 3 or more comorbidities (38.0%) compared with adult non-Indigenous people (26.0%).(9)

The differences in patient characteristics between NTASM Aboriginal and Torres Strait Islander patients and non-Indigenous patients are seen in Table 15.

Aboriginal and Torres Strait Islander patients were 16 years younger than non-Indigenous patients and were 3 times more likely to be younger than 50 years.

Aboriginal and Torres Strait Islander patients were nearly twice as likely to be female; 4 times more likely to be transferred and twice as likely to have a delay in surgical diagnosis than non-Indigenous patients. Aboriginal and Torres Strait Islander patients were 60% more likely to present to hospital with an infection present compared with non-Indigenous patients (Table 15).

There was no statistical difference in the presence of comorbidities between Aboriginal and Torres Strait Islander patients and non-Indigenous patients with comorbidities (Table 15), although Aboriginal and Torres Strait Islander patients were twice as likely to have renal disease and diabetes compared with non-Indigenous patients. They were also more likely to have cardiovascular disease, hepatic disease and other diseases than non-Indigenous patients (Table 16).

Aboriginal and Torres Strait Islander patients who were admitted under General Surgeons were 10% more likely to have an operation than non-Indigenous patients admitted under General Surgeons (Table 17).

Table 15: Characteristics and clinical outcomes of NTASM Aboriginal and Torres Strait Islander and non-Indigenous patients, 2016–2021

Patient demographics	Aboriginal and Torres Strait Islander patients (n = 134) (36.2%)	Non-Indigenous patients (n = 236) (63.8%)	Risk ratio** (95% CI)
Age at death (years): • Mean (±SD) • Median (IQR) • Range	 54.5 (17.9) 56.0 (45.8–67.0) 0–96	 68.9 (17.6) 73.0 (62.0–80.0) 9–99	
Age 0–49 years	48/134 (35.8)	25/236 (10.6)	3.38 (21.9–5.22)*
Female sex	78/134 (58.2)	76/236 (32.2)	1.81 (1.43–2.28)*
Transferred	51/133 (38.3)	22/229 (9.6)	4.08 (2.60–6.42)*
Public hospital admission	133/134 (99.3)	224/236(94.9)	1.04 (1.01–1.08)*
Emergency admission	129/134 (96.3)	210/236 (89.0)	1.08 (1.02–1.14)*
Comorbidities present	116/134 (86.6)	206/236 (87.3)	0.99 (0.91–1.08)
Operation performed	115/134 (85.8)	190/236 (80.5)	1.07 (0.97–1.17)
Delays in diagnosis	17/132 (12.9)	14/236 (5.9)	2.19 (1.11–4.26)*
Postoperative complication	25/113 (22.1)	48/189 (25.4)	0.93 (0.60–1.43)
Fluid balance issue	13/128 (10.2)	15/235 (6.4)	1.59 (0.78–3.23)
Clinically significant infection	51/132 (38.6)	78/236 (33.1)	0.12 (0.08–0.16)
Community acquired infection	36/ 132 (27.3)	34/ 236 (14.4)	1.89 (1.24–2.87)*
Hospital acquired infection	15/96 (15.6)	43/202 (21.3)	0.73 (0.43–1.25)

There is denominator variation as not all questions were answered.
*Statistically significant at P←0.05 but may not be clinically significant.
** The risk ratio reference group is non-Indigenous patients.
**Risk ratios are at 95% confidence interval. Risk ratio is the cumulative incidence or risk of disease in one group divided by the cumulative incidence or risk in a second or reference group, also described as relative risk (Section 1.10).

Table 16: Most frequently occurring comorbidities in NTASM Aboriginal and Torres Strait Islander patients and non-Indigenous patients, 2016–2021 (n = 320)

Comorbidities	Aboriginal and Torres Strait Islander patients	Non-Indigenous patients (n = 236) (63.8%)	Risk ratio** (95% CI)
Cardiovascular disease	86 (74.1)	125 (61.3)	1.21 (1.04—1.41)*
Renal	76 (65.5)	50 (24.5)	2.67 (2.03—3.52)*
Diabetes	65 (56.0)	48 (23.5)	2.38 (1.77—3.20)*
Other***	47 (40.5)	60 (29.4)	1.38 (1.01—1.87)*
Respiratory	42 (36.2)	71 (34.8)	1.04 (0.77—1.41)
Hepatic	31 (26.7)	31 (15.2)	1.76 (1.13—2.74)*
Neurological	20 (17.2)	43 (21.1)	1.26 (0.85—1.89)
Advanced malignancy	17 (14.7)	77 (37.7)	0.39 (0.24—0.62)
Obesity	12 (10.3)	23 (11.3)	0.92 (0.47—1.77)

