Royal Australasian College of Surgeons

NTASM ANNUAL REPORT

(1 July 2010 to 30 June 2020)

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

Contact

Royal Australasian College of Surgeons
Northern Territory Audit of Surgical Mortality
PO Box 7385
East Brisbane Qld 4169
Australia

Telephone: 61 7 3249 2903
Facsimile: 61 7 3391 7915
Email: NTASM@surgeons.org
Website: www.surgeons.org/en/research-audit/surgical-mortality-audits/regional-audits/ntasm

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).

Contents

Tables

Figures

Data Tables

NTASM CLINICAL DIRECTOR'S REPORT

The 2020 NTASM report represents a milestone in Northern Territory surgical practice and patient care delivery.

This is our **tenth year**, and I would like to sincerely thank all those who have made this decade a reality and worked hard to complete surgical case forms, undertake assessments and learn from this unique process.

All hospitals and surgeons in the Northern Territory participate in NTASM. This ensures that continuing high quality data analysis can take place and ensures the delivery of invaluable quality feedback to hospitals, government, and surgeons.

Participation by surgeons in all stages of the audit is always a learning exercise. Feedback to surgeons allows them to learn and, if necessary, modify by reviewing the feedback through all that is published and presented from the data.

This self-reflection learning process will always remain a powerful learning tool for all surgeons.

Assessors also learn from this activity whether it be as a first-line assessor or a second-line assessor. Sincere thanks to all who are assessors and if you are not one at present, please contact us and we will bring you on board.

As Clinical Director, I trust that this report encourages further reflection and the learning that comes from this. Let us make surgery in the Northern Territory world class in every way as we reflect on and contribute to NTASM.

Finally, I would like to thank Dr Sabu Thomas for chairing the NTASM Steering Committee for the last two years.

Dr John North
NTASM Clinical Director

NTASM MANAGEMENT COMMITTEE CHAIR'S REPORT

The year 2020 has been a difficult one for the world and for parts of Australia due to the COVID-19 pandemic and its consequences. But we consider ourselves privileged in the Northern Territory, because here the effect of the pandemic has not been overly disruptive.

It is satisfying to look at the data at the end of the year and be assured that the quality of surgical care that we provide to our patients in the Territory continues to be of a high standard — one that is largely comparable with national trends and outcomes. Our consultants continue to be directly involved in caring for our patients and are present at most operations (87.9%).

We are aware that many of our patients (58.5%) come to us with the disadvantages of comorbidities and pre existing infections. But this has not had a significant impact on the outcome of their operations, when compared with national figures.

As the purpose of NTASM is to identify what we could be doing better, we noted that about 8.5% of our deaths had areas of concern or adverse events, and assessors noted preventable factors in 56.3% of them.

We will continue to learn from this.

We are thankful to the Northern Territory Government for making this possible. Our commitment to Territorians is that we are doing our best, as surgeons, and we will continue to do our best.

We have seen an increasing use of technology for patient consultations and multidisciplinary meetings this year and we are now sure that the way in which care is delivered is going to change in the coming years. In this instance, something bad (the pandemic) may turn out to contribute something good (use of technology for consultations and treatment), provided we keep our minds open to the possibilities.

Dr. Manimaran Sinnathamby, who is a breast and general surgeon at the Royal Darwin Hospital, will be taking over as Chair in my place as I move to Western Australia.

I am thankful to Dr John North for his advice, to the NTASM staff, and my colleagues here in Northern Territory for the collegiality and mateship they have demonstrated through this relatively difficult year.

I hope you all have a great year ahead. Let us all remember to stay safe for the sake of our families and our communities.

Dr Sabu Thomas
NTASM Management Committee Chair

SHORTENED FORMS

ACTASM	Australia 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
CVD	cardiovascular disease
DVT	deep vein thrombosis
HDU	high dependency unit
ICU	intensive care unit
IQR	interquartile range
NT	Northern Territory
NTASM	Northern Territory Audit of Surgical Mortality
RACS	Royal Australasian College of Surgeons
RANZCOG	Royal Australian and New Zealand College of Obstetricians and Gynaecologists
RR	risk ratios
SCF	Surgical Case Form
TASM	Tasmanian Audit of Surgical Mortality
TED	thrombo-embolus deterrent

ACKNOWLEDGEMENTS

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

- the NT government for funding NTASM
- the surgeons for diligently completing their assessments
- the Chair Dr Sabu Thomas 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 Sabu Thomas,
Chair, NTASM Steering Committee, RACS

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

Dr Ollapallil Jacob,
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,
General Manager, Research Audit and Academic Surgery

Dr Helena Kopunic,
Manager, Surgical Audit

Dr Lettie Pule,
Research Officer, Surgical Audit

NTASM STAFF

Dr John North,
Clinical Director

Jenny Allen,
NTASM Project Manager

Therese Rey-Conde,
Senior Research Officer

Kyrsty Webb,
Administration Officer

NTASM SUPPORT STAFF

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

Robert Ware,
School of Medicine, Griffith University

NT GOVERNMENT DEPARTMENT OF CORPORATE AND DIGITAL DEVELOPMENT DATA SERVICES

Peta Archer,
Senior Data Analyst

Kerry Gregory,
Data Analyst

Seethadevi Sadaiappan,
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 the patient had an operation.
- 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 2010 to 30 June 2020 (census date 6 August 2020).

NORTHERN TERRITORY BASELINE DATA

- NTASM data are compared with NT baseline data in section 7 of this report.
- The NT baseline data includes patients admitted to all NT public hospitals between January and December 2019, who had an operation or surgical procedure that required a general anaesthetic and was performed by a surgeon. 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.
- The NT baseline data is provided by the Northern Territory Government Department of Corporate and Digital Development Data Services (approval number DMSR 13143).

HOSPITALS

- All seven hospitals in the NT participate in NTASM.

SURGEONS

- All 68 surgeons in the NT participate in NTASM.
- Locum surgeons are encouraged to participate in NTASM.
- A consultant surgeon was present for 87.9% (725/825) of operations.

PATIENTS

- 641 patient cases were completed by the census date (6 August 2020) and are the basis of this report (2010 – 2020).
- 61.9% of patients (397/641) were male.
- 82.8% of patients (530/640) had at least one comorbidity. Nationally, 90.1% of patients (28,701/31,862) had at least one comorbidity between 2009 and 2016 (1).
- Cardiovascular disease was the most frequently documented comorbidity (51.4%, 329/640). This prevalence is in line with previous NTASM Annual Reports (2019 and 2018): 51.6% (295/572) and 61.0% (50/82).

ABORIGINAL AND TORRES STRAIT ISLANDER PEOPLE

- According to the Australian Bureau of Statistics, 30.0% of the NT population and 3.0% of the total Australian population are Aboriginal or Torres Strait Islander people (2).
- Aboriginal and Torres Strait Islander patients comprised 36.0% (231/641) of NTASM surgical deaths.
- NTASM Aboriginal and Torres Strait Islander patients were more likely to have cardiovascular disease, renal disease, diabetes and hepatic disease than non-Indigenous patients.

OPERATIONS CONDUCTED

- 825 operations were conducted.
- 78.6% of patients (504/641) had at least one operation.
- 31.2% of patients (157/504) had more than one operation.

CLINICAL MANAGEMENT ISSUES

- 78.5% of patients (498/634) had no clinical management issues.
- 21.5% of patients (136/634) had clinical management issues.
- 12.9% of patients (82/634) had an area of consideration.
- 5.2% of patients (33/634) had an area of concern.
- 3.3% of patients (21/634) had an adverse event.
- Assessors considered that 56.3% (71/126) of the areas of consideration, concern and adverse events were preventable.

POSTOPERATIVE COMPLICATIONS

- 23.8% of patients (119/501) had a postoperative complication, between 2010 and 2020.
- Nationally, between 2009 and 2016, 33.9% of patients (8,675/25,596) had postoperative complications (1).

POSTOPERATIVE INTENSIVE CARE

- 68.7% of patients (345/502) were postoperative admissions to intensive care.
- 26.1% of patients (87/333) had an unplanned postoperative admission to intensive care.

INFECTION

- 34.1% of patients (198/580) had an infection.
- 58.5% of patients (114/195) acquired the infection before admission and 41.5% (81/195) acquired the infection during their admission.
- Intra-abdominal sepsis (acquired before admission) and pneumonia (acquired during admission) were the main types of infection.
- Nationally, between 2009 and 2016, 34.2% of patients (5,267/15,404) acquired an infection prior to admission and 58.0% of patients (2,965/5,093) acquired an infection during admission (1).

TRAUMA

- 26.0% of NTASM patients (153/589) had trauma.
- The most frequent causes of trauma were falls (58.8%; 90/153), road traffic accidents (24.2%; 37/153) or violence (15.7%; 24/153).

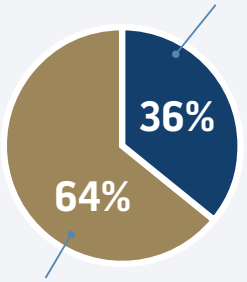
10 years of NTASM: 2010 to 2020

NTASM patients

median age of
65 years

62% : 38%
Males : Females

Aboriginal or Torres Strait Islander people



non-Indigenous people

92%
emergency admissions

8%
elective admissions

83%
have comorbidities on admission

34%
had a clinically significant infection present at the time of death

79%
have at least one operation

26%
of the deaths involved trauma

NTASM surgeons

68 (100%)
surgeons in the NT participate

641 first-line assessment reports completed

76 second-line assessment reports completed

9 surgical specialities (General, Orthopaedics, Vascular, Urology, Neurosurgery, Ophthalmology, Plastic and Reconstructive, Otolaryngology Head and Neck, Oral and Maxillofacial)

NTASM feedback to surgeons and hospitals

21 volumes of *Lessons from the Audit*

18 volumes of *Case Note Review Booklets*

Recommendations

The following recommendations are derived from the quantitative and qualitative responses collected in the 2019–20 NTASM and from trends over time identified in previous NTASM reporting periods. 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 NT.

1. INCREASE THE SURGICAL WORKFORCE IN THE NT

- The Department of Health is encouraged to continue to recruit additional surgeons and implement strategies to retain current surgeons in the NT.

Overall, the surgical workforce in the NT is expanding. The number of surgeons increased from 45 in 2018–19 to 68 in 2019–20. These numbers do not include locum surgeons or Specialist International Medical Graduate surgeons. NTASM is pleased to see that previous recommendations to increase the number of vascular and urology surgeons have been adopted; the NT now has two vascular surgeons and three urology surgeons.

2. IMPROVE COMMUNICATION WITH PATIENTS AND THEIR FAMILIES AND COMMUNITIES

- The NT Steering Committee is encouraged to 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.
- The NT Steering Committee, NTASM and all audit Clinical Directors should review questions about communication in the surgical case form (SCF) and consider adding additional questions to elicit more detailed responses.

The NT Steering Committee identified communication as an area for focus for surgeons, in a meeting held on 2 November 2020.

In the qualitative response section of NTASM, multiple surgeons indicated that suboptimal communication with patients or their family or community impacted the patient's care. This was attributed to geographical remoteness, language barriers, patient distrust of medical staff, and impaired decision-making ability (e.g. because of alcoholism or cognitive impairment). Further, multiple surgeons reflected that they should have referred some patients to palliative care. For some surgeons, the reason they proceeded to operate rather than refer the patient to palliative care was because of communication issues with the patient or with their family or community.

However, in response to a quantitative question in the SCF, surgeons indicated communication was an issue for only 8.2% patient cases (50/613). This suggests that the communication section in the SCF is not capturing the true experience of consultant surgeons.

3. INCREASE PUBLIC EDUCATION ABOUT CARDIOVASCULAR DISEASE

- The Department of Health is encouraged to offer cardiovascular disease (CVD) prevention initiatives and continue public education about the causes, symptoms and prevention of CVD.

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

Of the 16,639 patients in the NT baseline data, 2.3% had CVD recorded as a comorbidity. This is much lower than the 50.6% of NTASM patients who were inpatients in the same months and had CVD recorded as a comorbidity.

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

- The Department of Health should continue to promote all aspects of day-to-day life that will improve health care in the community.
- RACS should continue to highlight the need to 'close the gap' and promote the newly published RACS Indigenous Health Position Paper (3).

In NTASM, Aboriginal and Torres Strait Islander patients are on average 16 to 20 years younger than non-Indigenous patients.

5. EDUCATE ABOUT RISKS OF ALCOHOL CONSUMPTION

- The Department of Health should continue to educate the public about the risks of alcohol consumption, with a particular focus on women and Aboriginal and Torres Strait Islander people.
- The NT Steering Committee should continue to petition for the inclusion of alcohol and other addictive substances as a comorbidity in the SCF.
- RACS should continue to support liquor licensing regulations in the NT.

In NTASM, alcohol use was reported as an 'other' comorbidity that increased the risk of death in 9.2% of patients. There was no difference in the reporting of alcohol use between male and female patients in NTASM. Nationally, however, men are more likely to exceed recommended alcohol consumption guidelines than are women (4). Aboriginal and Torres Strait Islander patients in NTASM were significantly more likely to have alcohol listed as an 'other' comorbidity than were non-Indigenous patients. RACS is supportive of the NT Government's Liquor Licensing Act (5).

6. REFINE NTASM PROCESSES AND SYSTEMS

- NTASM and RACS should continue to refine audit processes and systems

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.

Planned improvements include:

- An e-learning module about the audit and completion of SCFs will be made available to surgeons in 2021, with the aim of decreasing the need for second-line assessments (SLAs) because of inadequate information in the SCF.

Suggested improvements include:

- Ask hospitals to increase the frequency of death notifications to NTASM from monthly to weekly and encourage surgeons to proactively report cases.
- Discuss amendments to the surgical case form (SCF) with ANZASM Clinical Directors as follows:
  - Define unclear terms, such as fluid balance (question 20)
  - Include 'addictive substances/alcohol' in the list of comorbidities (question 4). (Current reports of alcohol are manually derived by NTASM staff reviewing what surgeons have reported as an 'other' comorbidity.)
  - Include 'current smoker' in the list of comorbidities (question 4). Cigarette smoking is associated with tissue damage over time, which can place patients who smoke at increased risk of not surviving surgery (6). In the NT baseline data 26.9% of patients were smokers; however, the statistic is not known for NTASM patients.
  - Provide definitions for each listed comorbidity (question 4). More than one third of audit patients had an 'other' comorbidity. This category is large because surgeons currently apply their own definitions and interpretations to comorbidities undefined in the SCF.
- Develop a short online survey about the NTASM annual report for surgeons to provide feedback about the usefulness and relevance of the report to the surgical community. The survey should include quantitative and qualitative questions and would be dispatched with the annual report.

1 INTRODUCTION

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 is funded by the NT Government Department of Health. The first audit was conducted in 2010.

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 written 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 2010 to 30 June 2020 (census date 6 August 2020). Data analysis relates 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 as at the census date. These patient cases will be included in the next NTASM report. Please note that denominators in this report sometimes differ because not all questions were answered for each patient.

1.2 Objectives

The objectives of the audit are to:

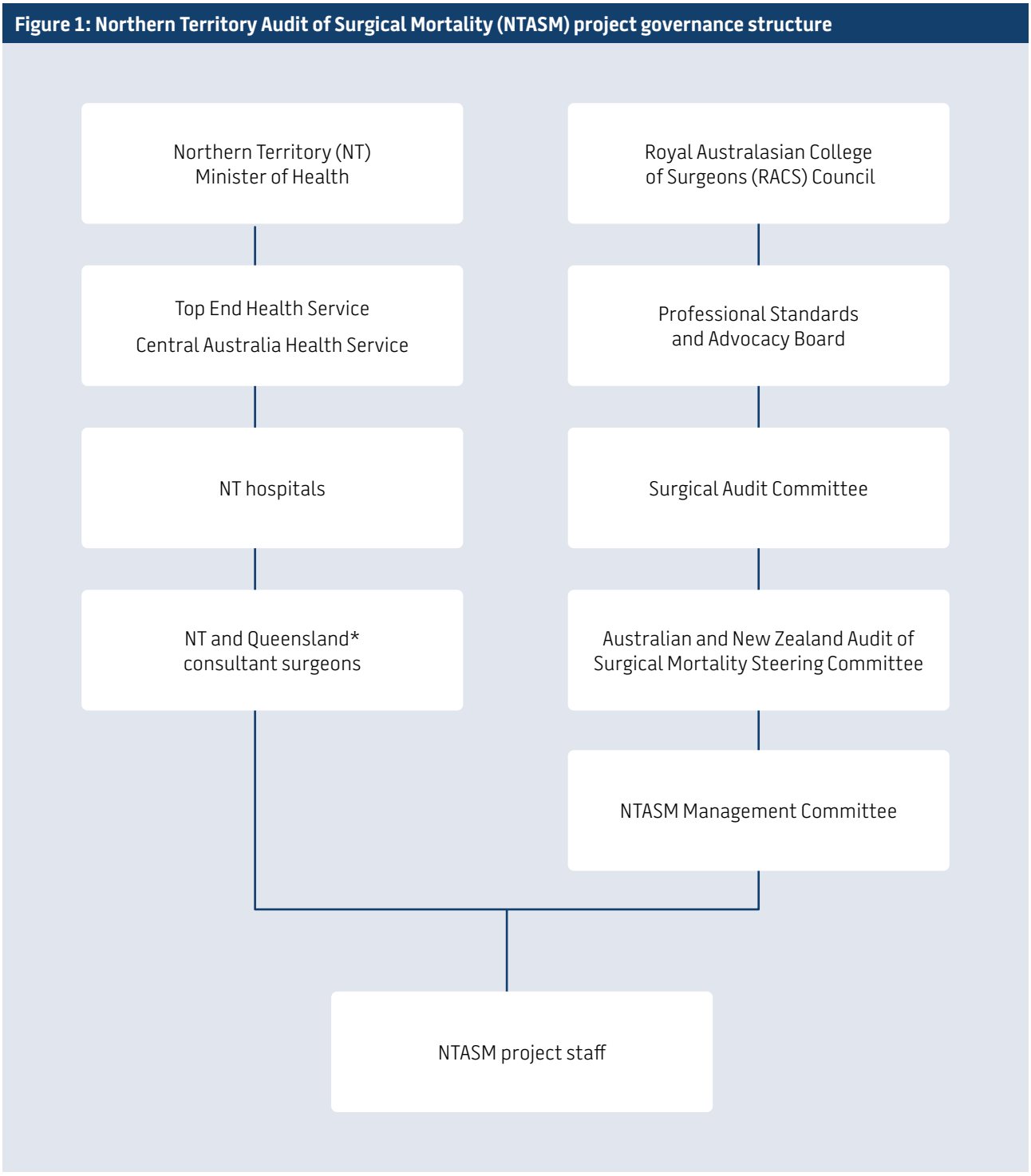
- encourage and support surgeons to self-appraise their clinical care management
- encourage and support surgeons to appraise the clinical care management of their peers
- inform, educate, facilitate change and improve practice by providing feedback on surgical deaths in the NT.

