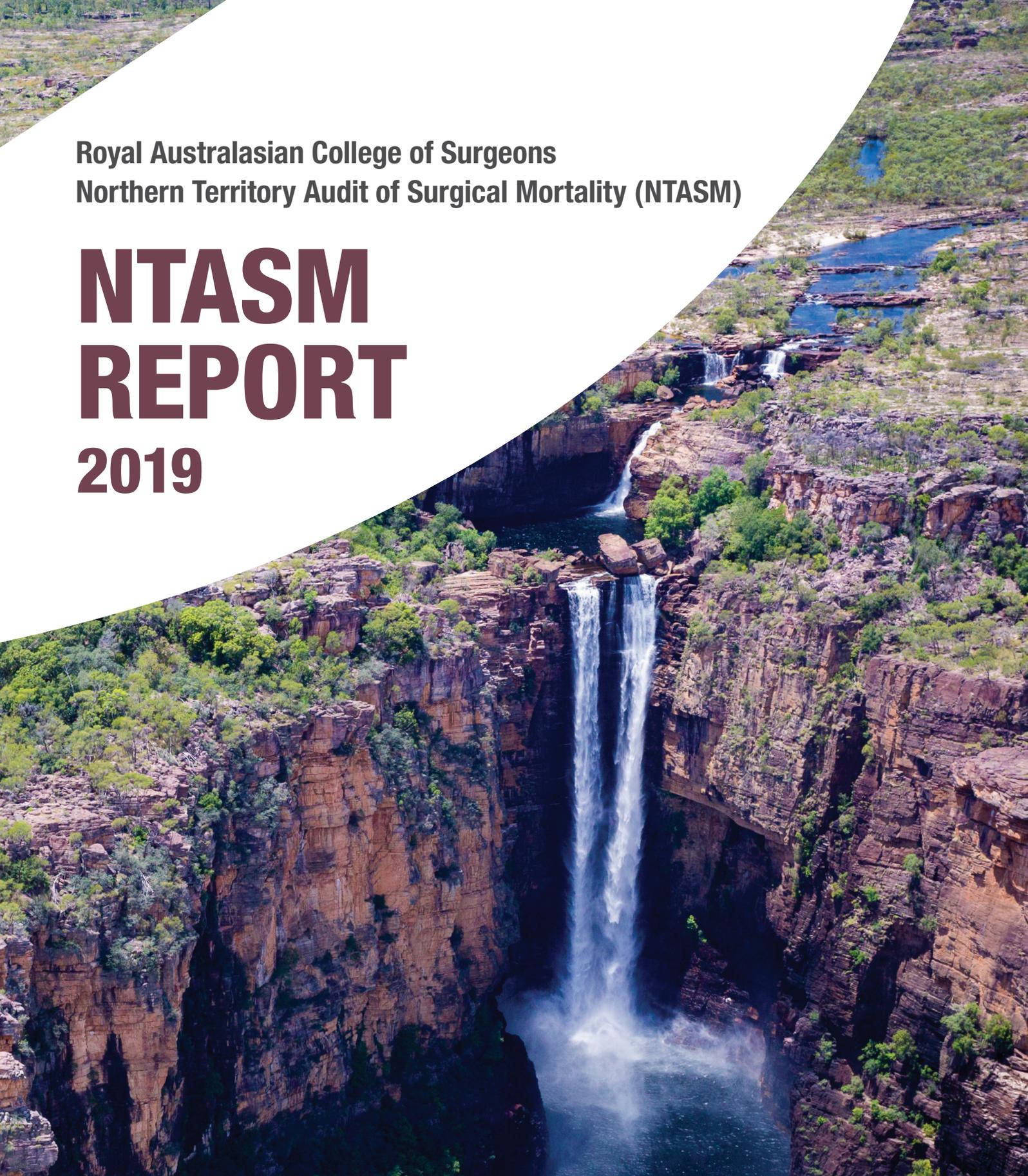
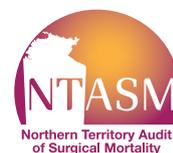


Royal Australasian College of Surgeons
Northern Territory Audit of Surgical Mortality (NTASM)

NTASM REPORT 2019



ROYAL AUSTRALASIAN
COLLEGE OF SURGEONS





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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 25th July 2016).