Patients often have more than one comorbidity. Total of 1076 comorbidities reported for 320 patients.
*Statistically significant at P<0.05 but may not be clinically significant.
**The risk ratio reference group is non-indigenous patients.
**Risk ratios are at 95% confidence interval. Risk ratio is the cumulative incidence or risk of disease in one group divided by the cumulative incidence or risk in a second or reference group, also described as relative risk (Section 1.10).
***Other includes alcohol abuse, anticoagulation, dementia/Alzheimer's, depression, frailty, immunosuppression, leukaemia, malnutrition, paraplegia, peripheral vascular disease, rheumatoid arthritis, smoking.
Source: Surgical case form

Table 17: The distribution of NTASM Aboriginal and Torres Strait Islander patients and non-Indigenous patients admitted by surgical specialty and the percentage who had an operation, 2016–2021

Specialty	Aboriginal and Torres Strait Islander patients (n = 115) (%)	Non-Indigenous patients (n = 190) (%)	Risk ratios** (95% CI)
General	77/87 (88.5)	129/163 (79.1)	0.12 (1.00–1.25)*
Neurosurgery	13/20 (65.0)	12/14 (85.7)	0.76 (0.52–1.12)
Orthopaedic	11/12 (91.7)	26/31 (83.9)	1.09 (0.87–1.38)
Other***	14/15 (93.3)	23/28 (82.1)	1.14 (0.91–1.41)

Specialities are not reported where patient numbers are fewer than 5.
*Statistically significant at P<0.05 but may not be clinically significant.
**The risk ratio reference group is non-indigenous patients.
**Risk ratios are at 95% confidence interval. Risk ratio is the cumulative incidence or risk of disease in one group divided by the cumulative incidence or risk in a second or reference group, also described as relative risk (Section 1.10).
***Other includes vascular, urology, plastic, otolaryngology head and neck, ophthalmology, obstetrics and gynaecology, oral/maxillofacial surgery.

Second-line assessments were completed for 12.7% of Aboriginal and Torres Strait Islander patients (17/134). This was higher than the 8.9% for non-Indigenous patients' deaths (21/236). This difference was not statistically significant (RR 1.43; 95% CI 0.78–2.61).

Assessors also consider the care provided to patients when doing assessments. Assessors found no significant difference between the care provided to Aboriginal and Torres Strait Islander patients and that provided to non-Indigenous patients (Table 18).

Table 18: Assessors opinions on difference of care between NTASM Aboriginal and Torres Strait Islander and non-Indigenous patients who had an operation, 2016–2021

Difference in care	Aboriginal and Torres Strait Islander patients (n = 115) (%)	Non-Indigenous patients (n = 190) (%)	Risk ratio** (95% CI)
Preoperative care	8/114 (7.0)	14/190 (7.4)	0.95 (0.41–2.20)
Decision to operate	8/114 (7.0)	10/190 (5.3)	1.33 (0.54–3.28)
Timing of operation	10/114 (8.8)	12/190 (6.3)	1.39 (0.62–3.11)
Postoperative care	7/113 (6.2)	11/190 (5.8)	1.06 (0.42–2.66)

Results to be treated with caution as numbers are low
**The risk ratio reference group is non-Indigenous patients
**Risk ratios are at 95% confidence interval. Risk ratio is the cumulative incidence or risk of disease in one group divided by the cumulative incidence or risk in a second or reference group, also described as relative risk (Section 1.10).

Assessors considered that CMIs did not occur in 85.0% of NTASM Aboriginal and Torres Strait Islander patients (113/133). Twenty Aboriginal and Torres Strait Islander patients had CMIs, and 70% were areas of consideration, the lowest area of importance (14/20). Areas of concern and adverse events occurred in 3 patients each, respectively (15.0%; 3/20). Of the 6 patients in which areas of concern and adverse events were identified, assessors considered that two-thirds were preventable, and one-third caused the death of the patient.

8 Outcomes of peer-review assessments

KEY POINTS

- Assessors considered that most patients (82.6%; 304/368) had no clinical management issues (CMIs) and 64 patients had CMIs (17.4%; 64/368).
- Of all the CMIs, 65.6% (42/64) were areas of consideration; 21.9% (14/64) were areas of concern and 12.5% (8/64) were adverse events.
- Of all the CMIs, 57.4% (35/61) were considered definitely or probably preventable.
- Of the areas of consideration, 57.1% (24/42) made no difference to the outcome.
- Of the areas of concern, 85.7% (12/14) may have contributed to the outcome.
- Of the adverse events, 62.5% (5/8) caused the death of the patient.