2 METHODS

2.1 Project governance structure

The NTASM project governance structure is illustrated in Figure 1

Figure 1: Northern Territory Audit of Surgical Mortality (NTASM) project governance structure



*Consultant surgeons from Queensland also undertake assessments for NTASM.

2.2 Definition of a surgical death

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:

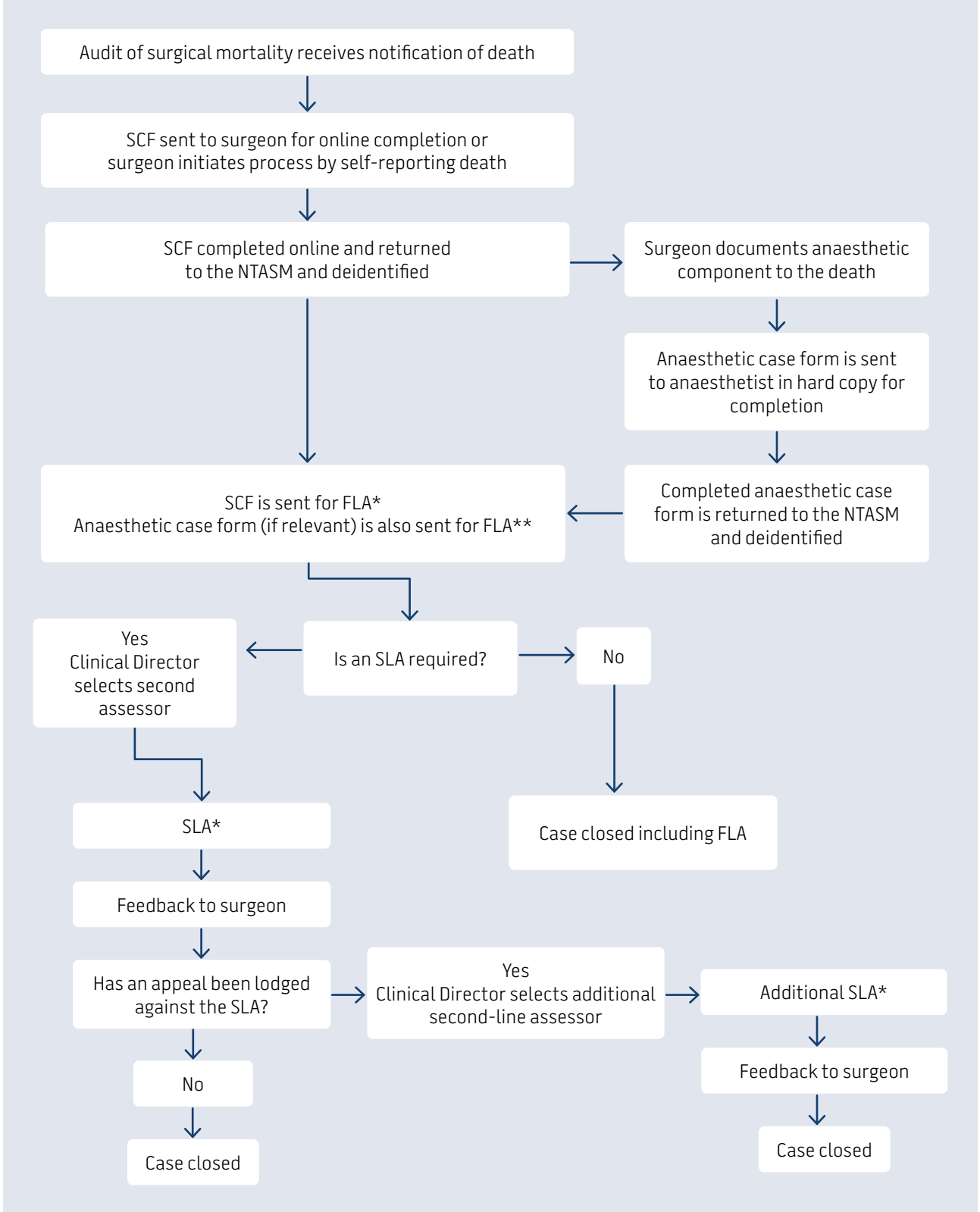
- The patient was deemed terminal upon admission and did not have an operation.

2.3 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 if 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
**TASM and ACTASM anaesthetists perform assessments on NT anaesthetic cases.
NTASM = Northern Territory Audit of Surgical Mortality; SCF = surgical case form; FLA = first-line assessment; SLA = second-line assessment

The following key definitions apply to Figure 2 and are referred to in this report.

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.

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.

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.

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 a letter summarising issues to be addressed in their report.

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.

Surgeons assessors

Surgeons participate in NTASM in the following capacities:

- as a consultant surgeon who **self-assesses** the clinical management provided to the patient under review
- as a **peer assessor** who conducts an FLA or SLA. First-line and second-line assessors are surgical peers from a different Australian state or territory to the NT, in order to preserve anonymity and facilitate impartiality.

Consultant surgeons and peer surgeons (first- or second-line assessors) review patient cases to identify any clinical management issues (CMIs), including hospital systems and processes, where care could have been better. Some patients may have more than one CMI reported. This NTASM report includes only one clinical management issue per patient (that reported by the highest-level assessor: this would be the second-line assessor if an SLA is performed, otherwise it would be the first-line assessor).

Consultant surgeons and assessors provide clinical judgement on one of two possible alternatives:

1. The patient's death was a direct result 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.

Consultant surgeons and assessors may identify CMIs, which are classified as an:

- **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:
  - lead to prolonged hospitalisation, or
  - lead to temporary or permanent impairment or disability of the patient at the time of discharge, or
  - contribute to or cause death.

Consultant surgeons and assessors are asked to:

- report the impact of the CMI on the patient 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 who the issue was associated with, using the following categories:
  - audited surgical team
  - hospital
  - another clinical team
  - other.

Anaesthetist assessors

Fellows of the Australian and New Zealand College of Anaesthetists (ANZCA) began participating in NTASM in August 2016. Anaesthetists may 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).

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.

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 may voluntarily participate in the audit as first-line 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 (detailed in Figure 2).

Obstetricians and gynaecologists who participate in NTASM also perform assessments for relevant patient cases in the Queensland Audit of Surgical Mortality (QASM).

2.4 Data management, storage and analysis

All NTASM data are deidentified and described in terms that cannot identify the patient, surgeon or 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 enabling NTASM staff to generate letters, reminders and management reports. NTASM staff routinely cross-check all data against the original SCF and FLA and SLA forms. Data are cleaned using logic testing and manually reviewed before analysis.

Statistical analysis and coding

Statistical analysis was performed using Statistical Package for Social Sciences (IBM-SPSS version 24.0). Graphs were produced with Microsoft Office Excel (2010).

Numbers in parentheses (n) in the figures and tables of this report represent the number of patients analysed. Because not all data points were completed, the total number of patients used in each analysis varies. Low case numbers for some surgical specialties may compromise confidentiality and the deidentification process. In these circumstances the surgical specialty is listed, and the deaths are instead aggregated under the specialty of 'other'. Continuous variables are summarised using medians and the interquartile range (IQR). The IQR shows the values for the data within the 25% and 75% limits. Reporting the IQR overcomes the problems that arise when reporting the range because extreme values are ignored. 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 greater than 1: if the patient has the characteristic of interest, they have a greater risk of that outcome than the reference group.
- RR of 1 or close to 1: no difference or little difference in risk (incidence in each group is the same).
- RR less than 1: if the patient has the characteristic of interest, they have a lower risk than the reference group.

Qualitative responses are independently analysed by NTASM staff and classified into themes. NTASM team members then compare the themes they have independently identified and discuss any key differences until consensus is reached.

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.

3 AUDIT PARTICIPATION

3.1 Hospitals

All seven hospitals in the NT participate in NTASM. Six hospitals have participated in NTASM since June 2010, and Palmerston Regional Hospital has participated in NTASM since opening in April 2018. Data in this report are from public and private hospitals.

Patients are transferred to either Alice Springs Hospital or Royal Darwin Hospital for major surgery as the smaller hospitals provide limited surgery for low-risk patients only. Darwin Private hospital transfers to Royal Darwin Hospital if ICU admission is required. Surgeons from the Royal Darwin Hospital provide a surgical service to Katherine Hospital on a two-week rotation. Tennant Creek surgical services are provided by Alice Springs Hospital. The Royal Darwin Hospital receives transfers from the surrounding islands and from northern Western Australia.

Table 1: Hospitals in the NT by distance from Royal Darwin Hospital

Hospital name	Distance from Royal Darwin Hospital
Alice Springs Hospital	1,498 km
Darwin Private Hospital	0.75 km
Gove District Hospital	1,042 km
Katherine Hospital	319 km
Palmerston Regional Hospital	21.7 km
Tennant Creek Hospital	Transfers to Alice Springs Hospital (510 km) Transfers to Royal Darwin Hospital (989 km)

3.2 Anaesthetist participation

Thirty-five of the 44 anaesthetists in the NT (79.5%) participated in NTASM in the current reporting period (June 2016–July 2020). Half of the non-participating anaesthetists are GP anaesthetists based at smaller hospitals and cover low-risk surgical care.

NTASM captures every possible anaesthesia-related death because such deaths are reported by both anaesthetists and surgeons. Of the 57 NTASM anaesthetic deaths, surgeons reported 56 and an anaesthetist reported one. The audit process is complete for 48 (84.2%) of these deaths.

To date, NT anaesthetists have completed 11 assessments for either ACTASM or TASM.

3.3 Obstetrician and gynaecologist participation

Participation of RANZCOG Fellows in the audit is voluntary. Of the 15 RANZCOG Fellows in the NT, 14 (93.3%) participate in the audit. Two obstetrics and gynaecology cases have been reported to NTASM (2012–2020). Both cases have completed the audit review process but to preserve confidentiality these will not be further discussed in this report.

3.4 Surgeon participation

3.4.1 Surgeon SCF completion

The audit relies on surgeons returning completed SCFs, which are sent to surgeons on the same day that the death notification is received. Over the 10-year reporting period, the median time for SCFs to be returned was 53 days (IQR 22–110). The longest return time was 653 days. Surgeons returned 38 SCFs (5.9%) within 1 day (data not shown). Approximately one third (31.5%) of SCFs were returned within 1 month of notification of the death to NTASM (Table 2).

Table 2: SCFs completed and returned within 31 days of death notification to NTASM											
	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Returned within 31 days	15	13	20	11	16	17	30	40	28	12	202
Notifications	53	43	68	53	53	61	78	96	85	51	641
% of closed cases per year	28.3%	30.2%	29.4%	20.8%	30.2%	27.9%	38.5%	41.7%	32.9%	23.5%	31.5%

Reference: Appendix data table 1

3.4.2 Surgical workforce in the NT

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 September 2020, 68 consultant surgeons in the NT from 9 specialities were participating in the audit (Table 3). Nine locum surgeons and three Specialist International Medical Graduate surgeons also participated.

Overall, the number of surgeons in the NT has increased. Since the 2019 NTASM report, eight surgeons from the following specialties have joined the NT surgical workforce: vascular (n=1), maxillofacial (n=1), orthopaedic (n=1), general (n=3) and urology (n=2). (Participating NT surgeons over the 10-year reporting period are listed by speciality in Appendix data table 2.)

Table 3: NT surgeons participating by surgical speciality as of September 2020	
Surgical specialty	**Surgeons participating***
General Surgery	34
Orthopaedics	14
Otolaryngology, Head and Neck	6
Urology	3
Oral and Maxillofacial	3
Vascular	2
Neurosurgery	2
Plastic and Reconstructive	2
Ophthalmology	2
Total	**68**

*Excluded from this table are surgeons who have retired (n=2), left practice (n=11), are locum (n=9), or are Specialist International Medical Graduate surgeons (n=3) in the NT.

NTASM welcomes government initiatives that support surgeons to relocate to the NT:

- In 2020, the Royal Darwin Hospital gained one new Fellow who moved to the NT as part of the Fellow Rural Placement Pilot funded by the Department of Health's Specialist Training Program. This program provides new Fellows (within their first two years of practice after attaining Fellowship) with a comprehensive experience in a rural location (8).

NTASM recognises the success of surgeons in the NT:

- RACS Fellow Dr Ollapallil Jacob is the NT nominee for the 2021 Senior Australian of the Year award. Dr Ollapallil Jacob has been a surgeon in Alice Springs for more than 20 years and was the recipient of the inaugural RACS Indigenous Award in 2015.

NTASM implements strategies to support surgeons in the NT to participate in the audit:

- As of 2020, NTASM is funding one surgeon to attend and present at the QASM meeting. Each year, NT surgeons will be asked to nominate a peer whom they believe deserves recognition of service.

The RACS *Reconciliation Action Plan May 2020–May 2022* outlines strategies the College is taking to improve health outcomes for Aboriginal and Torres Strait Islander people. A key measurable target is for RACS to, "increase the percentage of Aboriginal and Torres Strait Islander staff employed in our workforce." (p. 18) (9).

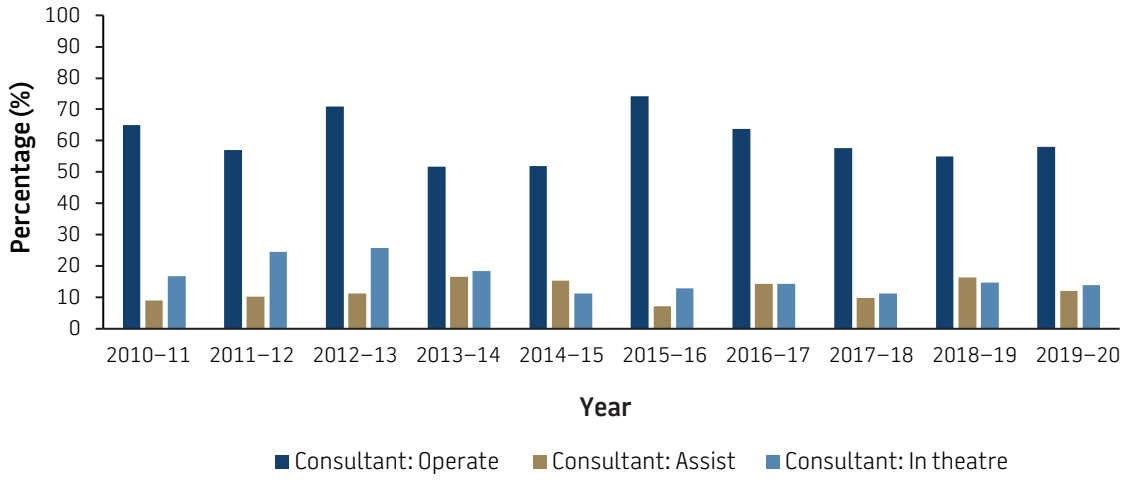
- Locum surgeons are a valuable component of the NT surgical workforce. Modifications to the RACS Fellows Interface now enable surgeons in the NT, including locum surgeons, to self-generate a notification of death and report case details at the same time. This has made it easier for locums to complete an SCF if they are still working at that hospital at the time of the patient's death. It remains a challenge collecting completed SCFs from locums who have left the hospital before the patients die.

3.4.3 Consultant surgeon presence in theatre

Consultant surgeons may be in theatre to perform, assist or supervise an operation. The presence of consultant surgeons in theatre, in any capacity, is high in the NT: a consultant surgeon was present for 87.9% of the operations (725/825) in this reporting period.

Consultants performed 60.0% of all operations (495/825), assisted in 12.5% of operations (103/825), or were in theatre in an unspecified capacity (i.e., performing, assisting or supervising the operation) for 15.4% of operations (127/825) (Figure 3).

Figure 3: Operations conducted with a consultant surgeon present in theatre, 2010–20 (n=725*)



*Data not provided n=100 (12.1%)
Consultant in theatre = surgeon may have performed, assisted with, or supervised the operation (not specified)
Reference: Appendix data table 3

3.4.4 Consultant surgeon views in retrospect

Consultant surgeons were asked whether, in retrospect, they would have done anything differently in terms of patient management. This question was not answered for 18 patients (3.6%).

- For 78.8% (383/486) of patients, the surgeon would not have changed the patient's management.
- For 21.2% (103/486) of patients, the surgeon would have done something differently.

Areas of care identified for improvement by surgeons covered all aspects of patient management. Sample comments are provided below.

Enhanced communication with patients or their family

I would have liked to establish goal of care much earlier if possible. However, the challenge was that this patient's family was in remote community.

He was a difficult patient…Communication was poor between medical staff and the patient.

There were significant language and trust issues in this case.

This was a patient with significant comorbidities and very non-compliant patient.

Better teamwork

Engaged more active participation of medical and HDU teams

Investigated his drowsiness and referred the gentleman to the medical team for further input.

Better handover between teams surgical and non-surgical.

Organised palliative care

If we had been aware of his cognitive impairment initially, I would have palliated him from the start.

The other option was palliation at an earlier stage; however, the family was not united enough to reach a consensus.

Liaised with palliative care. Got a second opinion.

Palliated patient early. Stopped him bouncing between nursing home and hospital.

This patient should not have undergone any surgery. She could have been referred for palliative care.

Early referral to palliative care and return to community care facility.

Not made decision to perform operation

Maybe not have operated at all.

I would not have operated. The outcome was unavoidable.

Returned patient to theatre within a shorter timeframe

A prompt return to theatre upon detecting [condition deidentified for privacy].

Re-operation 6 hours sooner, despite all clinical; radiological and biochemical evidence to the contrary.

Requested additional pre-operation reviews

I would have ordered a physician review preoperatively.

It may have been worthwhile him having preop chest physio; and respiratory review.

Admitted patient to HDU postoperatively

HDU admission would have been appropriate following surgery.

3.4.5 Surgeon communication

The SCF asks surgeons to indicate if the case involved a communication issue. Surgeons indicated communication was an issue in 8.2% (50/613) of cases, not an issue in 90.7% (556/613) 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.