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NTASM CLINICAL DIRECTOR'S REPORT

This 2019 NTASM report welcomes a new management committee chair, Dr Sabu Thomas. We would both like to extend our thanks to Dr John Treacy for all his past efforts relating to the NTASM and related annual reports.

A strength of the NTASM is that all NT hospitals and surgeons participate. This allows for meaningful data analysis to take place and invaluable feedback to be given to hospitals and surgeons.

NT surgeons can continue to learn and develop professionally via their participation in all stages of the Audit process. These surgeons review their own NTASM cases in depth and are asked, *in retrospect would you have done anything differently?* This self-reflective process is a powerful learning tool, especially for challenging cases and NT-related scenarios.

A small proportion of all NTASM cases need a second-line assessment. The medical records are forensically reviewed by a second-line assessor and their educative reports are returned to the treating surgeon.

After each peer review assessment stage (first-line and second-line), it is clear from our research that assessors also learn in a substantial way.¹

As a Clinical Director, it is encouraging to know that the NTASM continues to be a central learning tool for all participants.

I hope the data in this report encourages further reflection and contributes, as always, to best-care surgical practice.



Dr John North
NTASM Clinical Director

1. Lui C-W, Boyle FM, Wysocki AP, et al. How participation in surgical mortality audit impacts surgical practice. *BMC Surgery* 2017;17:42. Available from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5395878/pdf/12893_2017_Article_240.pdf
DOI: 10.1186/s12893-017-0240-z

NTASM MANAGEMENT COMMITTEE CHAIR'S REPORT

I would like to thank Dr John North and the NTASM management committee for this opportunity to be the new chair of NTASM. I am also thankful to Dr John Treacy for his many years of untiring leadership in that position.

Furthermore, I am thankful to the NT Government and the Department of Health for their ongoing funding of this important quality assurance activity which ensures surgery is both safe and accessible for all Territorians.

It is rewarding to note that, in the NT, surgery-related adverse events, complication rates, and hospital-acquired infection rates are the same or less than the national average.

We still grapple with the problem of high mortality among younger Aboriginal persons. While this could be due to the overall health status of Aboriginal patients, it is something we will continue to pay close attention to.

Statistical analysis of our data shows that alcohol use is five times more likely to contribute to death in the NT compared to other states. Therefore, we are fully supportive of NT Government initiatives aimed at limiting irresponsible alcohol use.

It is our hope that interpersonal violence as a cause of trauma (17%) in the NT, will reduce in coming years because of these initiatives.¹

It is noteworthy that, in the Territory, the rate of direct consultant involvement in the care of surgical patients is similar to the national average. We also had four post-FRACS Fellows assisting in various areas including busy operating nights.

This year, the NT Department of Health has kindly made baseline NT data available to NTASM. This made it possible to make more valid comparisons. For example, we noted that a higher proportion of NTASM patients had comorbidities (87%) compared to the baseline NT inpatient data (57%).

Subspecialty recruitment has always been a challenge in the NT. We are happy to now have two urologists looking after public patients. We also hope that the vascular surgery and plastic surgery departments will gain similar support in the future.

In 2019, anaesthetists have actively participated in the audit. Likewise, obstetrics and gynaecology specialists continue to participate (though their case numbers are too few to make valid conclusions).

The participation of surgeons in this audit is an essential prerequisite for their CPD, and hence their ongoing registration with the Medical Board of Australia. Qualified Privilege (QP) encourages them to be transparent and forthcoming in the collection of de-identified data.

I am sure that all my surgical colleagues will find going through this report an enriching and rewarding experience.



Dr Sabu Thomas
NTASM Management Committee Chair

1. Foundation for Alcohol Research and Education, Northern Territory alcohol harm-reduction report. 2019, Foundation for Alcohol Research and Education (FARE): Australian Capital Territory. Date accessed: 25 November 2019. Available from: <http://fare.org.au/wp-content/uploads/NT-Alcohol-Harm-reduction-Report.pdf>

EXECUTIVE SUMMARY

BACKGROUND

- The NTASM started in 2010 and is funded by the NT Government Department of Health.
- The NTASM is an external, independent, peer-review audit of care processes associated with surgically-related deaths in the NT.
- The NTASM has qualified privilege protection under Commonwealth legislation.
- This report covers surgically-related deaths that occurred from 1 July 2010 to 30 June 2019 (census date of 31 August 2019). Note: Denominators in this report may differ because not all questions were answered for each patient.