All surgical deaths included in this report had an FLA. An SLA was completed for 38 cases (10.3%; 38/370). Insufficient clinical information in the SCF was the key reason for SLA requests (63.8%; 482/756). First- and second-line assessors considered that DVT prophylaxis use was appropriate for most patients (79.5%; 294/361), unknown for 17.0% (63/361) of patients and inappropriate for 1.1% (4/361) of patients (data missing n=9/370 cases [2.4%]).

First- and second-line assessors consider whether patients should have received treatment in either an ICU or a high dependency unit (HDU). Of the 124 patient who were not treated in ICU, assessors considered that 4 patients would have benefited from ICU admission and that 9 patients would have benefited from an HDU admission.

8.1 Assessor-identified clinical management issues

First- and second-line assessors consider areas of the care pathway that could have been improved. These are termed clinical management issues (CMI), which may be classed as:

- an area of consideration
- an area of concern
- or an adverse event

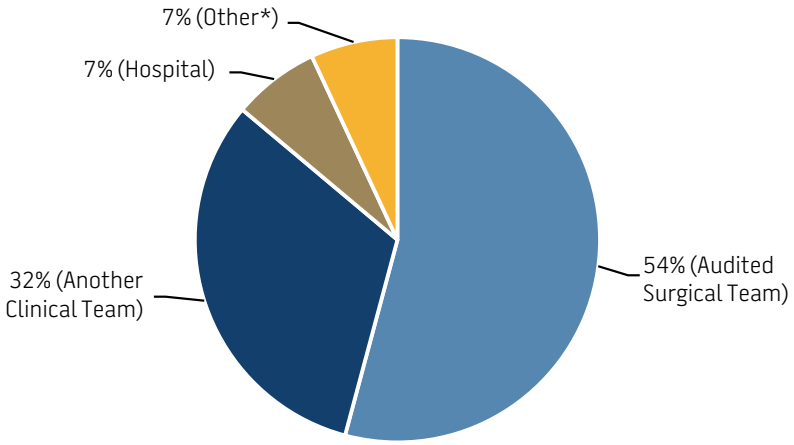
CMIs reported are those from the highest assessor (i.e. from the SLA if performed). Some patients had more than one CMI. For these patients, the most serious CMI was included in the analysis for this report (section 1.6).

First- and second-line assessors considered that most patients (82.6%; 304/368) had no CMIs (data not answered by assessors n=2/370; 0.5%). Assessors identified CMIs in 64 patients (17.4%; 64/368). Most (65.6%; 42/64) were areas of consideration; approximately one-fifth were areas of concern (21.9%; 14/64) and 12.5% (8/64) were adverse events.

Assessors are asked to consider if the CMI had any effect on the patient's outcome. Assessors considered that half (50.0%; 32/64) of the CMIs may have contributed to the outcome, 39.1% made no difference to the outcome (39.1%; 25/64) and 10.9% (7/64) caused the death of the patient who would otherwise be expected to survive.

Assessors also consider whether the CMIs were preventable. Assessors considered that 57.4% (35/61) of CMIs were preventable and, of these, 19.75% (12/61) were definitely preventable. More than half of the CMIs (54.2%; 39/59) were associated with the audited surgical team; nearly one-third were associated with another clinical team (31.9%; 23/59). A small percentage of CMIs were associated with hospital processes (6.9%; 5/59) (Figure 13).

Figure 13: Clinical team or facility associated with clinical management issue, 2016–2021 (n = 59)



*Other associations specified by surgeons included nursing homes, anaesthetics team and emergency department.
Not all surgeons reported associations with clinical incidents.
Source: Surgical case form
Reference: Appendix data table 14

The most frequently reported CMIs by both first- and second-line assessors were:

- delay to surgery (i.e. earlier operation desirable) (9.4%; 6/64)
- decision to operate (7.8%; 5/64).

There was no statistical difference between surgeons and assessors regarding areas in which management could be improved (Table 19). These included preoperative care, decision to operate, choice of operation, timing of operation, intraoperative management and postoperative care.

Table 19: Areas in which management could be improved, 2016–2021 (n = 304*)

Management areas	Surgeons	Assessors	
	Patients n = 304 (%)	Patients n = 303 (%)	Risk ratio** (95% CI)
Preoperative care	22/304 (7.2)	23/301 (7.6)	1.06 (0.60–1.85)
Decision to operate	18/304 (5.9)	14/303 (2.7)	0.78 (0.40–1.54)
Choice of operation	7/304 (2.3)	8/300 (4.6)	1.16 (0.43–3.15)
Timing of operation	22/304 (7.2)	23/302 (7.6)	1.05 (0.60–1.84)
Intraoperative management	18/304 (5.9)	12/303 (4.0)	0.67 (0.33–1.36)
Postoperative care	18/303 (5.9)	18/303 (5.9)	1.00 (0.53–1.88)

*Missing data n = 1
**The risk ratio reference group is Surgeons.
**Risk ratios are at 95% confidence interval. Risk ratio is the cumulative incidence or risk of disease in one group divided by the cumulative incidence or risk in a second or reference group, also described as relative risk (Section 1.10).