Surgeon 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: Communication issues reported by consultant surgeons (n=613*)

	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Communication issue	6	3	4	5	4	3	10	3	8	4	50
No communication issue	44	37	56	44	47	50	62	93	77	46	556
Unknown	1	0	0	0	1	1	3	0	0	1	7
Total	51	40	60	49	52	54	75	96	85	51	613

*Data missing n=28 (4.4%)

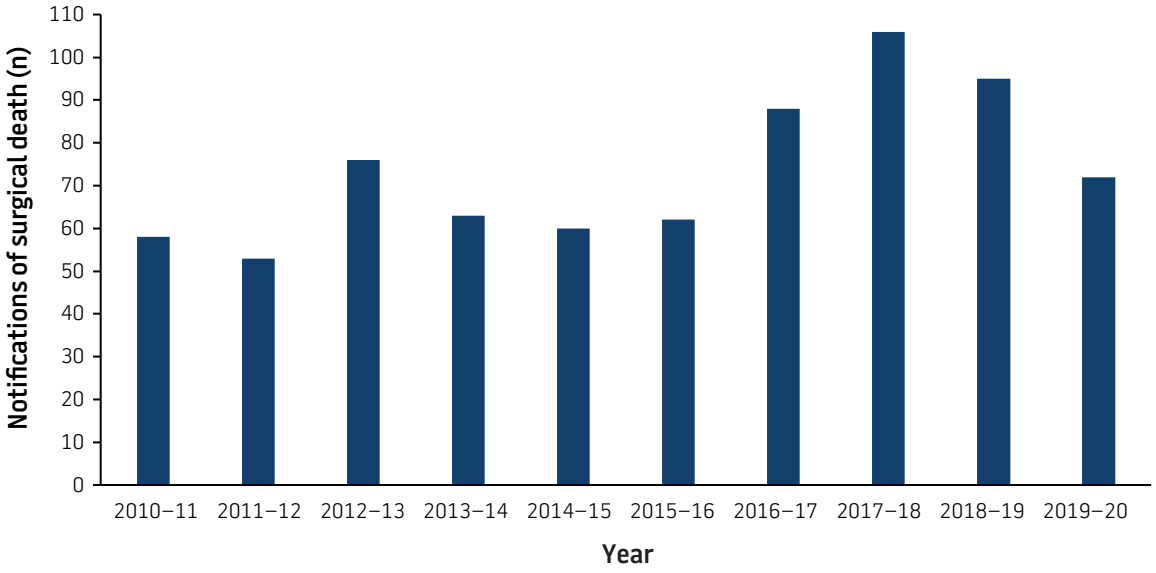
4 RESULTS: ALL PATIENTS

4.1 Notifications of surgical deaths

By the 2020 census date, NTASM had been notified of 733 surgery-related patient deaths over the 10-year reporting period. The audit process has been completed for the 641 cases presented in this report. The highest number of notifications to NTASM occurred between July 2017 and June 2019 (Figure 4).

At the census date (6 August 2020), SLAs had been completed for 10.6% (77/641) of these cases. (Appendix data table 1 shows the assessment and review status of all patient cases.)

Figure 4: Notifications of surgical deaths, 2010–20 (n=733)

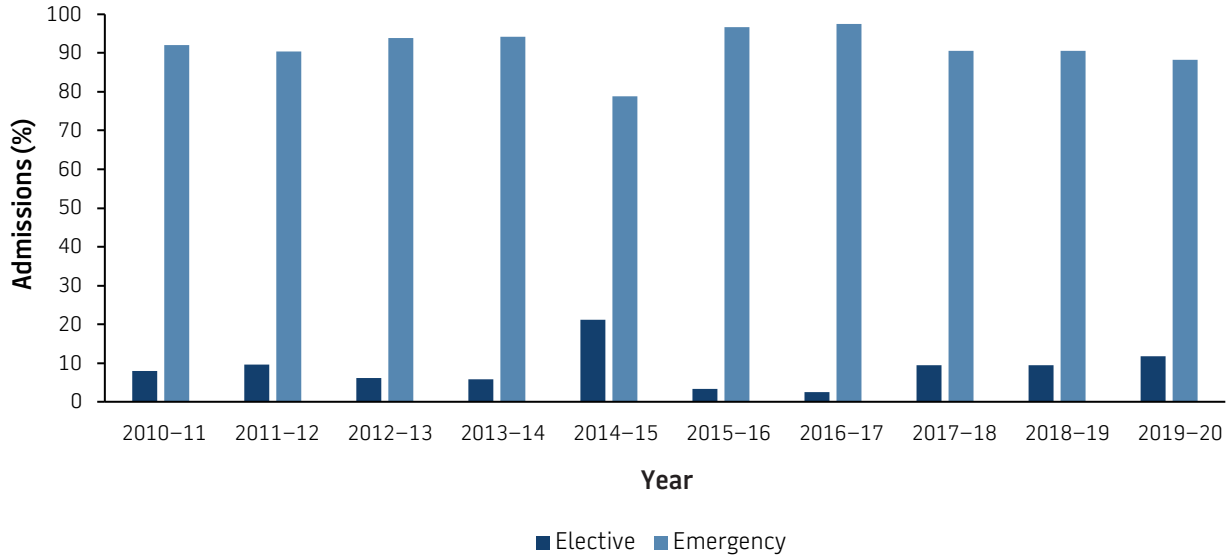


Reference: Appendix data table 1.

4.2 Patient admissions

Most patients arrived at hospital as an emergency admission (91.6%; 579/632) rather than an elective admission (8.4%; 53/632) (Figure 5). Most patients were admitted under the care of a general surgeon (72.7%; 466/641) (Appendix data table 2).

Figure 5: Elective and emergency admissions, 2010–20 (n=632*)



*Data missing n=9 (1.4%)
Reference: Appendix data table 4.

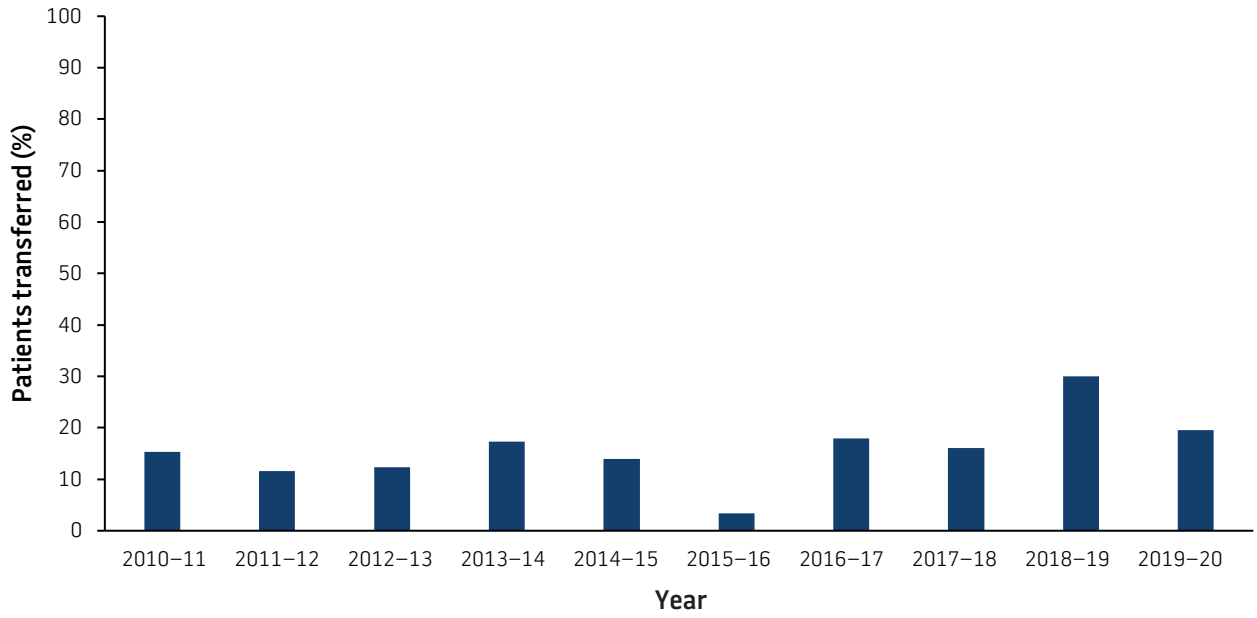
4.3 Patient length of hospital stay

Patients who had an operation had a longer stay in hospital. Overall, the median length of hospital stay for all patients was nine days (IQR 3–23 days). The median length of stay for patients who had an operation was 12 days (IQR 4–27 days), and the median length of stay for patients who did not have an operation was three days (IQR 1–8 days).

4.4 Patient transfers

A total of 102 patients (16.4%, 102/623) 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. There was an increase in patient transfers between July 2017 and June 2020 relative to previous years (Figure 6).

Figure 6: Patients transferred to another hospital, 2010–20 (n=623*)



*Data missing n=18 (2.8%)
Reference: Appendix data table 5.

4.5 Patient characteristics

Patient characteristics are presented in Table 5 for the total 641 patients included in this report. The number of patients who had an operation (n=504) is used as the denominator for analysis, particularly for infections, because these can be acquired prior to admission or during admission (preoperative or postoperative).

The median age of patients included in the audit ranges from 61 to 70 years, over the 10-year reporting period. The following patient characteristics have been noted:

- 61.2% are males and 38.1% are females
- 92% are emergency admissions and 8.4% are elective admissions
- 83.0% have comorbidities on admission and 17.2% have no comorbidities
- 36.0% are Aboriginal or Torres Strait Islander patients and 64.0% are non-Indigenous patients
- 78.6% have at least one operation
- 34.1% have a clinically significant infection present at the time of death
- 26.0% of the deaths involved trauma

Table 5: Characteristics of NTASM patients, 2010–20 (n=641)

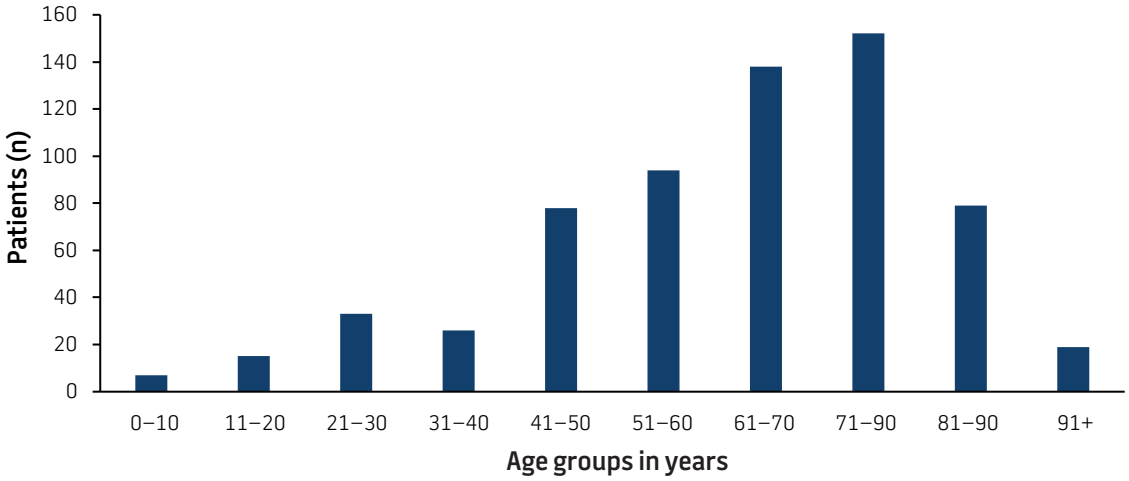
	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Age (n=641)											
Median years (IQR)	60 (47–71)	62 (45–76)	65 (47–76)	63 (46–78)	63 (54–72)	67 (50–76)	66 (49–72)	70 (54–79)	66 (52–77)	61 (54–73)	65 (50–75)
Sex (n=641)											
Male	40 75.5%	29 67.4%	39 57.4%	31 58.5%	35 66.0%	44 72.1%	50 64.1%	51 53.1%	51 60.0%	27 52.9%	397 61.9%
Female	13 24.5%	14 32.6%	29 42.6%	22 41.5%	18 34.0%	17 27.9%	28 35.9%	45 46.9%	34 40.0%	24 47.1%	244 38.1%
Admission status (n=632*)											
Elective	4 8.0%	4 9.5%	4 6.2%	3 5.8%	11 21.2%	2 3.3%	2 2.6%	9 9.4%	8 9.4%	6 11.8%	53 8.4%
Emergency	46 92.0%	38 90.5%	61 93.8%	49 94.2%	41 78.8%	59 96.7%	76 97.4%	87 90.6%	77 90.6%	45 88.2%	579 91.6%
Comorbidities (n=640*)											
Yes	38 73.1%	35 81.4%	53 77.9%	46 86.8%	44 83.0%	46 75.4%	68 87.2%	88 91.7%	73 85.9%	39 76.5%	530 82.8%
No	14 26.9%	8 18.6%	15 22.1%	7 13.2%	9 17.0%	15 24.6%	10 12.8%	8 8.3%	12 14.1%	12 23.5%	110 17.2%
Aboriginal and Torres Strait Islander status (n=640*)											
Aboriginal and Torres Strait Islander	23 43.4%	11 25.6%	25 36.8%	27 50.9%	15 28.3%	22 36.1%	27 34.6%	32 33.3%	33 38.8%	16 31.4%	231 36.0%
non-Indigenous	30 56.6%	32 74.4%	43 63.2%	26 49.1%	38 71.7%	39 63.9%	51 65.4%	64 66.7%	52 61.2%	35 68.6%	410 64.0%
Operation status (n=641)											
Yes	41 77.4%	32 74.4%	47 69.1%	42 79.2%	43 81.1%	45 73.8%	61 78.2%	84 87.5%	70 82.4%	39 76.5%	504 78.6%
No	12 22.6%	11 25.6%	21 30.9%	11 20.8%	10 18.9%	16 26.2%	17 21.8%	12 12.5%	15 17.6%	12 23.5%	137 21.4%
Clinically significant infection present at time of death (n=572*)											
Yes	2 25.0%	19 55.9%	21 31.3%	19 38.0%	19 36.5%	20 32.8%	28 36.4%	29 30.5%	26 30.6%	15 29.4%	198 34.1%
No	6 75.0%	15 44.1%	46 68.7%	31 62.0%	33 63.5%	41 67.2%	49 63.6%	66 69.5%	59 69.4%	36 70.6%	382 65.9%
Trauma involved in the patient's death (n=580*)											
Yes	5 55.6%	15 40.5%	17 25.0%	12 22.6%	14 26.9%	21 34.4%	16 20.8%	27 28.1%	17 20.0%	9 17.6%	153 26.0%
No	4 44.4%	20 54.1%	47 69.1%	40 75.5%	37 71.2%	40 65.6%	59 76.6%	69 71.9%	67 78.8%	42 82.4%	425 72.2%
Unknown	0 0.0%	2 5.4%	4 5.9%	1 1.9%	1 1.9%	0 0.0%	2 2.6%	0 0.0%	1 1.2%	0 0.0%	11 1.9%

*Data missing for admission status (n=9); comorbidities present (n=1); clinically significant infection (n=69); and trauma (n=61).
** Infection and trauma questions were included in NTASM from November 2011. Data from patients admitted prior to November 2011 are included here due to delays in notifications of deaths or surgeons completing the SCF, or surgeons providing additional information.

4.5.1 Patient age

Across the 10-year reporting period, the median age of surgical patients who died was 65 years (IQR 50–75 years, n=641). The most frequently recorded age was 78 years. Seven patients were younger than 10 years (1.1%, 7/641), and 19 patients were older than 90 years (3.0%, 19/641) (Figure 7).

Figure 7: Patients by age group, 2010–20 (n=641)



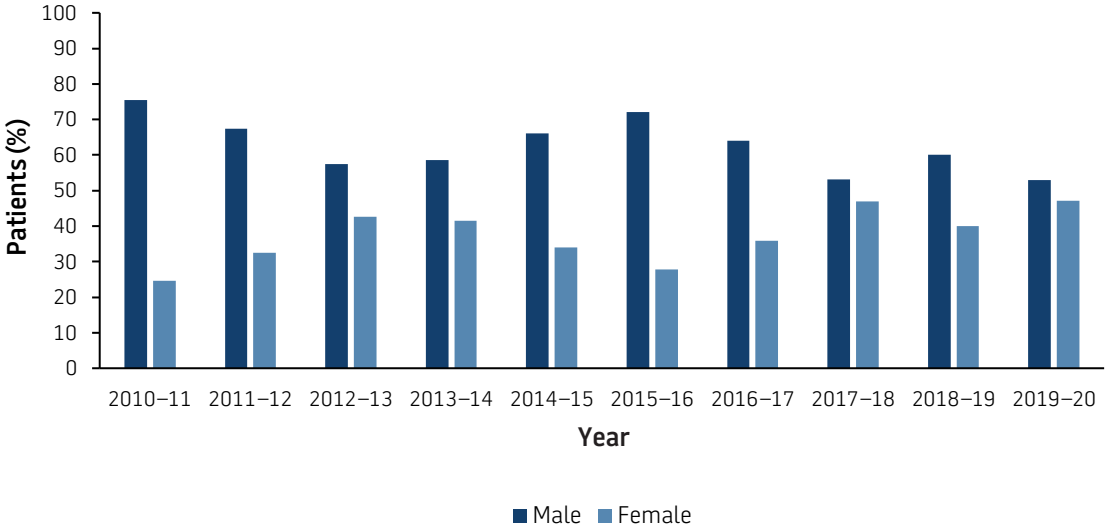
Reference: Appendix data table 6.

Median patient age has varied little over the 10 years of the audit. In 2010–11, the median patient age was 60 years (IQR 47–75, n=53), and in 2019–20 the median patient age was 61 years (IQR 54–73, n=51).

4.5.2 Patient sex

Across the 10-year reporting period, more surgical patients were males (61.6%, 397/641) than were females (38.1%, 244/641) (Figure 8). The higher number of male patients is expected because males out number females in the general population of the NT (10).

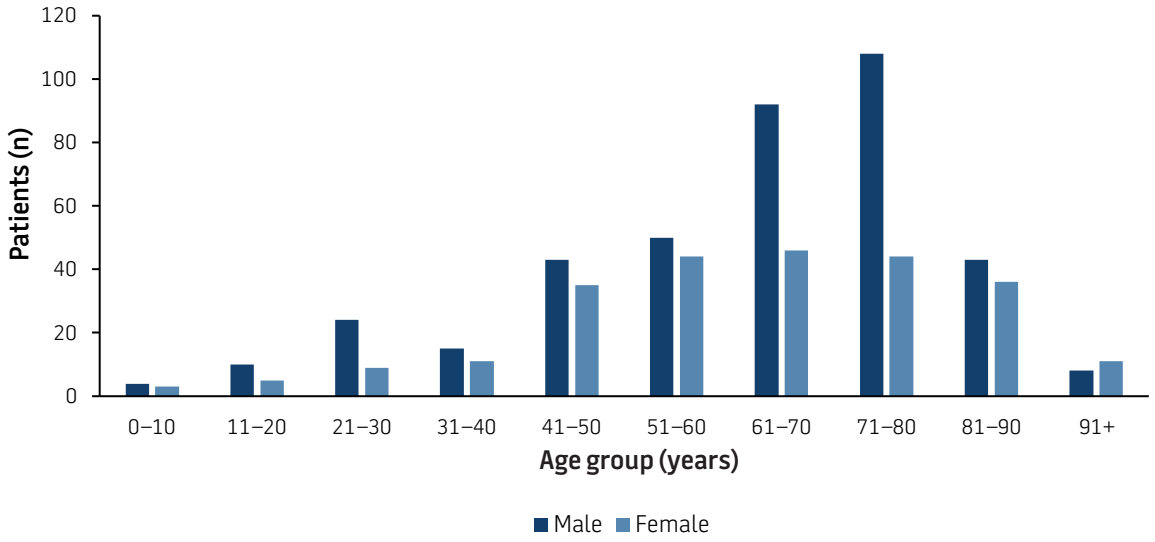
Figure 8: Sex distribution of patients, 2010–20 (n=641)



Reference: Appendix data table 7.