HOSPITALS

- All hospitals in the NT participated in the audit.

SURGEONS

- All surgeons in the NT participated in the NTASM.
- The return rate for SCFs was 97% (649/666).
- By the census date, 639 cases were completed (including cases reported in error and terminal care admissions). Of those, 572 were eligible for this report.

PATIENTS

- In NTASM, 63% (359/572) of patients were male and 37% (213/572) were female. Nationally between 2009 and 2016, 55% (18,525/33,438) of patients were male and 45% (14,913/33,438) were female.
- Comorbidities were present in 83% (476/571) of NTASM patients. Nationally between 2009 and 2016, there were 90% (28,701/31,862) of patients with comorbidities.⁽¹⁾
- Hepatic disease (19%; 107/571) was lower than previous years (23%; 73/318).
- Diabetes mellitus (28%; 158/571) was lower compared with previous years (32%; 101/318).
- Cardiovascular disease (CVD) was the most common comorbidity (52%; 295/572). This is similar to the prevalence of CVD in previous years (60%; 192/318).

ABORIGINAL AND TORRES STRAIT ISLANDER PERSONS

- According to the Australian Bureau of Statistics, 30% of the NT population and 3% of the total Australian population are Aboriginal and Torres Strait Islander persons.⁽²⁾
- In NTASM, Aboriginal and Torres Strait Islander persons comprised 37% (211/572) of surgically-related deaths.
- In NTASM, the median age of death of Aboriginal and Torres Strait Islander persons was 53 years, (interquartile range [IQR] 44 to 66) compared with the median age of non-Aboriginal and Torres Strait Islander persons of 71 years [IQR] 60 to 79.

CLINICAL INCIDENTS

- No clinical incidents were noted in 73% (420/572) of patients.
- An area of consideration occurred in 17% (95/572) of patients.
- An area of concern or adverse event occurred in 10% (57/572) of NTASM patients. Nationally between 2009 and 2016, there were 11% (3,655/33,356) of patients with areas of concern and adverse events.⁽¹⁾
- Assessors considered that 39% (22/57) of the areas of concern and adverse events were definitely preventable.
- Patients with an area of concern or adverse event were more likely to have been an emergency admission 72% (38/53) than an elective admission 28% (15/53).

OPERATIVE DEATHS

- No operations were performed in 22% (124/572) of patients.
- A total of 734 operations were performed on 448 patients.
- Multiple operations were performed on 31% (138/448) of patients who had operations.

POSTOPERATIVE COMPLICATIONS

- Postoperative complications occurred in 24% (107/448) of patients.
- Nationally between 2009 and 2016, there were 34% (8,675/25,596) of patients with postoperative complications.⁽¹⁾

USE OF INTENSIVE CARE UNIT (ICU)

- Postoperative admission to an ICU occurred in 69% (307/448) of patients.
- A postoperative unplanned admission to an ICU occurred in 18% (78/429) of patients.

TRAUMA

- Trauma was present in 27% (140/520) of patients. Nationally between 2009 and 2016, trauma was present in 27% (3,192/11,659) of patients.⁽¹⁾
- 61% (85/140) of trauma was associated with falls.
- 21% (30/140) of trauma was associated with road traffic accidents.
- 66% (93/140) of trauma occurred in non-Aboriginal and Torres Strait Islander persons.

INFECTION

- Infection was reported in 31% (178/511) of patients who died.
- Of the patients with infection, 59% (104/178) acquired the infection prior to admission and 41% (71/178) acquired the infection during the admission.
- The main types of infection were septicaemia 32% (57/178) and pneumonia 28% (49/178).
- Nationally between 2009 and 2016, there were 34% (5,267/15,404) of patients who acquired an infection. Of these patients, more than half (58%; 2,965/5,093) acquired the infection during the admission.⁽¹⁾

RECOMMENDATIONS AND KEY POINTS

Practice and policy

The audit is routine, systematic and clinically relevant, and it can inform hospital and clinical practice. The audit data should be used to:

- review existing clinical activities and hospital processes to improve delivery of care to patients (see adopted recommendations)
- influence public policy
- identify areas where clinical improvement could be made.