8.2 Assessor-identified areas of consideration

Of the 42 areas of consideration, assessors considered that 57.1% (24/42) made no difference to the outcome, 40.5% (17/42) may have contributed to death and 2.4% (1/42) caused the death of a patient who would otherwise be expected to survive. Assessors considered that 46.3% (19/42) of the considerations were preventable and, of these, 36.9% (15/42) were probably preventable and 9.8% (4/42) were definitely preventable. The majority of considerations were associated with the audited surgical team (59.0; 23/39) or another clinical team (46.2%; 18/39). A small proportion was associated with the hospital process or other departments (12.8%; 5/39).

8.3 Assessor-identified areas of concern

Of the 14 CMIs considered areas of concern, assessors noted that most (85.7%; 12/14) may have contributed to the outcome, 7.1% (1/14) made no difference, while 7.1% (1/14) were considered to have caused death. Assessors considered that 76.9% (10/13) of the CMIs were preventable with 5.0% (5/14) probably preventable and 5.0% definitely preventable (5/14). Most of the CMIs considered to be areas of concern were associated with either the surgical team (64.3% 9/14) or another clinical team (21.4%; 3/15). A small number were associated with a hospital process (14.3%; 2/14).

The 2 most frequent areas of concern were:

- delay to surgery (i.e. earlier operation desirable) (14.3%; 2/14)
- delay in recognising complications (14.3%; 2/14).

8.4 Assessor-identified adverse events

Assessors considered that almost two-thirds (62.5%; 5/8) of the adverse events caused the death of the patient and 37.5% (3/8) may have contributed to the outcome. Assessors considered that 85.7% (6/8) of the adverse events were preventable and, of these, half (50%; 3/5) were definitely preventable. Most were associated with either the surgical team (87.5%; 7/8) or another clinical team (25.0%; 2/8). One adverse event was associated with a hospital process (9.1%; 1/8). Four of the adverse events were iatrogenic events during surgery, of which 3 were injuries to the small bowel.

8.5 Preventable clinical management issues

Over the 5-year report period, assessors classified 35 CMIs (57.4%; 35/61) as definitely or probably preventable (areas of consideration, concern and adverse events). Of these preventable CMIs assessors reported that 71.4% (25/35) contributed to, or caused, a patient's death. These CMIs were unintended injuries caused by medical management rather than by the disease process, which led to prolonged hospitalisation. The following is a complete list of preventable events during the audit period (1 July 2016 to 30 June 2021):

- Delays to surgery, blood transfusion, recognising complications (n = 4)
- Decision to operate and choice of operation (n = 5)
- Unsatisfactory medical management (n = 5)
- Iatrogenic injury (n = 4)
- Communications (n = 2).

9 NT baseline patients

The NT Department of Health provides NTASM with baseline data from patients who had a surgical procedure in an NT public hospital and were discharged from hospital. The NT baseline data include patients admitted to all NT public hospitals between January and December 2020 who had a surgical procedure or operation that was performed by a surgeon and required a general anaesthetic. These patients may have been admitted by either a physician or a surgeon. The data reported are the last admission for each patient and exclude patients reported to NTASM.

A total of 17,340 baseline patients were admitted between January and December 2020. Obstetrics patients and those having dental or allied health procedures (n = 1,077) were excluded from the comparison. The remaining 16,263 patients had a total of 20,033 admissions, with 2,818 patients having 3,389 readmissions (ranging from 1 readmission [n = 2,108 patients] to 15 admissions [n = 1 patient]). Comparisons are based on the first admission of each patient only.

The characteristics of NT baseline patients and NTASM patients admitted during the same period are presented in Table 20.

The proportion of Aboriginal and Torres Strait Islander patients to non-Indigenous patients was similar in the baseline and NTASM datasets.

NTASM and baseline patient populations differed for other characteristics. Proportionally more NTASM patients were males than females. Proportionally, many more NTASM patients had emergency admissions than baseline patients had. The proportion of NTASM patients with comorbidities was double that of baseline patients with comorbidities. The greatest differences were seen in the proportion of patients with diabetes, renal disease, cardiovascular disease, respiratory disease, hepatic disease and obesity. The proportion of NTASM patients with a history of alcohol use was more than double the proportion of baseline patients with a history of alcohol use. NTASM patients had longer hospital stays and higher ASA classifications (ASA 4–6) than did baseline patients.