Across the 10-year audit period, the 91+ years age group was the only age group with more female patients than male patients. The largest difference in numbers of males and females was in patients aged 61 to 80 years (Figure 9).

Figure 9: Sex distribution by age group, 2010–20 (n=641)

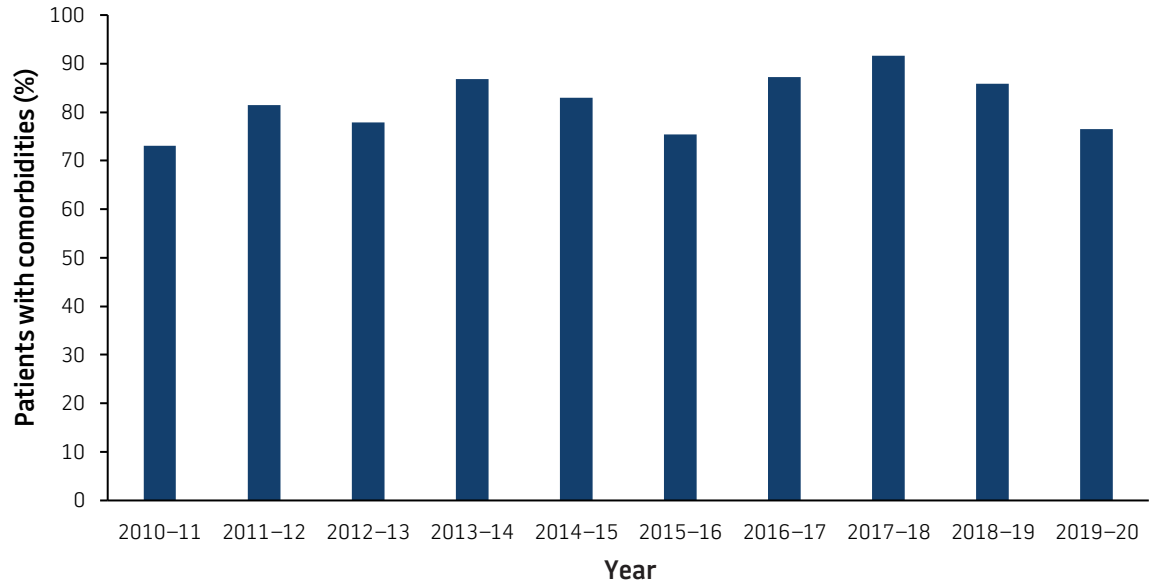


Reference: Appendix data table 6.

4.5.3 Patients with comorbidities

Across the 10-year audit period, 82.8% of patients (530/640) had at least one documented comorbidity (Figure 10). One third of patients had four comorbidities (33.6%, 215/640) (data not shown).

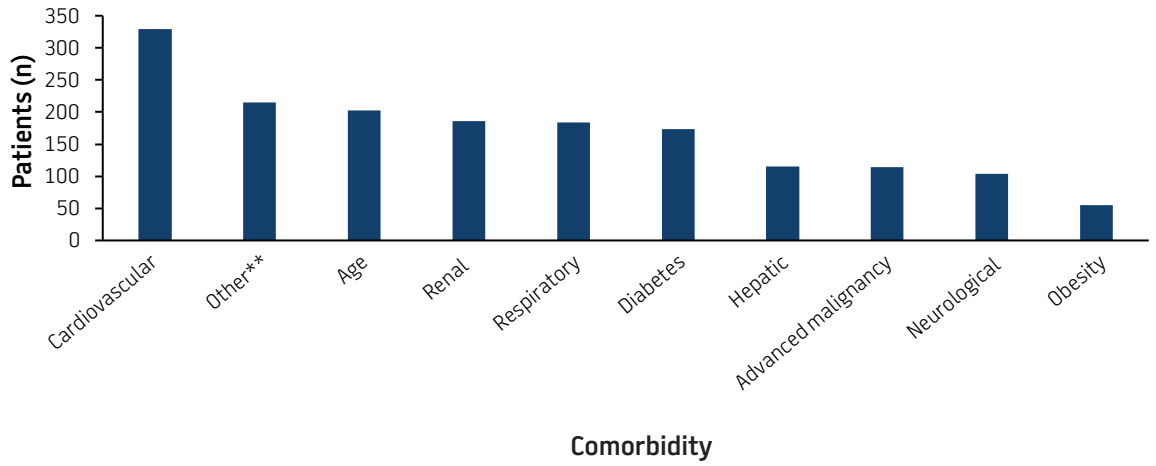
Figure 10: Patients with comorbidities, 2010–20 (n=640*)



*Data missing n=1 (0.2%)
Reference: Appendix data table 8.

Cardiovascular disease (CVD) was the most prevalent comorbidity, occurring in more than half of all audit patients (51.4%, 329/640). Comorbidities categorised as 'other' occurred in more than a third of patients (33.6%, 215/640). This category is large because the SCF does not define listed comorbidities, meaning surgeons apply their own definitions. For example, not all surgeons record dementia and Alzheimer's disease in the neurological category. The number of patients with specific types of comorbidities is depicted in Figure 11.

Figure 11: Types of comorbidities, 2010–20 (n=640*)



*Data missing for n=1.
**Other includes alcohol abuse, anticoagulation therapy, arthritis, dementia/Alzheimer's disease, malignancy, malnutrition/cachexia, peripheral vascular disease, smoking, ischaemic heart disease.
Reference: Appendix data table 9.

4.5.4 Patient alcohol use

Alcohol use was reported as an 'other' comorbidity that increased the risk of death in 9.2% of patients (59/641). Nationally, men are more likely to exceed recommended alcohol consumption guidelines than are women (4). In NTASM, there was no statistical difference in the reporting of alcohol use between male and female patients (Table 6).

Table 6: Patients for whom alcohol was a comorbidity that increased risk of death, 2010–20 (n=638*)

Male n=397	Female n=244	Risk ratios (95% CI)
34 (8.6%)	20 (8.3%)	0.95 (0.54–1.70)

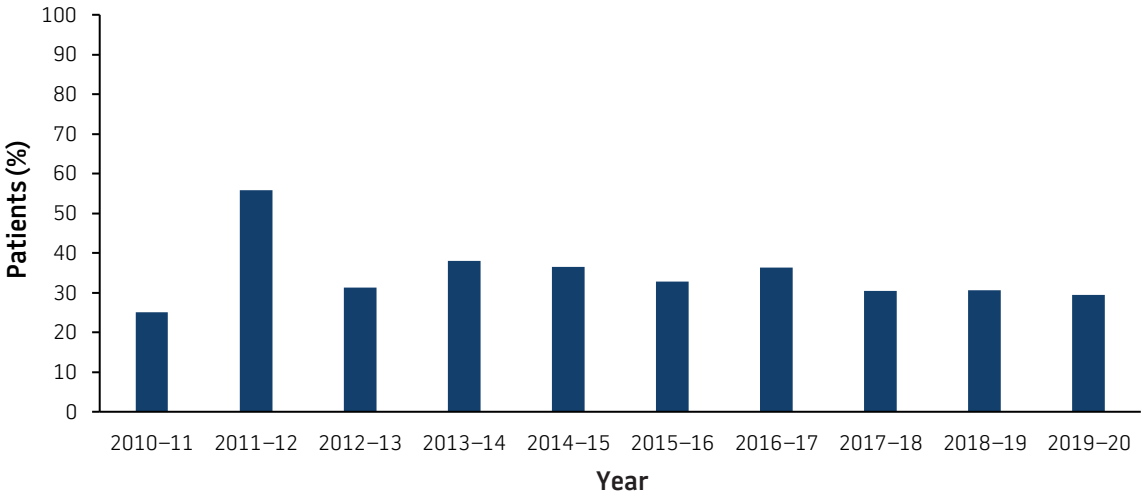
95% CI = 95% confidence interval
Reference group = male
*Data missing n=3 (0.5%)
Risk ratios = calculated to assess the risk of an event in one group versus the risk of the event in the reference group.

4.5.5 Patients who died with an infection

Infections can be acquired before admission or during admission. Surgeons document the site of infection (surgical site or other invasive site) and when it was acquired (before or during admission). Hospital-acquired infections are preventable.

Across the 10-year reporting period, 34.1% of patients had a clinically significant infection at the time of death (198/580). Infection rates are improving — the percentage of patients with a clinically significantly infection at the time of death has decreased in the past three audit years to an average of 30.2% of patients (Figure 12).

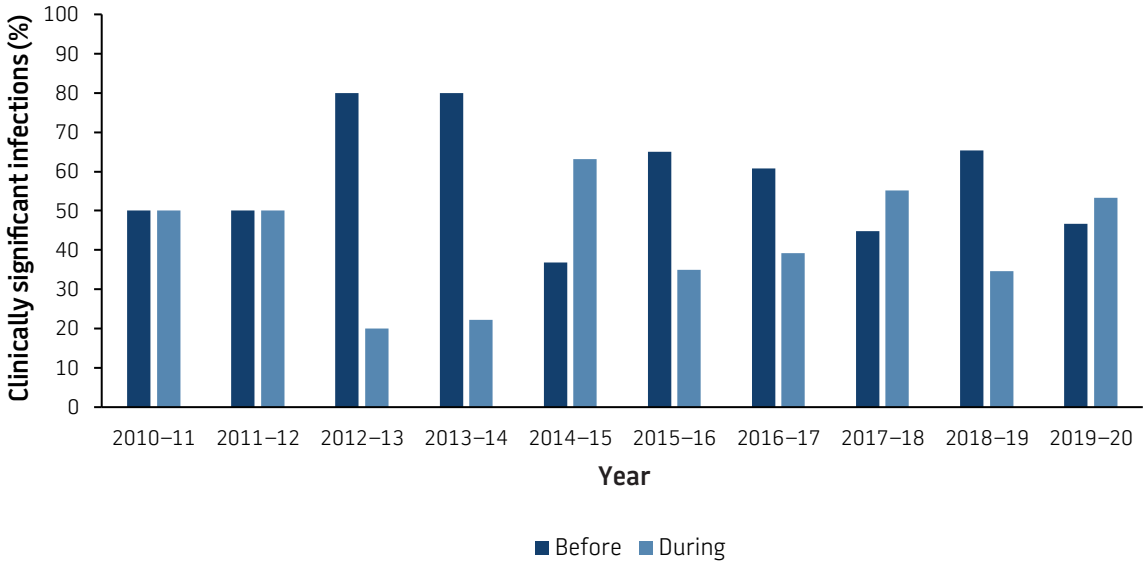
Figure 12: Patients with clinically significant infections at the time of death, 2010–20 (n=580*)



Infection questions were included in NTASM from November 2011. Data from eight patients admitted prior to November 2011 are included here due to delays in notifications of deaths or surgeons completing the SCF, or surgeons providing additional information.
*Data missing n=61 (9.5%)
Reference: Appendix data table 10.

Overall, more patients acquired their infection before admission (58.5%; 114/195) than during admission (41.5%; 81/195) (Figure 13).

Figure 13: Patients who died with a clinically significant infection that was acquired before or during hospital admission, 2010–20 (n=198*)



Infection questions were included in NTASM from November 2011. Data from eight patients admitted prior to November 2011 are included here due to delays in notifications of deaths or surgeons completing the SCF, or surgeons providing additional information.
*Data missing n=3 (1.5%)
Reference: Appendix data table 11.

Hospital-acquired infections were most frequently acquired postoperatively (60.3%; 47/78); less than 20% were acquired preoperatively (Note: not all surgeons indicated at what point in admission the infection was acquired). Intra-abdominal sepsis was the most frequent infection acquired before admission (39.3%; 44/112). Pneumonia was the most frequently acquired in-hospital infection (50.6%; 41/81) (Table 7).

Table 7: Infections acquired before or during admission, 2010–20 (n=193)

	Acquired before admission n=112*	Acquired in hospital n=81
Pneumonia	16 (14.3%)	41 (50.6%)
Septicaemia	17 (15.2%)	18 (22.2%)
Intra-abdominal sepsis	44 (39.3%)	13 (16.0%)
Other infections	35 (31.3%)	9 (11.1%)

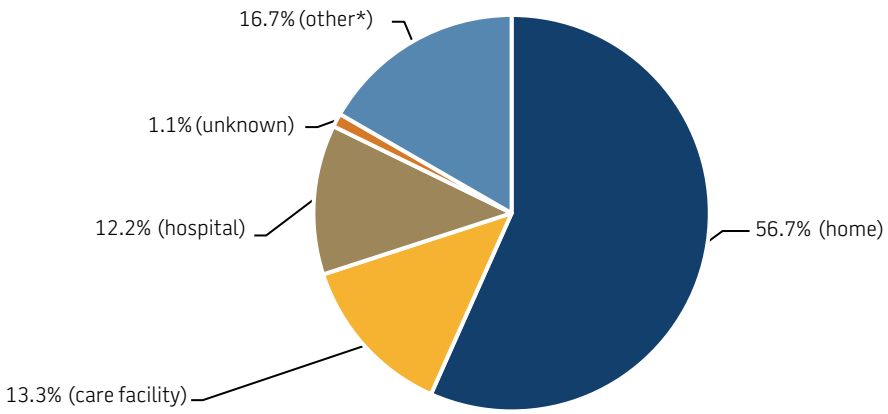
*Data missing n=2 (1.8%).

4.5.6 Patients with trauma (fall, traffic accident or violence)

Surgeons in the NT are often faced with challenges to repair trauma injuries (11, 12). Audit questions regarding trauma (introduced in November 2011) ask surgeons to document whether the trauma was a result of a fall, road traffic accident, violence or other cause.

More than a quarter of patients (26.0%; 153/589) were admitted to hospital because of trauma (Appendix data table 12). The most frequent causes of trauma were falls (58.8%; 90/153), road traffic accidents (24.2%; 37/153) or violence (15.7%; 24/153). Over 80% of falls occurred at a private home, care facility or hospital. Other fall locations were places of sport, recreation, farming or work (Figure 14).

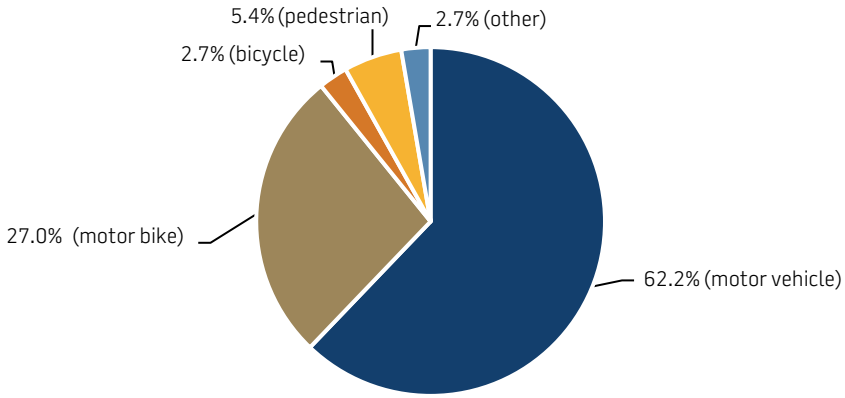
Figure 14: Patient location at time of fall that caused trauma, 2010–20 (n=90)



*Other includes sport/recreation/farm/work
Reference: Appendix data table 13.

The four main types of road traffic accidents that caused trauma are shown in Figure 15

Figure 15: Type of road traffic accidents that caused trauma, 2010–20 (n=37)



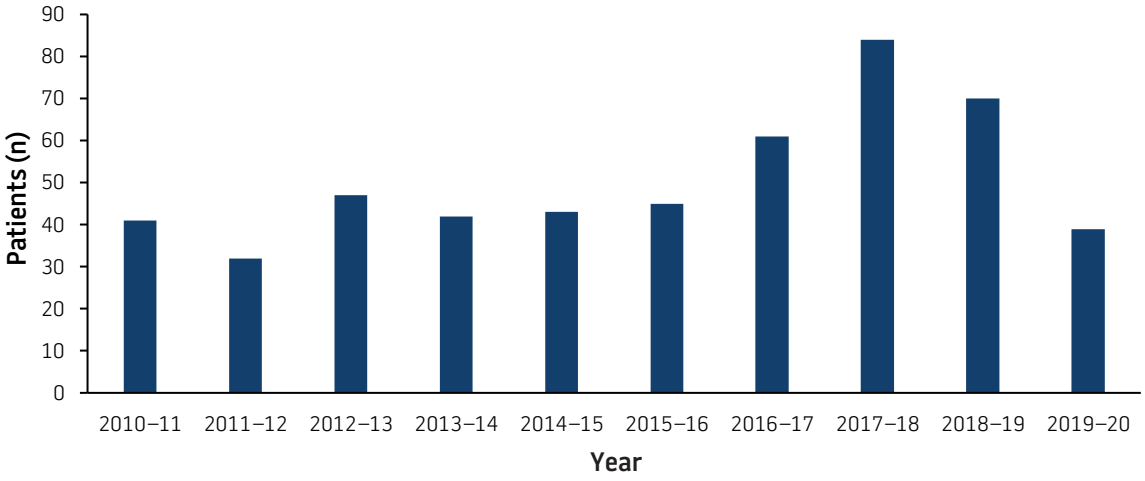
Reference: Appendix data table 14.

4.6 Patients who had operations

Nearly 80% of patients (78.6%; 504/641) had at least one operation (Figure 16).

Surgeons performed a total of 825 operations across the 10-year reporting period. Most patients had only one operation (68.8%; 347/504), but 31.2% of patients (157/504) had two or more operations. Two patients had 10 operations, one patient had 11 operations and one patient had 12 operations. Wound debridement was the most frequent reason for returns to theatre in patients who had more than five operations (data not shown).

Figure 16: Patients who had operations, 2010–20 (n=504)

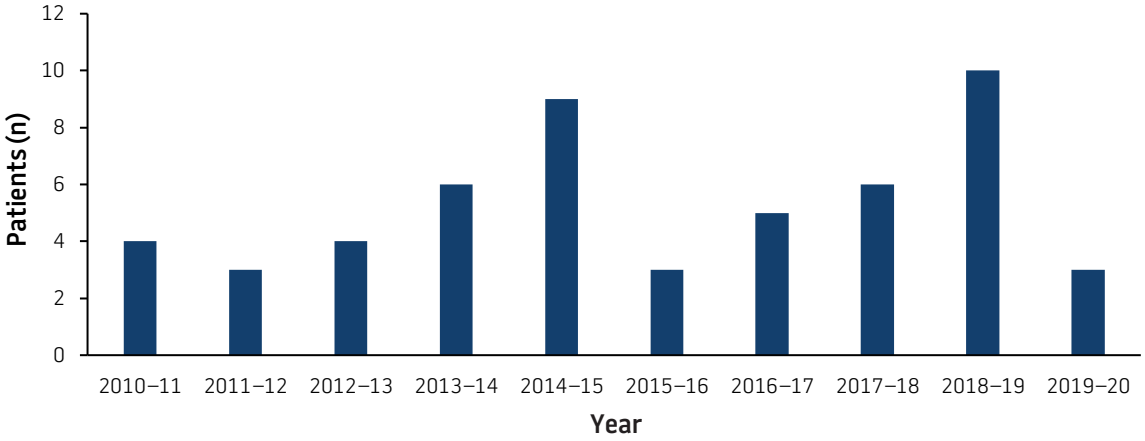


Reference: Appendix data table 15.