Learning through the audit

It is recognised that the audit provides a surgeon-specific yet effective form of learning. The audit should:

- encourage surgeons to be assessors to enhance their own learnings from the audit which can lead to change in practice. The number of NT surgeons doing assessments has increased.
- encourage surgeons to make use of the audit data in research publications. NTASM has suggested the “application for research using audit data” to NT trainees and registrars.
- identify emerging trends and address them in educational processes such as seminars and themed case note review booklets. The NTASM “*Case of the Month*” is sent to all NTASM surgeons. NT surgeons are invited to all seminars hosted by the Queensland Audit of Surgical Mortality (QASM). NT surgeons do present at QASM seminars.

Patient management

In this report, most of the patients in NTASM were older than Northern Territory baseline inpatients. NTASM patients are high-risk patients, however care provided to the surgical patient is high, because 73% of patients had no clinical incidents.

- Clinical incidents were considered probably or definitely preventable occurred in 10% (57/572) of the surgical mortality audit patients. Preventable clinical incidents occurred most frequently in the categories of open surgery, diagnosis-related complications, and incorrect therapy. Monitoring of these areas is encouraged.
- Senior surgeon supervision in theatre occurred in 60% of operations. High levels of safe and high-quality surgery occurs under this supervision.
- On average, Aboriginal and Torres Strait Islander persons are 18 years younger than non-Aboriginal and Torres Strait Islander persons. This is also reflected in the Northern Territory baseline inpatients. NTASM should continue to highlight the need to “close the gap”. The Department of Health should continue to promote all aspects of day-to-day life that will improve health care in the community.
- Second-line assessors reported, at a higher rate than the treating surgeon, that patient management could be improved in the following areas: preoperative (32% vs 13%), intraoperative (25% vs 12%), and timing of operation (24% vs 10%). Surgeons are encouraged to review practices to ensure improvement in these areas.
- The audit showed that infections acquired in the community were twice as likely to occur in Aboriginal and Torres Strait Islander persons than in non-Aboriginal and Torres Strait Islander persons. The NTASM and the Department of Health should continue to provide education regarding infection prevention. The Department of Health should promote the importance of early recognition of infection and sepsis.

- Alcohol use in the NTASM patient is five times higher than in patients in the rest of Australia (excluding NSW - as data was not available at the time of the report). NTASM patients in which alcohol use was recorded were, on average, younger than patients from the rest of Australia. The Department of Health is encouraged to continue to educate on the effects of long-term alcohol use. The Department of Health is encouraged to include routine blood alcohol testing in hospital emergency departments. The audits are encouraged to make alcohol use a formal question in its data collection form.
- The number of Vascular and Urology surgical patients have increased in the NTASM. In the Northern Territory public hospitals have only one Vascular Surgeon and one Urology Surgeon. This has the potential to impact on patient management. The Department of Health is encouraged to employ additional public hospital Vascular and Urology Surgeons to improve patient safety and quality in these two specialties.

Adopted recommendations

NTASM reports and findings have a continuous positive influence on surgical practice. Within the last 12 months the following areas have been improved, or changed, because of NTASM findings.

- *A Neurosurgical team in NT:* Two consultant neurosurgeons are now working in the Northern Territory.
- *Management of bleeding oesophageal varices:* An upper gastrointestinal surgical unit was formed to identify and manage these patients by an elective variceal screening program.
- *Use of NTASM online:* All NTASM surgeons are using NTASM online. Locum and resident surgeons are self-reporting NTASM cases.

1 AUDIT OVERVIEW

Key Points

- The NTASM is an independent, peer-review audit of all surgically-related deaths in the Northern Territory.
- The NTASM provides feedback to surgeons about surgical practice and encourages learning about surgical care.
- The NTASM reports from 1 July 2010 to 30 June 2019 (census date being 31 July 2019).
- The NTASM delivers analysis of 572 completed cases.

Audit assessors completed 572 first-line assessments and 73 second-line assessments. An overview of the status of NTASM patient cases is provided in Table 1 below.

- Note: At the census date (31 July 2019), 18 patient cases were pending submission.