A lower proportion of NTASM patients had no comorbidities. Less than 1.0% of NT baseline patients had 5 or more comorbidities whereas 23.6% (27/55) of NTASM patients had 5 or more comorbidities (Table 20 and Table 21).

Table 20: Characteristics of NT baseline patients and NTASM patients (January to December 2020)

Patient characteristics	NT baseline patients (n = 16,263)	NTASM patients (n = 55)
Sex		
Male	7,315 (45.0%)	32 (58.2%)
Female	8,947 (55.0%)	23 (41.8%)
Admission status		
Emergency	6,576 (40.4%)	53 (96.4%)
Elective	7,599 (46.7%)	2 (3.6%)
Not assigned	2,088 (12.8%)	0 (0.0%)
Indigenous status		
Aboriginal and Torres Strait Islander patients	6,334 (38.9%)	24 (43.6%)
non-Indigenous patients	9,925 (61.0%)	31 (56.4%)
Unknown	4 (0.0%)	0 (0.0%)
Comorbidities present*		
Diabetes	2,880 (17.7%)	20 (41.7%)
Renal	714 (4.4%)	24 (50.0%)
Obesity	633 (3.9%)	7 (14.6%)
Cardiovascular disease	409 (2.5%)	35 (72.9%)
Hepatic disease	356 (2.2%)	7 (14.6%)
Respiratory	337 (2.1%)	17 (35.4%)
Dementia**	82 (0.5%)	7(1.3%)
Smoking	4,238 (26.1%)	—
Alcoholic hepatic disease	48 (0.3%)	—
History of alcohol use	730 (4.5%)	6 (10.9%)
Length of hospital stay, median days (IQR)	1 (1–3)	14 (4–23)
ASA class		
Class 1	3,832 (23.6%)	1 (2.0%)
Class 2	7,152 (44.1%)	1 (2.0%)
Class 3	2,564 (15.8%)	10 (20.0%)
Class 4	456 (2.8%)	25 (50.0%)
Class 5	7 (0.1%)	13 (26.0%)
Class 6	0 (0.0%)	0 (0.0%)
Unknown/not stated/missing	2,225 (13.8%)	5 (9.1%)

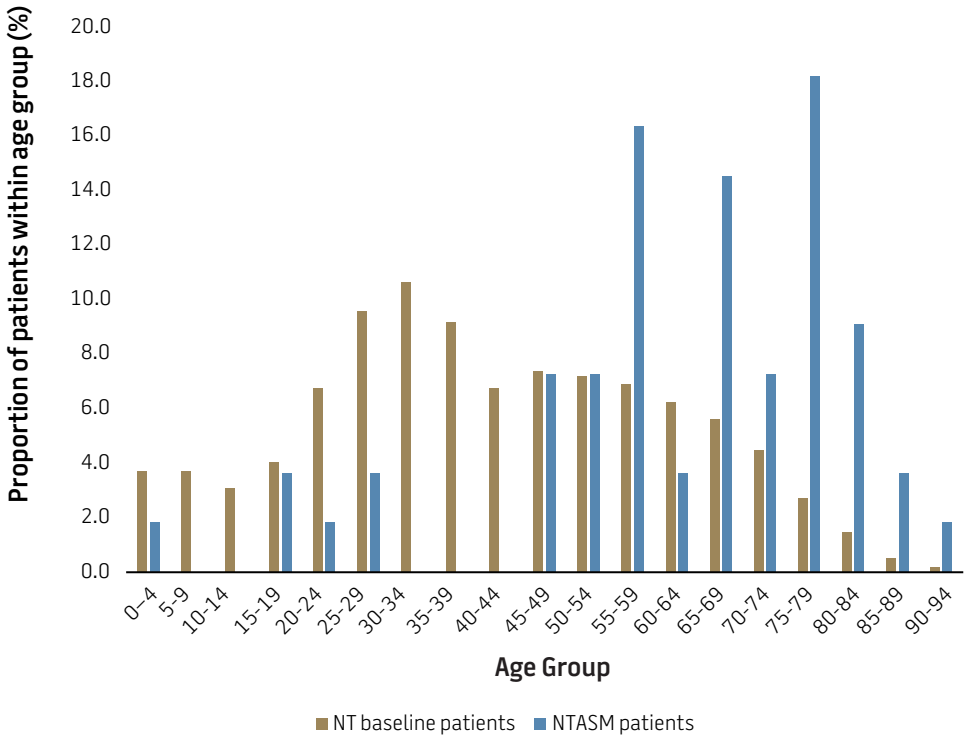
Note: All NT baseline patients were discharged from hospital and all NTASM patients died in hospital.
Note: Comorbidities and diagnoses for NT baseline data are provided by the NT Government with International Classification of Diseases codes (ICD-10). To enable comparison with NTASM data, NTASM recodes the ICD-10 categories to match the categories in the SCF.
*The number of variables supplied with the baseline data was similar to that provided with the 2019 data.
**Dementia in NTASM patients is recorded as Neurological.
IQR: interquartile range
ASA = American Society of Anesthesiologists; ASA class 1 = a normal healthy patient; ASA class 2 = a patient with mild systemic disease; ASA class 3 = a patient with moderate systemic disease; ASA class 4 = a patient with severe systemic disease that is a constant threat to life; ASA class 5 = a moribund patient unlikely to survive 24 hours, who is not expected to survive without an operation; ASA class 6 = a patient declared brain dead whose organs are being removed for donor purposes.