4.6.1 Patients with a delay in main surgical diagnosis

Delays in diagnosis can contribute to perioperative death (13). Across the 10-year reporting period, 10.6% of the patients who had surgery (53/499) had a delay in their surgical diagnosis (Figure 17).

Figure 17: Patients with preoperative delay in main surgical diagnosis, 2010–20 (n=499*)



*Data missing n=5 (1.0%)
Reference: Appendix data table 16.

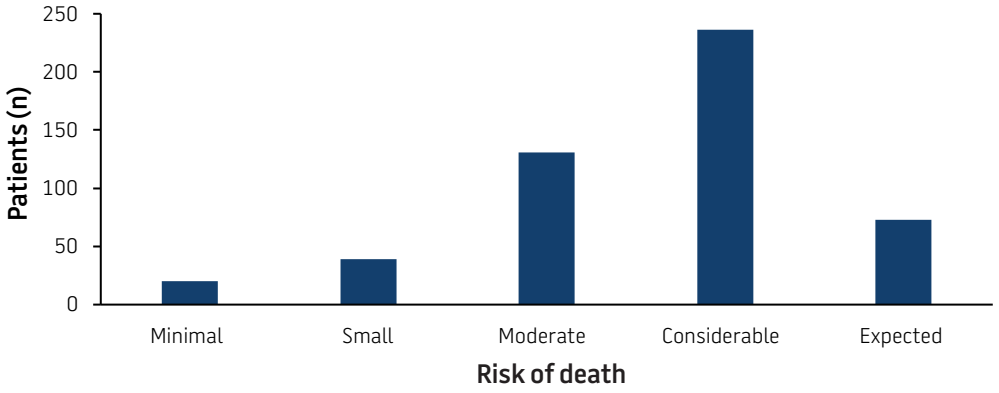
Delays in main surgical diagnosis can be associated with more than one department or health professional. Across the 10-year reporting period, delays in surgical diagnosis were attributed to surgical units (n=21 cases), medical units (n=12 cases), and general practitioners (n=4 cases).

The delays in diagnosis were mainly due to unavoidable causes (n=21) and staff inexperience (n=10). Other causes of delay were misinterpreted results (n=6), incorrect test used (n=2), and results not reviewed (n=1) (data not shown).

4.6.2 Patient preoperative risk of death

Surgeons assess each patient's risk of death prior to surgery. Surgeons assessed 73.6% of patients (367/499) as having a moderate or considerable risk of death prior to surgery. Death was expected for 14.6% of patients (73/499) who received at least one operation (Figure 18).

Figure 18: Risk of death as assessed by surgeon prior to surgery, 2010–20 (n=499*)



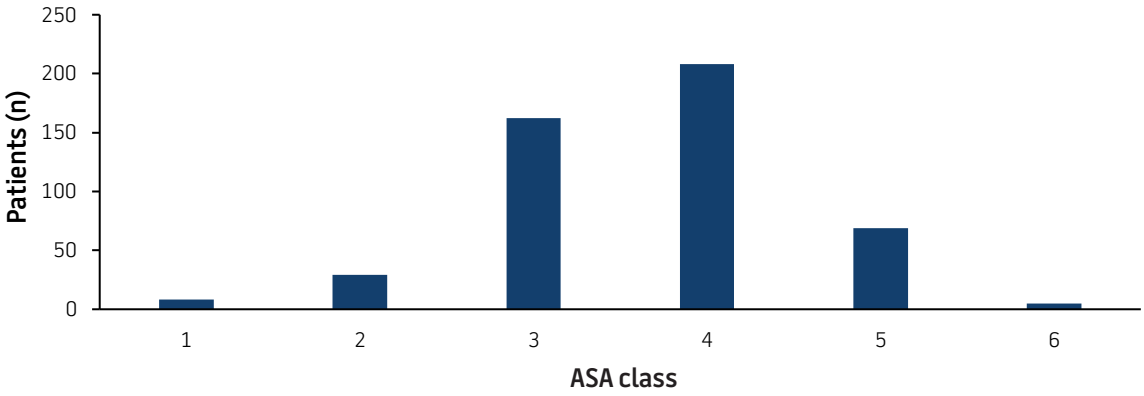
Data missing n=5 (1.0%)
Reference: Appendix data table 17.

4.6.3 American Society of Anesthesiologists classification

Anaesthetists use the American Society of Anesthesiologists (ASA) Physical Status Classification to assess a patient's preoperative risk, based on patient comorbidities (14). Classification levels range from ASA class 1 (normal, healthy patient) to ASA class 6 (patient declared brain-dead).

Across the 10-year reporting period, anaesthetists assigned ASA class 3 or 4 to 76.9% of patients who had an operation (370/481). This indicates that anaesthetists deemed that most patients had moderate to severe systemic disease at the time of assessment (Figure 19).

Figure 19: ASA class assigned to patients who had an operation, 2010–20 (n=481*)



*Data missing n=23 (4.6%) of patients who had an operation.
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.
Reference: Appendix data table 18.

4.6.4 Patients with postoperative complications

Most patients (76.2%; 382/501 who had surgery had no postoperative complication reported by the surgeon. The most frequently occurring postoperative complications are listed in Table 8.

Table 8: Most frequent postoperative complications among patients who had surgery, 2010–20 (n=501*)

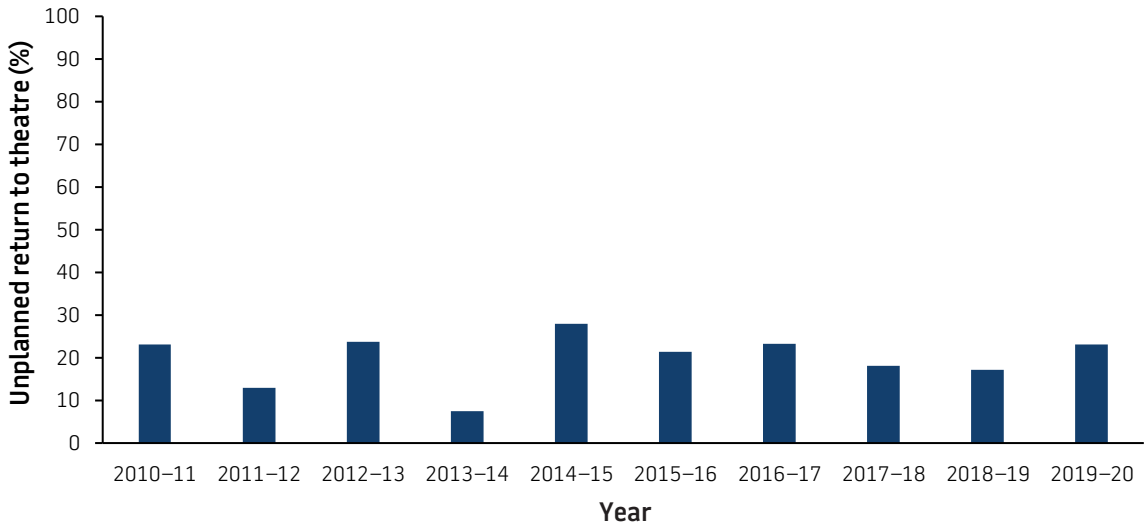
Postoperative complication	Frequency (%)
Other**	33 (6.6)
Significant postoperative bleeding	34 (6.8)
Tissue ischaemia	22 (4.4)
Procedure-related sepsis	19 (3.8)
Myocardial infarction	9 (1.8)
Vascular graft occlusion	6 (1.2)
Aspiration pneumonia	6 (1.2)
Anastomotic leak — small bowel	4 (0.8)
Pulmonary embolus	4 (0.8)
Pneumonia	4 (0.8)

*Data missing n=3 (0.6%)
**Includes disseminated intravascular coagulation, failure to heal, hospital-acquired pneumonia, ileus, lung collapse, necrotising fasciitis of abdominal wall, pancreatitis, spinal cord infarction, wound dehiscence and wound haematoma.

4.6.5 Patients with an unplanned return to theatre

Unplanned returns to theatre are a strong predictor of death (15). Of the patients who had surgery across the 10-year reporting period, 19.8 % had an unplanned return to theatre (97/489). Figure 20 shows the number of patients who had an unplanned return to theatre across each audit year.

Figure 20: Patients with an unplanned return to theatre, 2010–20 (n=489*)



*Data missing n=15 (3.0%); "unknown" response n=2 (0.4%)
Reference: Appendix data table 19.

4.6.6 Operation management

Surgeons and assessors consider the clinical management of each operation to identify areas that may require improvement. Agreement between surgeons and assessors was high, with no clinical management area where their opinions differed significantly (Table 9).

Table 9: Surgeon-identified and assessor-identified clinical management areas requiring improvement for patients who had an operation, 2010–20 (n=504)

	Surgeons	Assessors	Risk ratios (95% CI)
Preoperative management	38/496 (7.7%)	53/494 (10.7%)	1.45 (0.94–2.24)
Decision to operate	39/499 (7.8%)	31/496 (6.3%)	0.79 (0.48–1.28)
Choice of operation	15/496 (3.0%)	23/494 (4.7%)	1.57 (0.81–3.04)
Timing of operation	37/496 (7.5%)	37/494 (7.5%)	1.00 (0.63–1.61)
Intraoperative management	25/498 (5.0%)	23/492 (4.7%)	0.93 (0.52–1.66)
Postoperative care	24/493 (4.9%)	29/493 (5.9%)	1.22 (0.70–2.13)

95% CI = 95% confidence interval
Reference group = surgeons
Denominators differ from n=504 (patients who had an operation) because not all surgeons or assessors answered this question.
Risk ratios = calculated to assess the risk of an event in one group versus the risk of the event in the reference group.

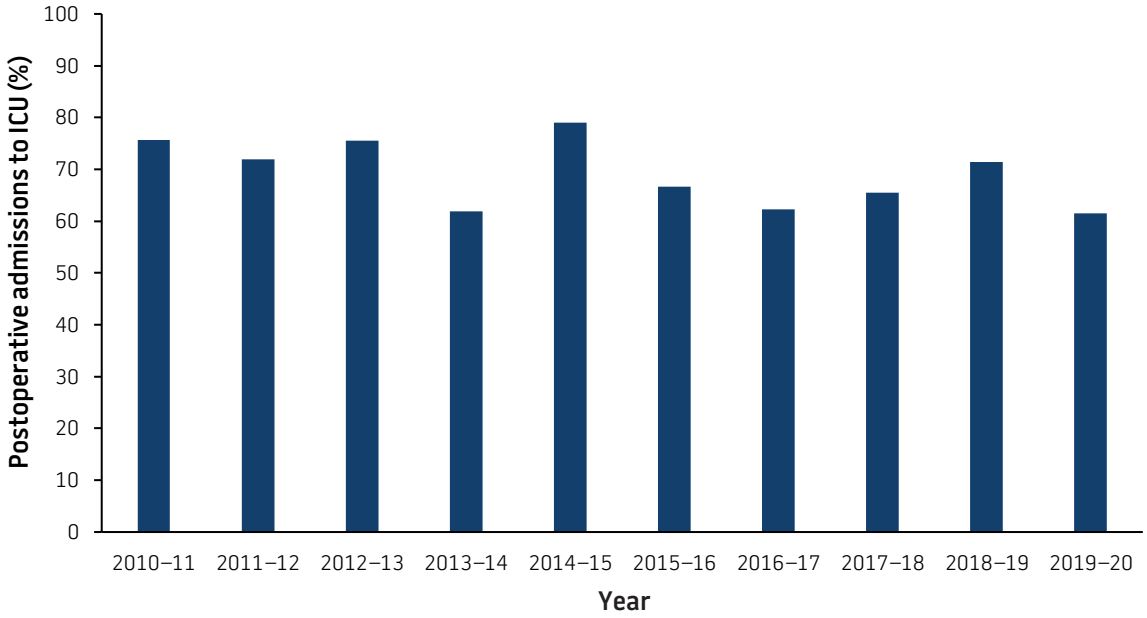
4.6.7 Patients admitted to an intensive care unit

Planned and unplanned admission to an intensive care unit (ICU) can occur at any time during a patient's hospital stay regardless of whether an operation is performed. Surgeons record whether a patient was admitted to ICU and the assessor comments on the appropriateness of that admission.

Two-thirds of all patients (67.9%; 434/639) were admitted to ICU across the 10-year reporting period. Admission to ICU was unplanned for 24.8% of patients (103/416).

Over two-thirds of patients were admitted to ICU postoperatively (68.7%; 345/502). Of these admissions, 26.1% (87/333) were unplanned. The percentage of patients with postoperative ICU admission ranged from 61.5% to 79.1% across the 10-year audit period (Figure 21).

Figure 21: Postoperative admissions to ICU, 2010–20 (n=502*)



ICU = intensive care unit
*Data missing n=2 (0.4%)
Reference: Appendix data table 20.

Surgeons felt that 2.5% of patients (15/472) should have been admitted to ICU but were not. Assessors also suggested that 15.0% would have benefited from admission to either a high dependency unit (HDU) or ICU (7 patients to HDU, 1 patient to ICU and 7 patients to either ICU or HDU).

4.6.8 Patients with deep vein thrombosis prophylaxis

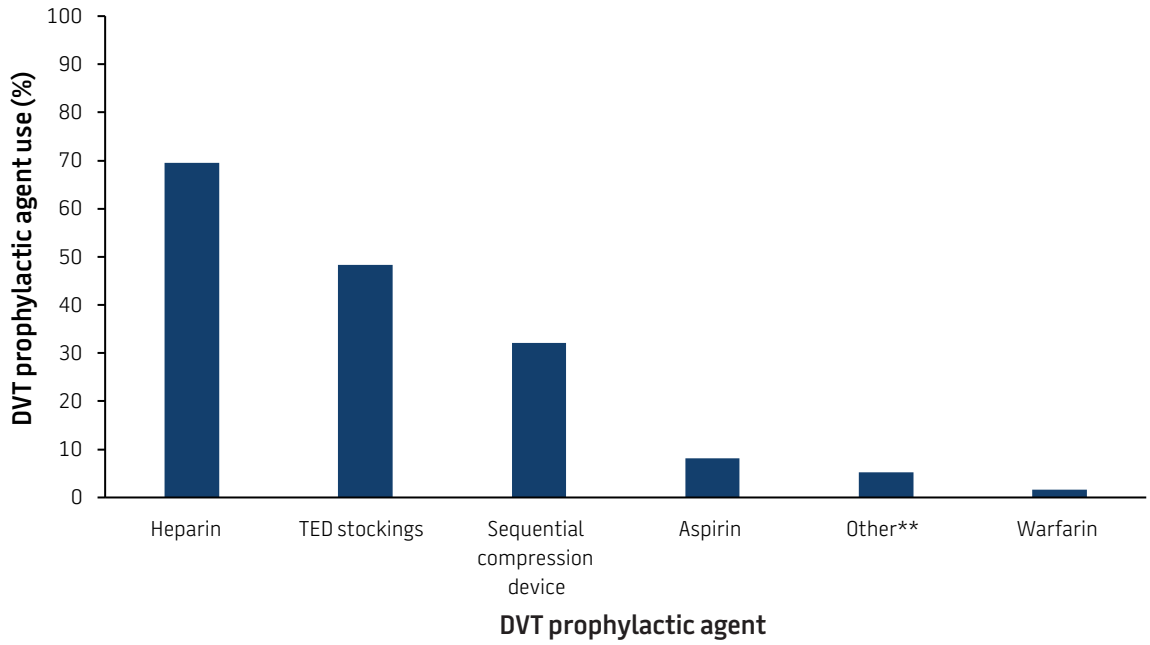
Deep vein thrombosis (DVT) prophylaxis may be used for patients regardless of whether they have an operation. Surgeons document any DVT prophylaxis used, and assessors comment on the appropriateness of DVT prophylaxis usage.

Surgeons provided DVT prophylaxis to 76.7% of patients (473/617). Of the patients who did not receive DVT prophylaxis, surgeons made an active decision not to use any prophylactic treatment (25.0%, 36/144), considered prophylactic treatment inappropriate (56.9%, 82/144) or did not consider the use of prophylaxis (4.9%; 7/144). Data were missing for 19 patients regarding appropriateness of withholding prophylactic treatment (13.2%; 19/144).

Generally, assessors agreed with the surgeon's decision regarding DVT prophylaxis. Assessors agreed with surgeons that the decision not to provide DVT prophylaxis was appropriate for 73.3% of patients (99/135). One assessor considered that the decision to not provide DVT prophylaxis had been inappropriate for 2.2% of patients. (3/135). Data were missing from assessors for nine patients.

Heparin was the most frequently provided DVT prophylactic agent to all patients (Figure 22).

Figure 22: Type of DVT prophylaxis used, all patients, 2010–20 (n=617*)



DVT = deep vein thrombosis; TED = thrombo-embolus deterrent
*Data missing n=24 (3.7%)
**Other includes Clexane (including renal dose), enoxaparin, clopidogrel, rivaroxaban, Clexane and Xarelto, inferior vena cava filter and dual antiplatelet therapy
Appendix data table 21.