Table 1: Overview of NTASM patient cases in the audit reporting period (n=97)

Audit report period June 2010 – July 2019	Number of patients cases
Closed patient cases	572
Patient cases pending	18
Assessments forms pending	9
Excluded (terminal care case)	47
Excluded (error)*	20
Total reported deaths	666

*Note: An error in reporting occurs when NTASM receives notification of a case that does not fulfil the inclusion criteria and cannot be included in the audit.

Note: Only the 572 closed patient cases are presented in this report.

2 RESULTS

2.1 CLINICAL INCIDENTS

Key Points

- There were no clinical incidents in 73% (420/572) of patients.
- An area of consideration was found in 17% (95/572) of patients.
- An area of concern or an adverse event was found in 10% (57/572) of patients. About half - 56% (32/57) of these were considered preventable.
- Two-thirds of patients with areas of concern or adverse events 67% (38/57) were emergency admissions.
- The most common serious preventable clinical incidents were complications in surgery, in diagnosis or in therapy.

Clinical incidents, as defined by NTASM, were:

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

Clinical incidents are reported by first-line and second-line assessors. Assessors may identify more than one clinical incident per patient. When more than one clinical incident is identified, the most severe incident was reported.

The most severe clinical incidents are areas of concern and adverse events. These two categories include issues that are specific to surgical care and may relate to hospital or patient management issues. These are the areas of care that were suboptimal and need to be improved.

Over the audit period, assessors reported that:

- there were no clinical incidents in 73% (420/572) of patients
- an area of consideration occurred in 17% (95/572) of patients
- an area of concern occurred in 7% (39/572) of patients
- an area of adverse event occurred in 3% (18/572) of patients.

The total proportion of patients with minor or no incidents regarding treatment was 90% (514/572) when no clinical incidents are combined with areas of consideration (the least serious area).

The proportion of NTASM patients for whom an area of concern or adverse event was identified (10%, 57/572) was lower than that for ANZASM patients (11%, 3,655/33,356).⁽¹⁾ The difference is not statistically significant (RR 1.10; 95% CI 0.86 to 1.41)

2.1.1 Preventable clinical incidents

Assessors also report on the preventability of clinical incidents. Table 2 shows the preventability of the most severe clinical incidents (areas of concern and adverse events) that occurred in 57 patients.

About half of the incidents of areas of concern or adverse events were preventable.

Preventability	Number of events (%)
Definitely preventable	22 (39%)
Probably preventable	26 (46%)
Probably not preventable	8 (14%)
Data not available: n=1 (2%).	

Of the patients with definitely and probably preventable areas of concern or adverse events, the most common categories* of preventable clinical events were:

- assessment (16)
- delays (7)
- suboptimal therapy (7)
- open surgery – organ related (5)
- diagnosis-related complication (3)
- radiological surgery – technical (3)

*Clinical incidents were categorised using a coded thesaurus of clinical terms (READ codes). READ codes are a clinical decision tree that contains terms, synonyms and abbreviations covering all aspects of patient care. It is a precursor to ICD9 coding: (Ref: NHS Digital).⁽³⁾

Preventable areas of concern and adverse events were associated with various hospital departments.

Assessors indicated that the following hospital departments were associated with the preventable areas of concern and adverse events:

- surgical team (23 events)
- another clinical team (20 events)
- hospital (3 events)
- other (2 events)
- data was missing for 9 patients
- Other** (7)

** Too identifiable to list separately (drug related, staffing, laparoscopic surgery - technical, failure to use facilities)

2.1.2 Elective admissions: areas of concern and adverse events as clinical incidents

The type of admission was an important predictor of clinical incidents. When an area of concern or adverse event was reported, it was less likely to occur in a patient who had an elective admission - 28% (15/53) compared with the occurrence in a patient with an emergency admission 72% (38/53). [RR = 2.5; 95% CI 1.6 to 4.0]. [data was missing for 4 patients]

2.2 SURGEONS

Key Points

- All NT surgeons participate in the audit.
- The NT relies on locum surgeons to supplement the surgical workforce.
- In the NT, consultant surgeons' supervision in theatre is high.

2.2.1 Overview

All 45 RACS surgeons in the NT participate in the audit. There were also 15 locum surgeons who participated in the audit.