Table 21: Frequency of comorbidities in NT baseline patients and NTASM patients (January to December 2020)

Number of comorbidities	NT baseline patients (n = 16,263)	NTASM patients (n = 55)
0	9,073 (55.8%)	7 (12.7%)
1	4,924 (30.3%)	6 (10.9%)
2	1,558 (9.6%)	4 (7.3%)
3	499 (3.1%)	11 (20.0%)
4	168 (1.0%)	14 (25.5%)
5	30 (0.2%)	12 (21.8%)
6+	11 (0.1%)	1 (1.8%)

In general, NT baseline patients were younger than NTASM patients (Figure 14).

Figure 14: NT baseline and NTASM patients by age group (January to December 2020)



Reference: Appendix data table 15

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11 Appendices

Appendix 1: What surgeons report they would have done differently

The following is a sample of statements made by surgeons regarding what they would have done differently in retrospect (in response to question 25 of the SCF).

Decision to operate
Unlikely to have agreed to operate.
Not performed liver resection.
I would not have operated. The outcome was unavoidable. I could not contact a senior colleague to back me up as a second opinion.
I would have ordered a physician review preoperatively and potentially cancelled the case if the severity of her cardiovascular disease was diagnosed. I have now initiated automatic preoperative physician consults for all major orthopaedic cases under my care.
I would have preferred not to have taken this man to theatre. He was a high-risk candidate for bowel resection and had refused elective surgery previously. I felt that this was ultimately the best option for him as he had ongoing bleeding from the identified caecal mass; had had multiple presentations and was transfusion dependent.
Reconsider indication for surgery.
If I had known how close to death he was, I would not have performed the procedure.
Different procedure
Different surgical approach to epiploic vein.
In retrospect, the only thing I would potentially have done differently is to do an ileostomy on first entering the abdomen and not perform the formal right hemicolectomy.
Earlier operation
In retrospect, I would have pushed his scopes/laparotomy to a much earlier date. I don't think this would have changed his outcome/prognosis in anyway, but it would have provided the family with a definitive diagnosis earlier.
Upgrade his theatre triage earlier.
Improved clinical handover
Better handover between teams surgical and non-surgical. Earlier and more definitive source control for intra-abdominal collection. (Duodenal hole was seeding haematoma).

Appendix 2: Data tables

Data table 1: Status of all NTASM cases at time of census, 2016–2021 (n = 428*)

Status	n (%)
SCF pending	8 (1.9)
FLA pending	1 (0.2)
SLA pending	2(0.5)
Reviewed	370 (86.4)
Excluded—terminal care	34 (7.9)
Excluded— error	11 (2.6)
Medical records pending	2 (0.5)
Total	**428 (100.0)**

FLA = first-line assessment; SLA = second-line assessment; SCF = surgical case form
*Only surgical deaths that have completed the audit review process and have a status of 'reviewed' were analysed in this report.

Data table 2: Notifications of surgical deaths reviewed in NTASM by year, 2016–2021 (n = 370)

Year	n
2016–2017	78
2017–2018	96
2018–2019	89
2019–2020	66
2020–2021	41

Source: Surgical case form

Data table 3: Consultant surgeon presence in theatre, 2016–2021 (n = 511)

Consultant presence in theatre	2016–2017 n = 102	2017–2018 n = 137	2018–2019 n = 121	2019–2020 n = 96	2020–2021 n = 55	Total n = 511
	n (%)					
Consultant operating	66 (84.6)	79 (82.3)	70 (78.7)	48 (72.7)	41 (100)	304 (59.5)
Consultant assisting	13 (12.7)	14 (10.2)	21 (17.4)	8 (8.4)	0 (0.0)	56 (11.0)
Consultant in theatre**	13 (12.7)	17 (12.4)	17 (14.0)	13 (13.5)	7 (12.7)	67 (13.1)
Total	**92 (90.2)**	**110 (80.3)**	**108 (89.3)**	**69 (71.9)**	**48 (87.3)**	**427 (83.6)**