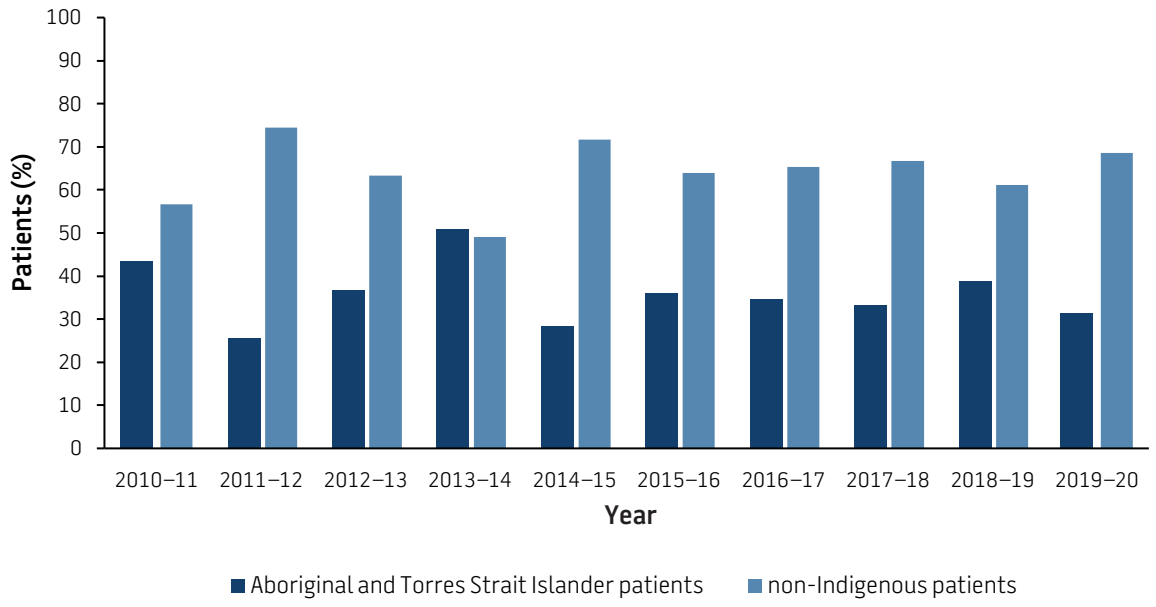
5 RESULTS: ABORIGINAL AND TORRES STRAIT ISLANDER PATIENTS

NTASM prioritises research on the health of Aboriginal and Torres Strait Islander people. The recently published RACS Indigenous Health position paper acknowledges that Aboriginal and Torres Strait Islander people experience poorer health outcomes compared to non-Indigenous people in Australia (3). This is despite NTASM data showing that surgical care between the two groups is comparable (16). The position paper reaffirms the College's commitment to improving health outcomes for Aboriginal and Torres Strait Islander people. The following section of this report compares characteristics and clinical outcomes of Aboriginal and Torres Strait Islander patients with those of non-Indigenous patients.

5.1 Overview

Aboriginal and Torres Strait Islander people comprise 36.0% (231/641) of NTASM patients. The number of Aboriginal and Torres Strait Islander people admitted to NT hospitals has remained similar across the 10 years of the audit (Figure 23).

Figure 23: Aboriginal and Torres Strait Islander NTASM patients and non-Indigenous patients, 2010–20 (n=641)



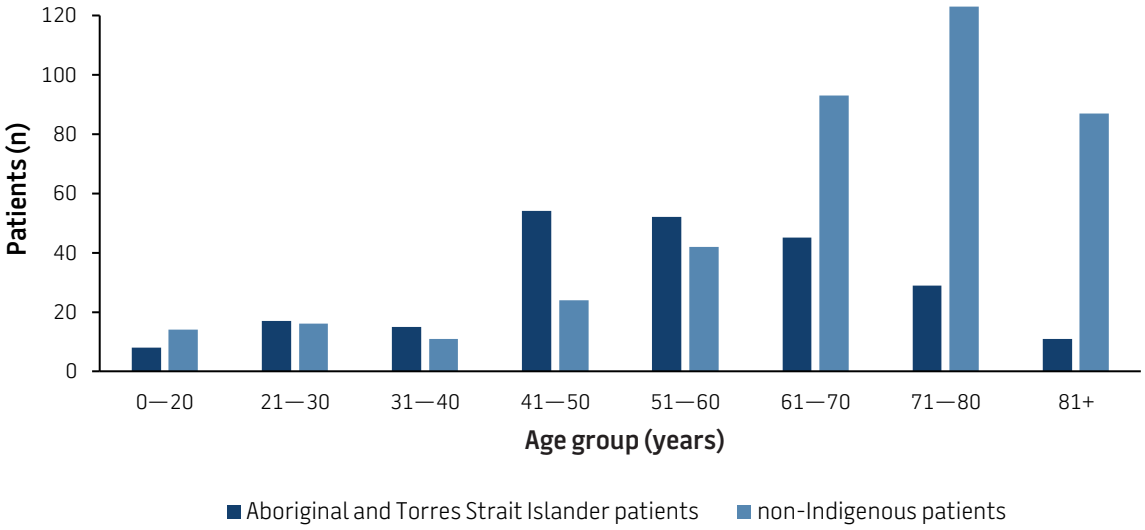
Aboriginal and Torres Strait Islander patients (n=231) and non-Indigenous patients (n=410)
Reference: Appendix data table 22.

5.2 Patient characteristics

5.2.1 Patient age

Aboriginal and Torres Strait Islander patients were younger than non-Indigenous patients (Figure 24).

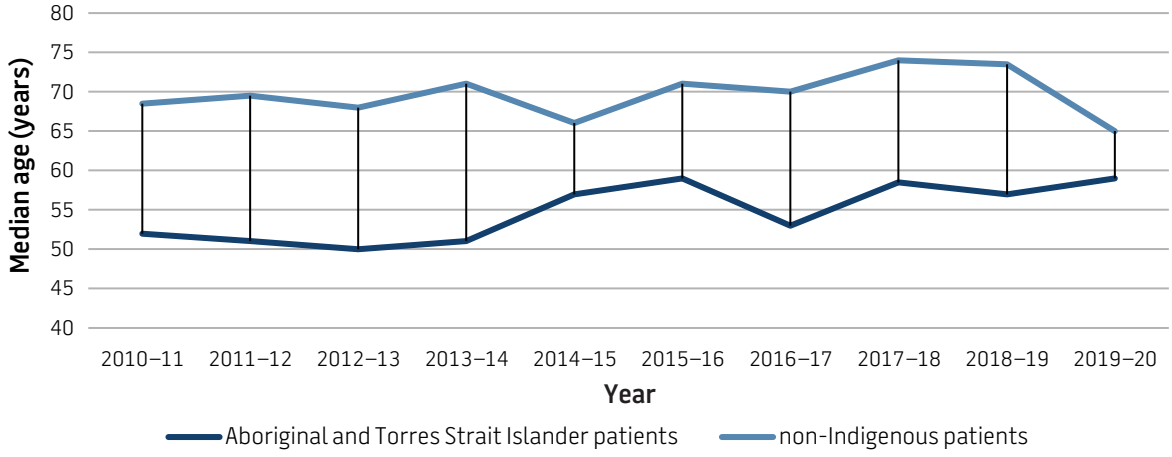
Figure 24: Aboriginal and Torres Strait Islander patients and non-Indigenous patients by age group, 2010–20 (n=641)



Aboriginal and Torres Strait Islander patients (n=231) and non-Indigenous patients (n=410)
Reference: Appendix data table 23.

Across the 10-year reporting period, the median age of Aboriginal and Torres Strait Islander patients was 53 years (IQR 44–66 years), and the median age of non-Indigenous patients was 70 years (IQR 60–78 years). Except for audit years 2014–15 and 2019–20, the difference in median ages is 16 to 20 years. This indicates that Aboriginal and Torres Strait Islander surgical patients are dying at a much younger age than non-Indigenous surgical patients (Figure 25).

Figure 25: Median age of Aboriginal and Torres Strait Islander patients and non-Indigenous patients, 2010–20 (n=641)



Aboriginal and Torres Strait Islander patients (n=231) and non-Indigenous patients (n=410)

5.2.2 Patient sex

Male and female Aboriginal and Torres Strait Islander patients were present in similar proportions (51.9% males, 48.1% females), in contrast with the proportions of non-Indigenous patients (67.6% males, 32.4% females) (Table 10).

Table 10: Sex of Aboriginal and Torres Strait Islander patients and non-Indigenous patients, 2010–20 (n=641)

	Male n=397	Female n=244	Total n=641
Aboriginal and Torres Strait Islander patients	120 (51.9%)	111 (48.1%)	231 (100%)
non-Indigenous patients	277 (67.6%)	133 (32.4%)	410 (100%)

5.2.3 Patients with comorbidities

The proportion of Aboriginal and Torres Strait Islander patients with comorbidities (83.5%; 192/230) was similar to the proportion of non-Indigenous patients with comorbidities (82.4%; 338/410) (Table 11).

Table 11: Presence of comorbidities in Aboriginal and Torres Strait Islander patients and non-Indigenous patients, 2010–20 (n=640*)

	Comorbidities n=530	No comorbidities n=110	Total n=640
Aboriginal and Torres Strait Islander patients	192 (83.5%)	38 (16.5%)	230 (100%)
Non-Indigenous patients	338 (82.4%)	72 (17.6%)	410 (100%)

*Data missing n=1 (0.2%).

Overall, there was no difference in the number of comorbidities between Aboriginal and Torres Strait Islander patients and non-Indigenous patients (Table 12) .

Table 12: Number of comorbidities in Aboriginal and Torres Strait Islander patients and non-Indigenous patients, 2010–20 (n=640*)

Number of comorbidities	Aboriginal and Torres Strait Islander patients n=230*	non-Indigenous patients n=410
None	38 (16.5%)	72 (18.0%)
1	17 (17.4%)	63 (15.4%)
2	38 (16.5%)	63 (15.4%)
3	41 (17.8%)	91 (22.2%)
4	47 (20.4%)	61 (14.9%)
5	33 (14.3%)	42 (10.2%)
6 or more	16 (7.0%)	16 (3.9%)

*Data missing n=1 (0.2%)

Aboriginal and Torres Strait Islander patients were more likely to have renal disease, diabetes, hepatic disease and 'other' comorbidities than were non-Indigenous patients (Table 13).

Table 13: Types of comorbidities in Aboriginal and Torres Strait Islander patients and non-Indigenous patients, 2010–20 (n=640)**

	Aboriginal and Torres Strait Islander patients n=230**	non-Indigenous patients n=410	Risk ratios (95% CI)
Cardiovascular disease	122 (52.8%)	207 (50.5%)	1.10 (0.66–1.26)
Renal	110 (47.6%)	76 (18.5%)	4.00* (2.79–5.72)
Diabetes	94 (40.7%)	79 (19.3%)	2.87* (2.01–4.12)
Other***	93 (40.3%)	122 (29.8%)	1.59* (1.14–2.23)
Hepatic	68 (29.4%)	47 (11.5%)	3.22* (2.13–4.88)
Respiratory	65 (28.1%)	119 (29.0%)	0.96 (0.67–1.37)
Age	46 (19.9%)	156 (38.0%)	0.40 (0.28–0.59)
Neurological	38 (16.5%)	66 (16.1%)	1.03 (0.66–1.59)
Advanced malignancy	23 (10.0%)	102 (24.9%)	0.33 (0.21–0.54)
Obesity	13 (5.6%)	42 (10.2%)	0.52 (0.27–1.00)

*Significant result
**Data missing n=1 (0.2%)
***Other includes advanced frailty, smoking, malnutrition, deep vein thrombosis, hepatitis, end stage liver disease, hypertension, peripheral vascular disease, immunosuppression, sepsis, anticoagulation therapy
95% CI = 95% confidence interval
Reference group = non-Indigenous patients
Risk ratios = calculated to assess the risk of an event in one group versus the risk of the event in the reference group.

5.2.4 Patient alcohol use

In NTASM, Aboriginal and Torres Strait Islander patients were more likely to have alcohol consumption listed as a comorbidity that increased risk of death than were non-Indigenous patients (Table 14).

Table 14: Aboriginal and Torres Strait Islander patients and non-Indigenous patients with alcohol consumption as a comorbidity, 2010–20 (n=641)

Aboriginal and Torres Strait Islander patients (n=231)	non-Indigenous patients (n=410)	Risk ratios (95% CI)
35 (15.2%)	24 (5.9%)	2.87*(1.66–4.96)

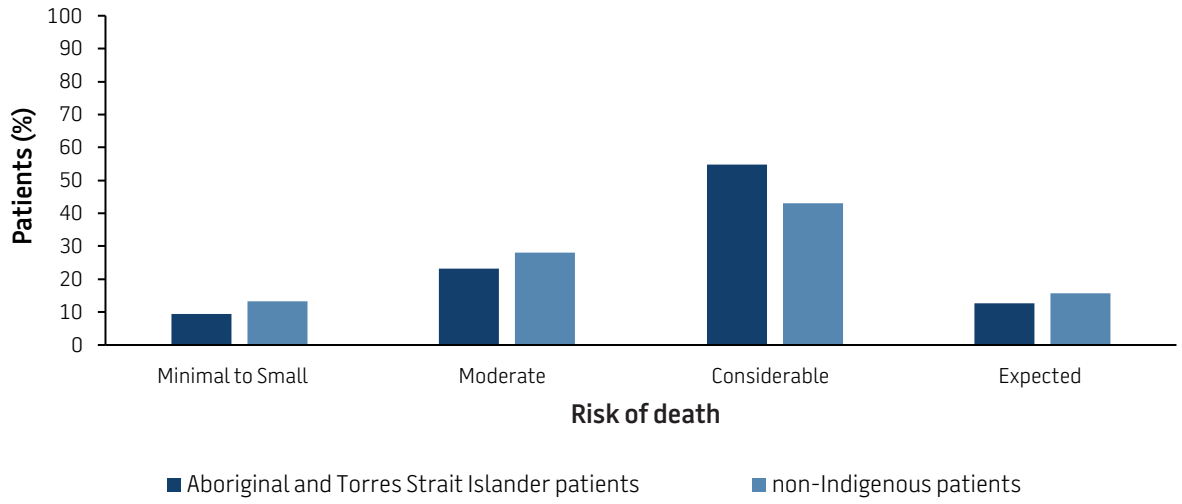
95% CI = 95% confidence interval
Reference group = non-Indigenous patients
*Significant result
Risk ratios = calculated to assess the risk of an event in one group versus the risk of the event in the reference group.

5.3 Patients who had operations

5.3.1 Patient preoperative risk of death

In the category of 'considerable' preoperative risk of death, Aboriginal and Torres Strait Islander patients had a higher risk than non-Indigenous patients (Figure 26). In all other categories, non-Indigenous patients had a higher preoperative risk of death, perhaps because these patients are older, with age listed as a comorbidity.

Figure 26: Preoperative risk of death for Aboriginal and Torres Strait Islander patients and non Indigenous patients, 2010–20 (n=504*)



*Data missing n=5 (1.0%)
Reference: Appendix data table 24

5.3.2 Operation management

According to both surgeons and assessors, there was no statistical difference in areas of operation management that required improvement for Aboriginal and Torres Strait Islander patients and non-Indigenous patients who had at least one operation (Table 15 and Table 16).

Table 15: Surgeon-identified operation management areas requiring improvement in Aboriginal and Torres Strait Islander patients and non-Indigenous patients, 2010–20 (n=504)

	Aboriginal and Torres Strait Islander patients (n=183)	non-Indigenous patients (n=321)	Risk ratios (95% CI)
Preoperative management	13/180 (7.2%)	25/316 (7.9%)	0.91 (0.45–1.82)
Decision to operate	14/181 (7.7%)	25/318 (7.9%)	0.98 (0.50–1.95)
Choice of operation	4/180 (2.2%)	11/316 (3.5%)	0.63 (0.20–2.01)
Timing of operation*	16/180 (8.8%)	21/316 (6.7%)	1.37 (0.70–2.70)
Intraoperative management	6/181 (3.3%)	19/317 (6.0%)	0.54 (0.21–1.37)
Postoperative care	8/178 (4.5%)	16/315 (5.1%)	0.88 (0.37–2.10)

95% CI = 95% confidence interval
Reference group = non-Indigenous patients
*For example, if timing of operation was too late, too soon, or at the wrong time of day
Risk ratios = calculated to assess the risk of an event in one group versus the risk of the event in the reference group.

Table 16: Assessor-identified operation management areas requiring improvement in Aboriginal and Torres Strait Islander patients and non-Indigenous patients, 2010–20 (n=504)

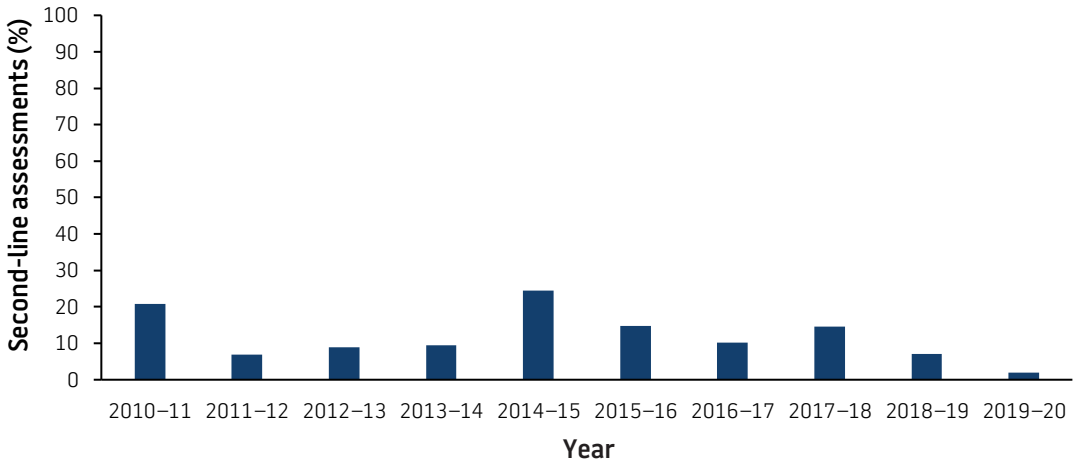
	Aboriginal and Torres Strait Islander patients (n=183)	non-Indigenous patients (n=321)	Risk ratios (95% CI)
Preoperative management	14/180 (7.8%)	39/314 (12.4%)	0.59 (0.31–1.13)
Decision to operate	9/180 (7.2%)	22/316 (7.0%)	0.70 (0.32–1.56)
Choice of operation	7/179 (3.9%)	16/315 (5.1%)	0.76 (0.31–1.89)
Timing of operation*	11/180 (6.1%)	26/314 (8.3%)	0.72 (0.35–1.50)
Intraoperative management	6/180 (3.3%)	17/312 (5.4%)	0.60 (0.23–1.55)
Postoperative care	8/178 (4.5%)	21/315 (6.7%)	0.66 (0.29–1.52)

95% CI = 95% confidence interval
Reference group = non-Indigenous patients
*For example, if timing of operation was too late, too soon, or at the wrong time of day
Risk ratios = calculated to assess the risk of an event in one group versus the risk of the event in the reference group.

6 OUTCOMES OF PEER REVIEW ASSESSMENTS

An FLA was completed for all 641 patient deaths included in this report and an SLA was completed for 76 deaths (11.9%; 76/641). The number of SLAs has fluctuated across the 10-year reporting period (Figure 27). Of the SLAS conducted, 26.0% (20/76) were requested because of a lack of clinical information in the FLA (data not shown).

Figure 27: Completed second-line assessments, 2010–20 (n=641)



Reference: Appendix data table 25

General surgeons completed two-thirds of all SLAs (Table 17). Overall, just under 90% of SLAs were completed by general surgeons, orthopaedic surgeons or vascular surgeons.