Historically, locum surgeons' involvement in the NTASM has been a challenge. With the latest enhancement to the NTASM database, locum surgeons can self-generate a notification of death and report the case details at the same time. NTASM proposes that this becomes standard practice for all locum RACS surgeons.

2.2.2 Audit participation

All the participating surgeons in NTASM are Fellows of RACS. Surgeons must have their RACS Fellowship to perform first-line or second-line assessments. Table 3 highlights audit participation by surgical speciality.

Table 3: Participation by speciality

Specialty	Number participating*
Surgeons - General Surgery	20
Surgeons - Orthopaedic Surgery	8
Surgeons - Otolaryngology, Head and Neck Surgery	3
Surgeons - Plastic and Reconstructive Surgery	2
Surgeons - Vascular Surgery	1
Surgeons - Urology	1
Surgeons - Oral and Maxillofacial Surgery	2
Surgeons - Neurosurgery	2
Surgeons - Ophthalmology	6
Total	45

*Excluded from this analysis were surgeons who have either retired or left practice in the Northern Territory, and locum surgeons.

2.2.3 Completion of Surgical Case Forms (SCFs)

Consultant surgeons completed 99% (648/666) of all SCFs.

The median time taken to return a SCF was 50 days, ranging from less than 1 day to 448 days.

- 34 SCFs were returned in less than 1 day.
- 70 SCFs were returned within 7 days.
- 502 SCFs had a median return time of 63 days (IQR 32.75 - 124).
- The maximum return time was 653 days.

2.2.4 Consultant surgeon involvement in operations

Surgeons performed 734 operations on 448 patients. Two or more operations were performed on 138 patients, with the maximum number of operations on a single patient being 12.

The level of consultant input into the surgical management of patients was high. Their grades and roles are shown in Table 4.

- Consultant surgeons made the decision to operate in 87% (637/734) of operations. This is similar to ANZASM data, where 88% (32,369/36,842) of consultant surgeons made the decision to operate.
- Consultant surgeons operated in 60% (443/734) of operations. This is slightly lower than in previous years, although is not statistically significant – for 2010-2016 it was 62% (262/423); [RR = 1.03; 95% CI 0.93 to 1.13]. This is similar to ANZASM data, where 63% (23,070/36,842) of consultant surgeons performed the operation.¹
- Consultant surgeons were present in the theatre for 15% (114/734) of operations.

Table 4 : Grade of NTASM surgeon deciding, operating, assisting or in theatre

	Deciding	Operating	Assisting	In theatre
Consultant	87% (637/734)	60% (443/734)	12% (89/734)	15% (113/734)
SET trainee	2% (18/734)	11% (83/734)	19% (141/734)	3% (20/734)
Service registrar	1% (7/734)	6% (46/734)	17% (125/734)	2% (18/734)
IMG	1% (11/734)	4% (31/734)	5% (36/734)	1% (8/734)
Fellow	3% (23/734)	19% (137/734)	13% (94/734)	2% (12/734)

Note: the column percentages do not add up to 100%. In many instances multiple surgeons were performing and assisting during the operation. In addition, the surgeon's role and involvement were not always provided for each operation.
SET: Surgical Education and Training; IMG: International Medical Graduate.

2.2.5 Surgeon supervision in theatre

Consultant surgeon supervision covers assisting and being present in the theatre while SET trainees, IMGs and service registrars operate.

- SET trainees performed 83 operations, and in 87% (72/83) of these operations the consultant had made the decision to operate.
- Service registrars performed 46 operations, and in 72% (33/46) of these operations the consultant had made the decision to operate.
- IMGs performed 31 operations, and in 74% (23/31) of these operations the consultant had made the decision to operate.

2.2.6 Specialty of surgeon

Northern Territory hospitals have a variety of surgical specialties. Table 5 shows the number of patients with operations, admitted for each surgical specialty. Surgically-related deaths primarily occurred in the four specialties, attracting the highest percentage of patients: General Surgery, Orthopaedic Surgery, Vascular Surgery and Neurosurgery.

Specialty	Number of patients	Percentage of all patients
General Surgery	318	71%
Orthopaedic Surgery	58	13%
Vascular Surgery	27	6%
Neurosurgery	21	5%
Otolaryngology Head and Neck	10	2%
Urology	6	1%
Oral/Maxillofacial	5	1%
Other*	4	1%
Total	448	100%

*Other surgical specialties include Ophthalmology, Obstetrics & Gynaecology and Plastic Surgery.