**In theatre = surgeon in theatre in an unspecified capacity (i.e. supervised an operation)

Data table 4: Anaesthesia category classification, 2016–2021 (n = 57*)	
Anaesthesia Category Classification	**n (%)**
Category 1	0 (0.0)
Category 2	3 (5.3)
Category 3	1 (1.8)
Category 4	13 (22.8)
Category 5	39 (68.4)
Category 6	1 (1.8)

*Missing data n = 1

Data table 5: Age of NTASM patients in 5-year age groups, 2016–2021 (n = 370)	
Age group (years)	**n (%)**
0–4	6 (1.6)
5–9	0 (0.0)
10–14	0 (0.0)
15–19	6 (1.6)
20–24	6 (1.6)
25–29	8 (2.2)
30–34	3 (0.8)
35–39	8 (2.2)
40–44	14 (3.8)
45–49	22 (5.9)
50–54	26 (7.0)
55–59	27 (7.3)
60–64	33 (8.9)
65–69	41 (11.1)
70–74	52 (14.1)
75–79	49 (13.2)
80–84	37 (10.0)
85–89	20 (5.4)
90–94	8 (2.2)
95–99	4 (1.1)
Total	**370 (100.0)**

Data table 6: Most frequently occurring comorbidities in NTASM patients with comorbidities, 2016–2021 (n = 320*)

Comorbidities	n (%)
Cardiovascular disease	211 (65.9)
Renal	126 (39.4)
Diabetes	113 (35.3)
Respiratory	113 (35.3)
Other**	107 (33.4)
Advanced malignancy	94 (29.4)
Neurological	63 (19.7)
Hepatic	62 (19.4)
Obesity	35 (10.9)

Patients often have more than one comorbidity. Total 1076 comorbidities reported for 320* patients.
*Missing data n= 2 patients (0.6%)
**Other includes: alcohol abuse, anticoagulation therapy, arthritis/osteoporosis, dementia/Alzheimer's disease, cerebral palsy, hyperthyroidism, malignancy, malnutrition/cachexia, peripheral vascular disease, smoking, ischaemic heart disease.
Source: Surgical case form

Data table 7: Delays in surgical diagnoses in NTASM patients who had an operation, 2016–2021 (n = 304*)

Year	n (%)
2016–2017	5 (8.3)
2017–2018	6 (7.1)
2018–2019	11 (15.1)
2019–2020	3 (5.7)
2020–2021	2 (5.9)
Total	**27 (8.9)**

Source: Surgical case form
*Missing data n=1 patient (0.3%)

Data table 8: Surgeon-assessed risk of death for NTASM patients who had an operation, 2016–2021 (n = 302*)

Surgeons view (before any surgery) of overall risk of death	n (%)
Minimal	14 (4.6)
Small	29 (9.6)
Moderate	77 (25.5)
Considerable	131 (43.4)
Expected	51 (16.9)

Source: Surgical case form
*Missing data n=3 patients (1.0%)

Data table 9: ASA class recorded for NTASM patients who had an operation, 2016–2021 (n = 285*)

ASA class	n (%)
1	3 (1.1)
2	12 (4.2)
3	91 (31.9)
4	126 (44.2)
5	50 (17.5)
6	3 (1.1)
Total	**285 (100.0)**

*Missing data n=20 patients (6.6%)
ASA = American Society of Anaesthesiologists; ASA class 1 = a normal healthy patient; ASA class 2 = a patient with mild systemic disease; ASA class 3 = a patient with moderate systemic disease; ASA class 4 = a patient with severe systemic disease that is a constant threat to life; ASA class 5 = a moribund patient unlikely to survive 24 hours, who is not expected to survive without an operation; ASA class 6 = a patient declared brain dead whose organs are being removed for donor purposes.