Table 17: Completed second-line assessments by surgical speciality, 2010–20 (n=76)

	Frequency (%)
General Surgery	50 (65.8%)
Orthopaedic Surgery	9 (11.8%)
Vascular Surgery	9 (11.8%)
Other*	8 (10.5%)

*Other includes specialties with fewer than 5 patient cases: Oral/Maxillofacial, Urology, Otolaryngology Head and Neck and Ophthalmology

6.1 Assessor-identified clinical management issues

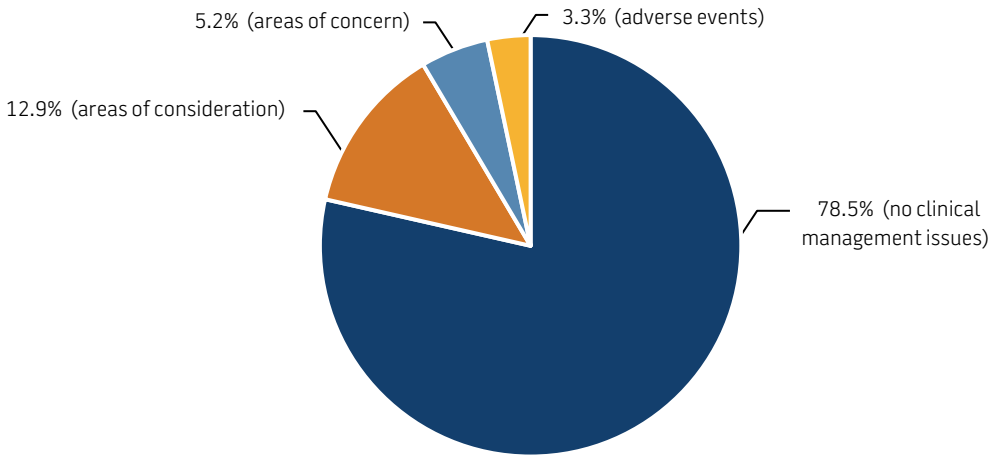
Assessors may report more than one clinical management issue (CMI) per patient. This NTASM report includes only one CMI per patient (the most severe) and this is reported from the highest-level assessor (i.e. this would be the second-line assessor if an SLA is performed, otherwise it would be the first-line assessor).

A CMI may be classed as an area of consideration (lowest level of concern), an area of concern or an adverse event (most serious level of concern). Assessors reported no CMIs for most patients (78.5%; 498/634). CMIs occurred for 136 patients (21.5%; 136/634).

Figure 28 shows the distribution of CMIs reported by assessors:

- 12.9% were areas of consideration (82/634)
- 5.2% were areas of concern (33/634)
- 3.3% were adverse events (21/634).

Figure 28: Assessor-identified clinical management issues, 2010–20 (n=634*)



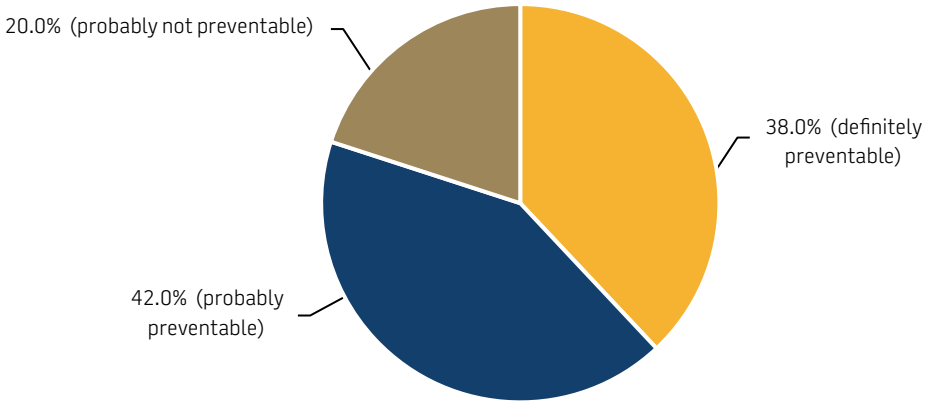
*Data missing n=7 (1.1%)

6.2 Preventable clinical management issues

Assessors determine whether CMIs were preventable. Of the patients with an identified CMI, more than half the patients (56.3%, 71/126) had a CMI considered to be preventable. (Note: assessor CMI preventability data was missing for 10 patients). Of these, 50 patients had experienced a CMI that an assessor classed as serious (either an area of concern or an adverse event).

Assessors considered that 80.0% of the serious CMIs (40/50) were definitely or probably preventable (Figure 29).

Figure 29: Assessor-identified preventable serious clinical management issues, 2010–20 (n=50)



Data missing n=3 (5.7%)
Reference: Appendix data table 26

Of the 40 patients who had a preventable serious CMI, 90.0% were in the charge of a general surgeon or a vascular surgeon (Table 18).

Table 18: Surgical specialty for patients with a preventable serious clinical management issue, 2010–20 (n=40)

	Frequency (%)
General surgery	28 (70.0%)
Vascular surgery	8 (20.0%)
Other*	4 (10.0%)

*Other includes Orthopaedic surgery and Urology.

Assessors also determine whether the preventable serious CMI impacted patient outcome. For 90.0% of patients, the preventable serious CMI either possibly or directly impacted the patient's outcome (Table 19).

Table 19: Impact of preventable serious clinical management issue on patient outcome, 2010–20 (n=40)

	Frequency (%)
May have contributed to death	25 (62.5%)
Caused death of patient otherwise expected to survive	11 (27.5%)
Made no difference	4 (10.0%)

Assessors indicate which clinical team or hospital they believe the CMI was associated with. Over 90% of the preventable serious issues were deemed to be associated with the audited surgical team or another clinical team (Table 20).

Table 20: Clinical team or facility associated with the preventable serious clinical management issue, 2010–20 (n=38*)

	Frequency (%)
Audited surgical team	22 (57.9%)
Another clinical team	13 (34.2%)
Hospital	1 (2.6%)
Other**	2 (5.3%)

*Data missing n=2 (5.0%)
**Other includes radiology and emergency care

7 NT BASELINE INPATIENT DATA

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. This baseline data is used to make comparisons with data from audit patients admitted during the same period.

A total of 18,817 baseline patients were admitted between January and December 2019. Obstetrics patients and those having dental or allied health procedures (n=2,269) were excluded from the comparison. The remaining 16,436 patients had a total of 20,033 admissions, with 2,818 patients having 3,597 readmissions (ranging from 1 readmission [n=2,239 patients] to 12 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 21. 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 did baseline patients. The proportion of NTASM patients with comorbidities was nearly double that of baseline patients with comorbidities. The greatest differences were seen in the proportion of patients with CVD, renal disease, respiratory disease, diabetes and hepatic disease. 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. More NTASM patients had trauma, longer hospital stays and higher ASA classifications (ASA 4–6) than did baseline patients.

Table 21: Characteristics of NT baseline patients and NTASM patients (January to December 2019)

	NT baseline patients (n=16,436)	NTASM patients (n=79)
Sex		
Male	7,604 (46.3%)	49 (62.0%)
Female	8,832 (53.7%)	30 (38.0%)
Admission status		
Emergency	8,431 (51.3%)	70 (88.6%)
Elective	5,879 (35.8%)	9 (11.4%)
Not assigned	2,126 (12.9%)	0 (0.0%)
Indigenous status		
Aboriginal and Torres Strait Islander patients	6,070 (36.9%)	24 (30.4%)
non-Indigenous patients	10,363 (63.1%)	55 (69.6%)
Comorbidities present*	6,672 (40.6%)	62 (78.5%)
Diabetes	1,866 (11.4%)	16 (20.3%)
Cardiovascular disease	370 (2.3%)	40 (50.6%)
Renal	725 (4.4%)	24 (30.4%)
Obesity	593 (3.6%)	5 (6.3%)
Respiratory	327 (2.0%)	22 (27.8%)
Hepatic disease	374 (2.3%)	12 (15.2%)
Alcoholic hepatic disease	56 (0.3%)	—
Dementia**	75 (0.5%)	—
Smoking	4,415 (26.9%)	—
History of alcohol use	544 (3.3%)	6 (7.6%)
Trauma	1,282 (7.8%)	17 (21.5%)
Length of hospital stay, median days (IQR)	1 (1–3)	11 (4–28)
ASA class		
Class 1	391 (2.4%)	—
Class 2	4,031 (24.5%)	—
Class 3	7,068 (43.0%)	18 (22.8%)
Class 4	316 (1.9%)	33 (41.8%)
Class 5	13 9 (0.1%)	10 (12.7%)
Class 6	0 (0.0%)	—
Unknown/not stated/missing	2,247 (13.7%)	11 (13.9%)

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 were fewer than previous years. This has impacted on the proportion of patients with comorbidities.
**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.

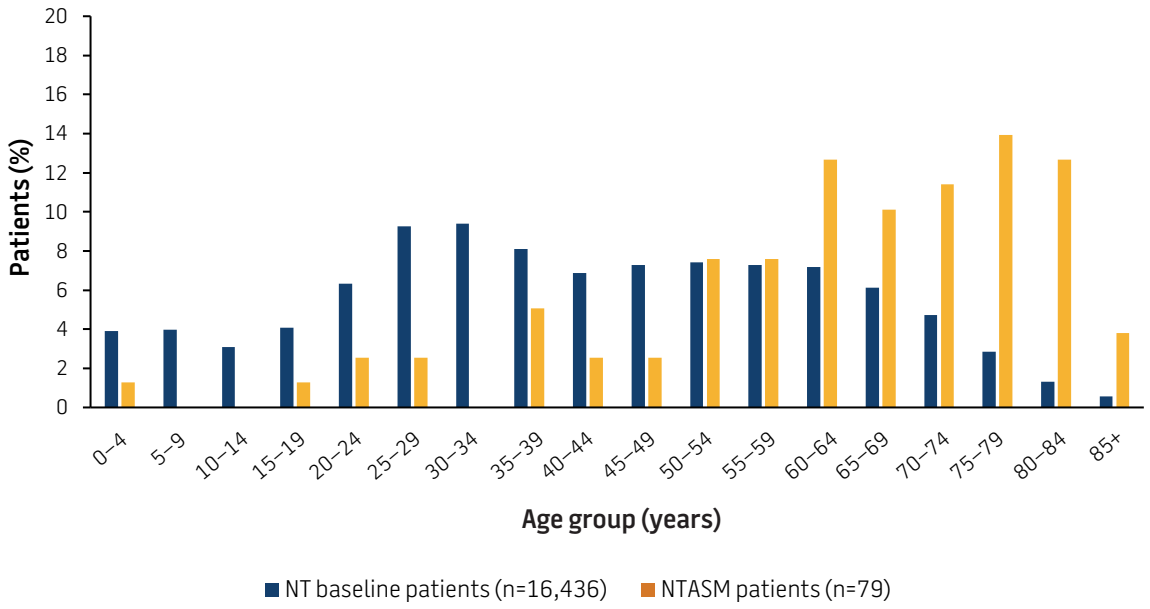
A lower proportion of NTASM patients had no comorbidities. Less than 1.0% of NT baseline patients had five or more comorbidities whereas 20.3% of NTASM patients had five or more comorbidities (Table 22).

Table 22: Frequency of comorbidities in NT baseline patients and NTASM patients (January to December 2019)

Number of comorbidities	NT baseline patients (n=16,436)	NTASM patients (n=79)
0	9,764 (59.4%)	18 (22.8%)
1	4,759 (71.3%)	8 (10.1%)
2	1,365 (20.5%)	13 (16.5%)
3	392 (5.9%)	14 (17.7%)
4	111 (1.7%)	10 (12.7%)
5	36 (0.5%)	6 (7.6%)
6+	9 (0.1%)	10 (12.7%)

In general, NT baseline patients were younger than NTASM patients (Figure 30).

Figure 30: NT baseline and NTASM patients by age group, January to December 2019



Reference: Appendix data table 27

8 REFERENCES

1: Royal Australasian College of Surgeons. Australian and New Zealand Audit of Surgical Mortality National Report 2016. Adelaide Royal Australasian College of Surgeons; 2017. Available from: https://www.surgeons.org/-/media/Project/RACS/surgeons-org/files/surgical-mortality-audits/anzasm-reports/2017-10-05_rpt_racs_anzasm_national_report_2016.pdf?rev=84d67d943ed14d05a502f9509adbbf3b&hash=B44712AAF2D2D0DE36985EE6F6846C8F

2: Australian Bureau of Statistics. 3238.0.55.001-Estimates of Aboriginal and Torres Strait Islander Australians. 2018 31 August. Available from http://www.abs.gov.au/ausstats/abs@.nsf/mf/3238.0.55.001

3: Royal Australasian College of Surgeons. Indigenous Health Position Paper June 2020. Available from: https://www.surgeons.org/en/News/News/Updated-Indigenous-Health-position-paper

4: Australian Bureau of Statistics. National Health Survey: First results (2017–18). 2018. Available from: https://www.abs.gov.au/statistics/health/health-conditions-and-risks/national-health-survey-first-results/latest-release

5: Surgeons reaffirm support for new NT Liquor Licensing Act. The National Tribune. 2019, 16 August. Available from: https://www.nationaltribune.com.au/surgeons-reaffirm-support-for-new-nt-liquor-licensing-act/

6: Yoong SL, Tursan d'Espaignet E, Wiggers J, St Claire S, Mellin-Olsen J, Grady A, et al. WHO tobacco knowledge summaries: tobacco and postsurgical outcomes. Licence: CC BY-NC-SA 3.0 IGO. Geneva: World Health Organization; 2020. Available from: https://escholarship.org/content/qt13388068/qt13388068_noSplash_420f052cb3d06b4b74d76e0280c2dac9.pdf?t=qjy8uj

7: Australian Institute of Health and Welfare. Australian hospital peer groups. Health services series no. 66. Cat. no. HSE 170. Canberra: AIHW; 2015. Available from: https://www.aihw.gov.au/reports/hospitals/australian-hospital-peer-groups/summary

8. Royal Australasian College of Surgeons. New Fellows enjoy rural placement opportunities. Surgical News [Internet]. 2020; 21(5):[44–5 pp.]. Available from: https://www.surgeons.org/-/media/Project/RACS/surgeons-org/files/surgical-news/Surgical-News-volume-21-issue-5.pdf?rev=e533697c82d042278d005688f883a899&hash=BAB0E9466F4AD49C33C06DCFA132A640

9: Royal Australasian College of Surgeons Indigenous Health Committee. Reconciliation Action Plan: May 2020–May 2021. East Melbourne, Victoria: Royal Australasian College of Surgeons; 2020. Available from: https://www.surgeons.org/-/media/Project/RACS/surgeons-org/files/interest-groups-sections/indigenous-health/RACSInnovateReconcilliationActionPlan20202022.pdf?rev=a5874bfafa8a4579bbcbf986f77e898c&hash=0960A50B04B2F8338F52F0064C195089

10: Australian Bureau of Statistics. Regional population by age and sex. 2019. Available from: https://www.abs.gov.au/statistics/people/population/regional-population-age-and-sex/latest-release

11: McDermott KM, Brearley MB, Hudson SM, Ward L, Read DJ. Characteristics of trauma mortality in the Northern Territory, Australia. *Inj Epidemiol.* 2017;4(1):15. Available from: https://injepijournal.biomedcentral.com/articles/10.1186/s40621-017-0111-1

12: Thomas M, Jameson C. Facial trauma and postinterventional quality of life in the Northern Territory, Australia. *Int J Oral Maxillofac Surg.* 2007;36(11):1081. Available from: https://www.ijoms.com/article/S0901-5027(07)00769-2/fulltext#relatedArticles

13: North J, Blackford F, Wall D, Allen J, Faint S, Ware R, et al. Analysis of the causes and effects of delay before diagnosis using surgical mortality data. *Br J Surg.* 2013;100(3):419-25. Available from: https://bjssjournals.onlinelibrary.wiley.com/doi/abs/10.1002/bjs.8986

14: American Society of Anesthesiologists. ASA physical status classification system. Developed by ASA House of Delegates/Executive Committee [original approval 15 October 2014; updated 23 October 2019]. Available from: https://www.asahq.org/standards-and-guidelines/asa-physical-status-classification-system

15: Lefaivre K, Macadam S, Davidson D, Gandhi R, Chan H, Broekhuyse H. Length of stay, mortality, morbidity and delay to surgery in hip fractures. *J Bone Joint Surg Br.* 2009;91(7):922-7. Available from: https://online.boneandjoint.org.uk/doi/full/10.1302/0301-620X.91B7.22446

16: Treacy PJ, North JB, Rey-Conde T, Allen J, Ware RS. Outcomes from the Northern Territory Audit of Surgical Mortality: Aboriginal deaths. *ANZ J Surg.* 2015;85(1-2):11-5. Available from: https://onlinelibrary.wiley.com/doi/epdf/10.1111/ans.12896

APPENDIX 1: DATA TABLES

- Denominators in this report sometimes differ because not all questions were answered for each patient.
- Data presented in this report have been collected between July 2010 and June 2020.

Appendix data table 1: Status of audit completion, 2010–20 (n=733)

	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Audit process completed	53 91.4%	43 81.1%	68 89.5%	53 84.1%	53 88.3%	61 98.4%	78 88.6%	96 90.6%	85 89.5%	51 70.8%	641 87.4%
Excluded – Terminal care	4 6.9%	7 13.2%	6 7.9%	8 12.7%	5 8.3%	0 0.0%	6 6.8%	7 6.6%	4 4.2%	7 9.7%	54 7.4%
Excluded – Error	1 1.7%	3 5.7%	2 2.6%	2 3.2%	2 3.3%	1 1.6%	4 4.5%	3 2.8%	2 2.1%	0 0.0%	20 2.7%
Surgical data pending	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	11 15.3%	11 1.5%
FLA pending	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	2 2.1%	1 1.4%	3 0.4%
SLA pending*	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	2 2.1%	2 2.8%	4 0.6%
Notification of deaths	58 100%	53 100%	76 100%	63 100%	60 100%	62 100%	88 100%	106 100%	95 100%	72 100%	733 100%

FLA = first-line assessment; SLA = second-line assessment
*SLA pending and medical record pending combined.