2.2.7 Treating surgeon and assessor views on patient management

To test for concordance in each case, the surgeon's views were compared to the second-line assessor's views. In general, the assessors were more critical of the patient management than the surgeons.

Surgeons identified the decision to operate as the area requiring the most improvement. Assessors identified preoperative management and postoperative care as the main areas requiring the most improvement.

Area in which patient management could have been improved	Surgeons' views (n=73)	Second-line assessors' views (n=73)	Risk Ratio (95% CI)
Preoperative management	13% (9/67)	32% (22/68)	2.41 (1.20 – 4.84)*
Decision to operate	21% (14/68)	16% (11/69)	0.77 (0.38 – 1.58)
Choice of operation	5% (3/67)	13% (9/68)	2.96 (0.84 – 10.44)
Timing of operation	10% (7/67)	24% (16/68)	2.25 (0.99 – 5.12)
Intraoperative management	12% (8/67)	25% (17/68)	2.09 (0.97 – 4.52)
Grade of surgeon operating	3% (2/67)	6% (4/67)	2.00 (0.38 – 10.55)
Postoperative care	15% (10/67)	27% (18/67)	1.80 (0.90 – 3.60)

95%CI = 95% confidence interval
 Note: not all questions for each case were answered
 *Statistically significant

2.2.8 Operation duration

The duration of an operation is an important predictor of adverse events in surgical admissions.

According to Kable et al., when adjusting for the type of surgery, the risk of an adverse event increases as the duration of the operation increases. Operations longer than 180 minutes compared to operations shorter than 60 minutes were 5.5 times more likely to have an adverse event.⁽⁴⁾

In the NTASM, operation duration was recorded for 82% (601/734) of operations.

- The median operation duration was 60 minutes (IQR 60 to 180 minutes).
- The minimum operation duration was less than 10 minutes.
- The maximum operation duration was 690 minutes (11.5 hours).

2.2.9 Surgeons' views in retrospect

Surgeons and different actions

Surgeons were asked whether, in retrospect, they would have done anything differently in terms of patient management. This question was not answered for 23 patients (4%).

- For 82% (449/549) of patients, the surgeon would not have changed the management.
- For 18% (100/549) of patients, the surgeon would have done something differently.

The areas of care identified for improvement by the surgeons covered all aspects of patient management. A sample of comments is provided below.

Patient management

- *Managed patient on surgical ward.*

Preoperative care

- *Upgrade his theatre triage earlier.*
- *Establish goal of care much earlier. This is a challenge with remote communities.*

Intraoperative care

- *Ensure a vascular surgeon was present in the hospital.*
- *Done an ileostomy on first entering the abdomen and not performed a formal right hemicolectomy to get him off the table quicker.*
- *Slightly different stent placement.*

Decision to perform the operation

- *Unlikely to have agreed to operate.*

Postoperative care

- *I would have pushed for earlier admission to ICU and more vigorous fluid resuscitation.*
- *More aggressive in documenting fluid balance chart. Supervised more aggressive fluid resuscitation.*

2.3 ANAESTHETISTS

Key Points

- Australian and New Zealand College of Anaesthetist (ANZCA) Fellows participate in the audit.

Since June 2016, the anaesthetic audit has been incorporated within the NTASM audit and is funded by the Northern Territory Department of Health.

ANZCA Fellows voluntarily participate in the audit. Some may also be accredited General Practice anaesthetists. Of the 47 anaesthetists in the NT, 39 (83%) participate in the audit. Most of the non-participants are from district hospitals where deaths are unlikely to occur.

ANZCA Fellows can be first-line or second-line assessors for anaesthetic-related cases.

During this reporting period:

- NT anaesthetists have assessed eight patient's cases from the Tasmanian Audit of Surgical Mortality and one from the Australian Capital Territory Audit of Surgical Mortality.
- Anaesthetists in Tasmania and Australian Capital Territory assess NT anaesthetic cases.
- The NT anaesthetic audit contributed to the Tri-annual anaesthetic report in 2018. Two anaesthetic cases were considered to have reportable events (i.e categories 1-3).