Data table 10: NTASM patients with postoperative complications by year, 2016-2021 (n = 302*)

Year	n (%)
2015–2016	12 (20.0)
2016–2017	24 (28.9)
2017–2018	18 (24.7)
2018–2019	12 (23.1)
2019–2020	7 (20.6)
Total	**73 (100.0)**

*Missing data n=3 patients (1.0%)

Data table 11: Operative NTASM patients with unplanned admission to ICU, 2016–2021 (n = 300*)

Year	n (%)
2016–2017	13 (22.0)
2017–2018	14 (17.1)
2018–2019	12 (16.7)
2019–2020	10 (18.9)
2020–2021	6 (17.6)
Total	**55 (100.0)**

*Missing data n=7 patients

Data table 12: Patient location at time of fall that caused trauma, 2016–2021 (n = 46)	
Location	**n (%)**
At home	31 (67.4)
At care facility	7 (15.2)
Other*	4 (8.7)
In hospital	4 (8.7)
Unknown	0 (0.0)

*Sport, recreation, farm, work

Data table 13: Type of road traffic accidents that caused trauma, 2016–2021 (n = 19)	
Location	**n (%)**
Motor vehicle	14 (73.7)
Motor bike	4 (21.1)
Pedestrian	1 (5.3)
Other	1 (5.3)
Bicycle	0 (0.0)

Data table 14: Clinical team or facility associated with NTASM CMI, 2016–2020 (n = 59)	
Associated clinical team or facility	**n (%)**
Audited surgical team	39 (54.2)
Another clinical team	23 (31.9)
Hospital processes	5 (6.9)
Other*	5 (6.9)

*Other associations specified by surgeons were mainly associated with: anaesthetics team (n = 4; 0.2%), another hospital (n = 3; 0.1%), ICU (n = 2; 0.1%). Not all surgeons reported associations with clinical incidents.

Data table 15: Age of Baseline and NTASM patients in 5-year age groups, (January to December 2020)

Age group (years)	Baseline patients n (%)	NTASM patients n (%)
0–4	598 (3.7)	1 (1.8)
5–9	604 (3.7)	0 (0.0)
10–14	500 (3.1)	0 (0.0)
15–19	657 (4.0)	2 (3.6)
20–24	1,099 (6.8)	1 (1.8)
25–29	1,555 (9.6)	2 (3.6)
30–34	1,729 (10.6)	0 (0.0)
35–39	1,493 (9.2)	0 (0.0)
40–44	1,093 (6.7)	0 (0.0)
45–49	1,195 (7.3)	4 (7.3)
50–54	1,171 (7.2)	4 (7.3)
55–59	1,121 (6.9)	9 (16.4)
60–64	1,011 (6.2)	2 (3.6)
65–69	914 (5.6)	8 (14.5)
70–74	728 (4.5)	4 (7.3)
75–79	441 (2.7)	10 (18.2)
80–84	239 (1.5)	5 (9.1)
85–89	85 (0.5)	2 (3.6)
90–94	300 (0.2)	1 (1.8)
Total	**16,263 (100.0)**	**55 (100.0)**

Appendix 3: Definitions

1. **Surgical case form (SCF):** A structured questionnaire completed by the consultant surgeon associated with the case. Consultant surgeons enter SCF responses into a bespoke online database—the RACS Audit of Surgical Mortality Fellows Interface.
2. **Anaesthetic case form:** A structured questionnaire optionally completed by the anaesthetist associated with the case (anaesthetist participation is voluntary). This form is available only in hard copy.
3. **First-line assessment (FLA):** Case assessment conducted by a surgeon from the same speciality as the consultant surgeon. The first-line assessor reviews the SCF (not patient files) and enters responses into the RACS Fellows Interface. The first-line assessor will either close the case or recommend further assessment by a second-line assessor.
4. **Second-line assessment (SLA):** Case assessment conducted by a surgeon from the same speciality as the consultant surgeon. Second-line assessors are generally specialists in the area under review. First- and second-line assessors respond to the same set of questions; however, SLAs are more in-depth and forensic because these assessors have access to all medical records. NTASM provides second-line assessors with a letter summarising issues to be addressed in their report.
5. **Cases may be referred for an SLA if:**
   - an area of concern or adverse event is thought to have occurred during the patient's clinical care and warrants further investigation
   - the patient's death was unexpected (i.e. a healthy patient not expected to die)
   - information provided by the consultant surgeon was insufficient to reach a conclusion in the FLA
   - an SLA report could highlight aspects of surgical practice and provide an educational opportunity for the surgeon involved and/or a wider audience by publication as a case note review.

   A surgeon can appeal the findings of an SLA, in which case the Clinical Director selects an additional independent second-line assessor. This has not occurred in NTASM to date.
6. **Operation** is used to refer to operations and procedures (i.e. in this report, an operation may refer to a relevant radiological or endoscopic procedure as well as a surgical procedure).
7. **Separation** is the process by which an episode of care for an admitted patient is completed. A separation may be formal or statistical. An episode of care may be completed because the patient's treatment is complete, the patient no longer requires care, the patient has died or is transferred to another hospital/care facility or leaves the hospital against medical advice.[2]

Notes

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Royal Australasian College of Surgeons
Northern Territory Audit
of Surgical Mortality

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Audits of Surgical Mortality

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