Appendix data table 2: NTASM patient admission by surgical specialty, 2010–20 (n=641)

	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
General Surgery	41 77.4%	36 83.7%	57 83.8%	40 75.5%	42 79.2%	46 75.4%	61 78.2%	60 62.5%	52 61.2%	31 60.8%	466 72.7%
Orthopaedic Surgery	6 11.3%	3 7.0%	6 8.8%	8 15.1%	4 7.5%	7 11.5%	7 9.0%	18 18.8%	8 9.4%	6 11.8%	73 11.4%
Vascular Surgery	5 9.4%	3 7.0%	5 7.4%	1 1.9%	2 3.8%	5 8.2%	5 6.4%	4 4.2%	4 4.7%	2 3.9%	36 5.6%
Neurosurgery	1 1.9%	1 2.3%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	10 10.4%	12 14.1%	8 15.7%	32 5.0%
Otolaryngology, Head and Neck	0 0.0%	0 0.0%	0 0.0%	2 3.8%	3 5.7%	2 3.3%	0 0.0%	2 2.1%	4 4.7%	1 2.0%	14 2.2%
Urology	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	1 1.6%	3 3.8%	1 1.0%	2 2.4%	2 3.9%	9 1.4%
Oral/ Maxillofacial	0 0.0%	0 0.0%	0 0.0%	2 3.8%	2 3.8%	0 0.0%	0 0.0%	1 1.0%	0 0.0%	0 0.0%	5 0.8%
Ophthalmology	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	2 2.6%	0 0.0%	0 0.0%	0 0.0%	2 0.3%
Plastic Surgery	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	1 1.2%	1 2.0%	2 0.3%
Obstetrics and Gynaecology	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	2 2.4%	0 0.0%	2 0.3%
Total	53 100%	43 100%	68 100%	53 100%	53 100%	61 100%	78 100%	96 100%	85 100%	51 100%	641 100%

Appendix data table 3: Consultant surgeon presence in theatre, 2010–20 (n=725*)

	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Consultant operating	50 64.9%	28 57.1%	44 71.0%	31 51.7%	51 52.0%	52 74.3%	67 63.8%	76 57.6%	67 54.9%	29 58.0%	495 60.0%
Consultant assisting	7 9.1%	5 10.2%	7 11.3%	10 16.7%	15 15.3%	5 7.1%	15 14.3%	13 9.8%	20 16.4%	6 12.0%	103 12.5%
Consultant in theatre**	13 16.9%	12 24.5%	16 25.8%	11 18.3%	11 11.2%	9 12.9%	15 14.3%	15 11.4%	18 14.8%	7 14.0%	127 15.4%
Total	70 90.9%	45 91.8%	67 108.1%	52 86.7%	77 78.6%	66 94.3%	97 92.4%	104 78.8%	105 86.1%	42 84.0%	725 87.9%

*Data not provided n=100 (12.1%)

**In theatre = surgeon may have performed, assisted with, or supervised the operation (not specified)

Appendix data table 4: Elective and emergency admissions, 2010–20 (n=632*)

	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Elective admission	4 8.0%	4 9.5%	4 6.2%	3 5.8%	11 21.2%	2 3.3%	2 2.6%	9 9.4%	8 9.4%	6 11.8%	53 8.4%
Emergency admission	46 92.0%	38 90.5%	61 93.8%	49 94.2%	41 78.8%	59 96.7%	76 97.4%	87 90.6%	77 90.6%	45 88.2%	579 91.6%
Total	50 100%	42 100%	65 100%	52 100%	52 100%	61 100%	78 100%	96 100%	85 100%	51 100%	632 100%

*Data missing n=9 (1.4%)

Appendix data table 5: Patients transferred to another hospital, 2010–20 (n=623*)

	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Transferred	8 15.4%	5 11.6%	8 12.3%	9 17.3%	7 14.0%	2 3.4%	14 17.9%	15 16.1%	24 30.0%	10 19.6%	10 26.4%
Not transferred	44 84.6%	38 88.4%	57 87.7%	43 82.7%	43 86.0%	57 96.6%	64 82.1%	78 83.9%	56 70.0%	41 80.4%	521 83.6%
Total	52 100%	43 100%	65 100%	52 100%	50 100%	59 100%	78 100%	93 100%	80 100%	51 100%	623 100%

*Data missing n=8 (2.8%)

Appendix data table 6: Patients by age group and sex, 2010–20 (n=641)

Age group, years	Male n=397	Female n=244	Total n=641
0–10	4 (57.1%)	3 (42.9%)	7 (1.1%)
11–20	10 (66.7%)	5 (33.3%)	15 (2.3%)
21–30	24 (72.7%)	9 (27.3%)	33 (5.1%)
31–40	15 (57.7%)	11 (42.3%)	26 (4.1%)
41–50	43 (55.1%)	35 (44.9%)	78 (12.2%)
51–60	50 (53.2%)	44 (46.8%)	94 (14.7%)
61–70	92 (66.7%)	46 (33.3%)	138 (21.5%)
71–80	108 (71.1%)	44 (28.9%)	152 (23.7%)
81–90	43 (54.4%)	36 (45.6%)	79 (12.3%)
91+	8 (42.1%)	11 (57.9%)	19 (3.0%)

Appendix data table 7: Patients by sex, 2010–20 (n=641)

	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Male	40 75.5%	29 67.4%	39 57.4%	31 58.5%	35 66.0%	44 72.1%	50 64.1%	51 53.1%	51 60.0%	27 52.9%	397 61.9%
Female	13 24.5%	14 32.6%	29 42.6%	22 41.5%	18 34.0%	17 27.9%	28 35.9%	45 46.9%	34 40.0%	24 47.1%	244 38.1%
Total	53 100%	43 100%	68 100%	53 100%	53 100%	61 100%	78 100%	96 100%	85 100%	51 100%	641 100%

Appendix data table 8: Presence of comorbidities in all patients, 2010–20 (n=640*)

	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Existing co-factor	38 73.1%	35 81.4%	53 77.9%	46 86.8%	44 83.0%	46 75.4%	68 87.2%	88 91.7%	73 85.9%	39 76.5%	530 82.8%
No existing co-factor	14 26.9%	8 18.6%	15 22.1%	7 13.2%	9 17.0%	15 24.6%	10 12.8%	8 8.3%	12 14.1%	12 23.5%	110 17.2%
Total	52 100%	43 100%	68 100%	53 100%	53 100%	61 100%	78 100%	96 100%	85 100%	51 100%	640 100%

*Data missing n=1 (0.2%)

Appendix data table 9: Types of comorbidities in all patients, 2010–20 (n=640*)

	Frequency (%)
Cardiovascular disease	329 (51.4%)
Other**	215 (33.6%)
Age	202 (31.6%)
Renal	186 (29.1%)
Respiratory	184 (28.8%)
Diabetes	173 (27.0%)
Hepatic	115 (18.0%)
Advanced malignancy	114 (17.8%)
Neurological	104 (16.3%)
Obesity	55 (8.6%)

*Data missing n=1 (0.2%)
**Alcohol abuse, anticoagulation therapy, arthritis, dementia/Alzheimer's disease, malignancy, malnutrition/cachexia, peripheral vascular disease, smoking, ischaemic heart disease.

Appendix data table 10: Presence of a clinically significant infection at the time of death, 2010–20 (n=572*)

	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Infection present	2 25.0%	19 55.9%	21 31.3%	19 38.0%	19 36.5%	20 32.8%	28 36.4%	29 30.5%	26 30.6%	15 29.4%	198 34.1%
No infection present	6 75.0%	15 44.1%	46 68.7%	31 62.0%	33 63.5%	41 67.2%	49 63.6%	66 69.5%	59 69.4%	36 70.6%	382 65.9%
Total	8 100%	34 100%	67 100%	50 100%	52 100%	61 100%	77 100%	95 100%	85 100%	51 100%	580 100%

Infection questions were included in NTASM from November 2011. Data from patients admitted prior to November 2011 are included here due to delays in notifications of deaths or surgeons completing the SCF, or surgeons providing additional information.
*Data missing n=61 (9.5%)

Appendix data table 11: Patients with a clinically significant infection at time of death, by timing of infection relative to admission, 2010–20 (n=193*)

	2010–2011	2011–2012	2012–2013	2013–2014	2014–2015	2015–2016	2016–2017	2017–2018	2018–2019	2019–2020	Total
Acquired before admission	1 50.0%	9 50.0%	16 80.0%	14 77.8%	7 36.8%	13 65.0%	17 60.7%	13 44.8%	17 65.4%	7 46.7%	114 58.5%
Acquired during admission	1 50.0%	9 50.0%	4 20.0%	4 22.2%	12 63.2%	7 35.0%	11 39.3%	16 55.2%	9 34.6%	8 53.3%	81 41.5%
Total	2 100%	18 100%	20 100%	18 100%	19 100%	20 100%	28 100%	29 100%	26 100%	15 100%	195 100%

Infection questions were included in NTASM from November 2011. Data from patients admitted prior to November 2011 are included here due to delays in notifications of deaths or surgeons completing the SCF, or surgeons providing additional information.
*Data missing n=5 (2.6%)

Appendix data table 12: Patients admitted due to trauma, 2010–20 (n=580*)

	2010–2011	2011–2012	2012–2013	2013–2014	2014–2015	2015–2016	2016–2017	2017–2018	2018–2019	2019–2020	Total
Trauma admission	5 55.6%	15 40.5%	17 25.0%	12 22.6%	14 26.9%	21 34.4%	16 20.8%	27 28.1%	17 20.0%	9 17.6%	153 26.0%
Not trauma admission	4 44.4%	20 54.1%	47 69.1%	40 75.5%	37 71.2%	40 65.6%	59 76.6%	69 71.9%	67 78.8%	42 82.4%	425 72.2%
Unknown	0 0.0%	2 5.4%	4 5.9%	1 1.9%	1 1.9%	0 0.0%	2 2.6%	0 0.0%	1 1.2%	0 0.0%	11 1.9%
Total	9 100%	37 100%	68 100%	53 100%	52 100%	61 100%	77 100%	96 100%	85 100%	51 100%	589 100%

Trauma questions were included in NTASM from November 2011. Data from patients admitted prior to November 2011 are included here due to delays in notifications of deaths or surgeons completing the SCF, or surgeons providing additional information.
*Data missing n=61 (11.3%)

Appendix data table 13: Locations where falls that caused trauma occurred, 2010–20 (n=90)

	Frequency (%)
At home	51 (56.7%)
At care facility	12 (13.3%)
Other*	15 (16.7%)
In hospital	11 (12.2%)
Unknown	1 (1.1%)

*Sport, recreation, farm, work

Appendix data table 14: Types of road traffic accidents that caused trauma, 2010–20 (n=37)

	Frequency (%)
Motor vehicle	23 (62.2%)
Motor bike	10 (27.0%)
Pedestrian	2 (5.4%)
Bicycle	1 (2.7%)
Other	1 (2.7%)

Appendix data table 15: Operation status in all patients, 2010–20 (n=641)

	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Operation	41 77.4%	32 74.4%	47 69.1%	42 79.2%	43 81.1%	45 73.8%	61 78.2%	84 87.5%	70 82.4%	39 76.5%	504 78.6%
No Operation	12 22.6%	11 25.6%	21 30.9%	11 20.8%	10 18.9%	16 26.2%	17 21.8%	12 12.5%	15 17.6%	12 23.5%	137 21.4%
Total	53 100%	43 100%	68 100%	53 100%	53 100%	61 100%	78 100%	96 100%	85 100%	51 100%	641 100%

Appendix data table 16: Delay in surgical diagnosis for patients who had an operation, 2010–20 (n=499*)

	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Delay	4 9.8%	3 9.4%	4 8.7%	6 14.3%	9 22.0%	3 6.8%	5 8.3%	6 7.1%	10 14.3%	3 7.7%	53 10.6%
No delay	37 90.2%	29 90.6%	42 91.3%	36 85.7%	32 78.0%	41 93.2%	55 91.7%	78 92.9%	60 85.7%	36 92.3%	446 89.4%
Total	41 100%	32 100%	46 100%	42 100%	41 100%	44 100%	60 100%	84 100%	70 100%	39 100%	499 100%

*Data missing n=5 (1.0%)

Appendix data table 17: Surgeon-assessed risk of death for patients who had an operation, 2010-20 (n=499*)

	Frequency (%)
Minimal risk of death	20 (4.0%)
Small risk of death	39 (7.8%)
Moderate risk of death	131 (26.3%)
Considerable risk of death	236 (47.3%)
Expected risk of death	73 (14.6%)

*Data missing n=5 (1.0%)

Appendix data table 18: ASA class assigned to patients who had an operation, 2010–20 (n=481*)

	Frequency (%)
ASA class 1	8 (1.7%)
ASA class 2	29 (6.0%)
ASA class 3	162 (33.7%)
ASA class 4	208 (43.2%)
ASA class 5	69 (14.3%)
ASA class 6	5 (1.0%)

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.
*Data missing n=23 (4.6% of patients who had an operation).

Appendix data table 19: Unplanned returns to theatre, 2010–20 (n=489*)

	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Unplanned return to theatre	9 23.1%	4 12.9%	10 23.8%	3 7.5%	12 27.9%	9 21.4%	14 23.3%	15 18.1%	12 17.1%	9 23.1%	97 19.8%
No unplanned return to theatre	30 76.9%	26 83.9%	32 76.2%	36 90.0%	31 72.1%	33 78.6%	46 76.7%	68 81.9%	58 82.9%	30 76.9%	390 79.8%
Unknown	0 0.0%	1 3.2%	0 0.0%	1 2.5%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	2 0.4%
Total	39 100%	31** 100%	42 100%	40** 100%	43 100%	42 100%	60 100%	83 100%	70 100%	39 100%	489 100%

*Data missing n=15 (3.0%).

Appendix data table 20: Postoperative ICU admissions, 2010–20 (n=502*)

	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Admitted to ICU	31 75.6%	23 71.9%	34 75.6%	26 61.9%	34 79.1%	30 66.7%	38 62.3%	55 65.5%	50 71.4%	24 61.5%	345 68.7%
Not admitted to ICU	10 24.4%	9 28.1%	11 24.4%	16 38.1%	9 20.9%	15 33.3%	23 37.7%	29 34.5%	20 28.6%	15 38.5%	157 31.3%
Total	41 100%	32 100%	45 100%	42 100%	43 100%	45 100%	61 100%	84 100%	70 100%	39 100%	502 100%

ICU = intensive care unit
*Data missing n=2 (0.4%)

Appendix data table 21: DVT prophylaxis for all patients, 2010–20 (n=617*)

	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
DVT prophylaxis	35 68.6%	29 72.5%	52 80.0%	36 72.0%	43 82.7%	38 67.9%	53 72.6%	83 87.4%	66 78.6%	38 74.5%	473 76.7%
No DVT prophylaxis	16 31.4%	11 27.5%	13 20.0%	14 28.0%	9 17.3%	18 32.1%	20 27.4%	12 12.6%	18 21.4%	13 25.5%	144 23.3%
Total	51 100%	40 100%	65 100%	50 100%	52 100%	56 100%	73 100%	95 100%	84 100%	51 100%	617 100%

DVT = Deep vein thrombosis
*Data missing n=24 (3.7%)

Appendix data table 22: Aboriginal and Torres Strait Islander patients and non-Indigenous patients, 2010–20 (n=641)

	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Aboriginal and Torres Strait Islander patients	23 43.4%	11 25.6%	25 36.8%	27 50.9%	15 28.3%	22 36.1%	27 34.6%	32 33.3%	33 38.8%	16 31.4%	231 36.0%
non-Indigenous patients	30 56.6%	32 74.4%	43 63.2%	26 49.1%	38 71.7%	39 63.9%	51 65.4%	64 66.7%	52 61.2%	35 68.6%	410 64.0%
Total	53 100%	43 100%	68 100%	53 100%	53 100%	61 100%	78 100%	96 100%	85 100%	51 100%	641 100%

Appendix data table 23: Patients by age group and Aboriginal and Torres Strait Islander status, 2010–20 (n=641)

Age group, years	Aboriginal and Torres Strait Islander patients n=397	non-Indigenous patients n=244	Total n=641
0–20	8 (36.4%)	14 (63.6%)	22 (3.4%)
21–30	17 (51.5%)	16 (48.5%)	33 (5.1%)
31–40	15 (57.7%)	11 (42.3%)	26 (4.1%)
41–50	54 (69.2%)	24 (30.8%)	78 (12.2%)
51–60	52 (55.3%)	42 (44.7%)	94 (14.7%)
61–70	45 (32.6%)	93 (67.4%)	138 (21.5%)
71–80	29 (19.1%)	123 (80.9%)	152 (23.7%)
81+	11 (11.2%)	87 (88.8%)	98 (15.3%)

Appendix data table 24: Risk of death for Aboriginal and Torres Strait Islander patients and non-Indigenous patients who had an operation, 2010–20 (n=499*)

	Aboriginal and Torres Strait Islander patients (n=181)	non-Indigenous patients (n=318)
Minimal–small risk of death	17 (9.4%)	42 (13.2%)
Moderate risk of death	42 (23.2%)	89 (28.0%)
Considerable risk of death	99 (54.7%)	137 (43.1%)
Expected risk of death	23 (12.7%)	50 (15.7%)

*Data missing n=5 (1.0%)

Appendix data table 25: Number of second-line assessments conducted, 2010–20 (n=641)

	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Second-line assessments	11 20.8%	3 7.0%	6 8.8%	5 9.4%	13 24.5%	9 14.8%	8 10.3%	14 14.6%	6 7.1%	1 2.0%	76 11.9%
Total closed cases	53 100%	43 100%	68 100%	53 100%	53 100%	61 100%	78 100%	96 100%	85 100%	51 100%	641 100%

Appendix data table 26: Assessor-identified preventable serious clinical management issues, 2010–20 (n=50*)

	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Definitely preventable	2 66.7%	2 50.0%	1 16.7%	1 25.0%	2 25.0%	3 42.9%	4 66.7%	4 66.7%	0 0.0%	0 0.0%	19 38.0%
Probably preventable	0 0.0%	2 50.0%	4 66.7%	3 75.0%	3 37.5%	3 42.9%	1 16.7%	2 33.3%	2 50.0%	1 50.0%	21 42.0%
Probably not preventable	1 33.3%	0 0.0%	1 16.7%	0 0.0%	3 37.5%	1 14.3%	1 16.7%	0 0.0%	2 50.0%	1 50.0%	10 20.0%
Total	3 100%	4 100%	6 100%	4 100%	8 100%	7 100%	6 100%	6 100%	4 100%	2 100%	50 100%

*Data missing n=3 (5.7%).

Appendix data table 27: Baseline patients and NTASM patients by age group, 2010–20

Age group, years	NT baseline patients (n=16,436)	NTASM patients (n=79)
0–4	641 (3.9%)	1 (1.3%)
5–9	655 (4.0%)	0 (0.0%)
10–14	507 (3.1%)	0 (0.0%)
15–19	669 (4.1%)	1 (1.3%)
20–24	1,039 (6.3%)	2 (2.5%)
25–29	1523 (9.3%)	2 (2.5%)
30–34	1,547 (9.4%)	0 (0.0%)
35–39	1,332 (8.1%)	4 (5.1%)
40–44	1,132 (6.9%)	2 (2.5%)
45–49	1198 (7.3 %)	2 (2.5%)
50–54	1,222 (7.4%)	6 7.6%)
55–59	1196 (7.3%)	6 (7.6%)
60– 64	1,178 (7.2%)	10 (12.7%)
65–69	1,009 (6.1 %)	8 (10.1%)
70–74	776 (4.7%)	9 (11.4%)
75–79	471 (2.9%)	11 (13.9%)
80–84	214 (1.3%)	10 (12.7%)
85+	127 (0.8%)	5 (6.3%)

Royal Australasian College of Surgeons

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