Category 1: Where it is reasonably certain that death was caused by the anaesthesia or other factors under the control of the anaesthetist.

Category 2: Where there is some doubt whether death was entirely attributable to the anaesthesia or other factors under the control of the anaesthetist.

Category 3: Where it is reasonably certain that death was caused by both surgical and anaesthetic factors.

2.3.1 Anaesthetic patient cases reported by surgeons

The NTASM anaesthetic audit captures every possible anaesthetic-related death. This is achieved because anaesthetic deaths are reported by both anaesthetists and surgeons.

Anaesthetists may self-report a patient's death when they feel there has been an anaesthetic component to the death. Surgeons report anaesthetic deaths if a patient dies within 48 hours of surgery or if the surgeon considers that there is an anaesthetic component associated with the patient's death.

These inclusion criteria result in high reporting rates. However, 95% of reported and reviewed cases had no anaesthetic issues. Every reported case is anonymously peer reviewed and feedback is provided to the responsible consultant anaesthetists.

Since the anaesthetic audit began in June 2016, 23%, (45/193) of patients who died following an operation, have been referred for independent interstate review. Of the anaesthetic cases reviewed, 95% did not show any anaesthetic issues.

Of these referred cases:

- five are still to be completed and one is under review.
- 87% (20/39) were reviewed automatically because the death occurred within 48 hours of surgery.
- 5% (2/39) were classified by independent review as Category 2 and 3 (Category 2: some doubt if the death was entirely attributable to anaesthesia, Category 3: both anaesthetic and surgical factors were involved)

Nationally between 2009 and 2016, according to surgeons' assessments, 7.5% (1,917/25,622) of patients were thought to have an anaesthetic component to the death.⁽¹⁾

An NT anaesthetic department has indicated that, "through the participation in the NTASM anaesthetic audit, their department have identified quality and safety issues that will result in improvements in patient outcomes."

2.4 OBSTETRICIANS AND GYNAECOLOGISTS

Key Points

- NT Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) Fellows participate in the audit.

RANZCOG Fellows voluntarily participate in the audit. Of the 15 RANZCOG Fellows in the NT, eight participate in the audit (53%). They can participate as first-line and second-line assessors for gynaecology-related patient cases.

During the auditing period, two gynaecology-related case were reported.

2.4.1 Obstetrics and Gynaecology patient cases reported

During the audit period, two Obstetrics and Gynaecology-related cases were reported. These cases will not be discussed any further in this report, because the numbers are low and thus identifiable.

2.5 HOSPITALS

Key Points

- All NT hospitals participate in the NTASM, including a day surgery facility.
- 16% (87/555) of patients were transferred from one hospital to another.
- 9% (50/564) of all patients had a delay in their main surgical diagnosis.

2.5.1 Hospital participation

All hospitals in the NT and one day surgery participate in NTASM.

Data in this report is from public and private hospitals. These hospitals service Central Australia and the whole Top End of the NT.

2.5.2 Hospital admissions

Most hospital admissions for surgical patients were emergencies – 92% (519/563), while 8% (44/563) of surgical patients were elective cases.

- Surgeons performed operations on 77% (398/519) of emergency admission patients.
- Transfers from one hospital to another occurred in 16% (87/555) of patients. This is comparable to the rate in previous years - 12% (40/335).
- According to surgeons, transfer authorities showed appropriate care in 99% (80/81) of transferred patients. [data missing for 6 patients]
- Long-distance transfers to NT hospitals are common. The median distance was 350 km [IQR 300km to 800km], with a maximum distance of 1,872 km.

2.5.3 Delays in main surgical diagnosis

Delays and errors in diagnosis are important factors that contribute to perioperative death. ⁽⁶⁾ There was a delay in obtaining the main surgical diagnosis in 9% (50/564) of patients who had operations. [data missing for 8 patients]

Some delays were associated with the surgical unit (n=18) and some were associated with the medical unit (n=12). Delays in the main surgical diagnosis were primarily due to unavoidable causes (n=18).

2.5.4 Patients with operations

Surgeons performed operations on more than three-quarters of NTASM surgical patients (78%; 448/572).

- A total of 734 operations were performed on 448 patients.
- 31% (138/448) of patients with operations had more than one operation.

2.5.5 Patients with postoperative complications

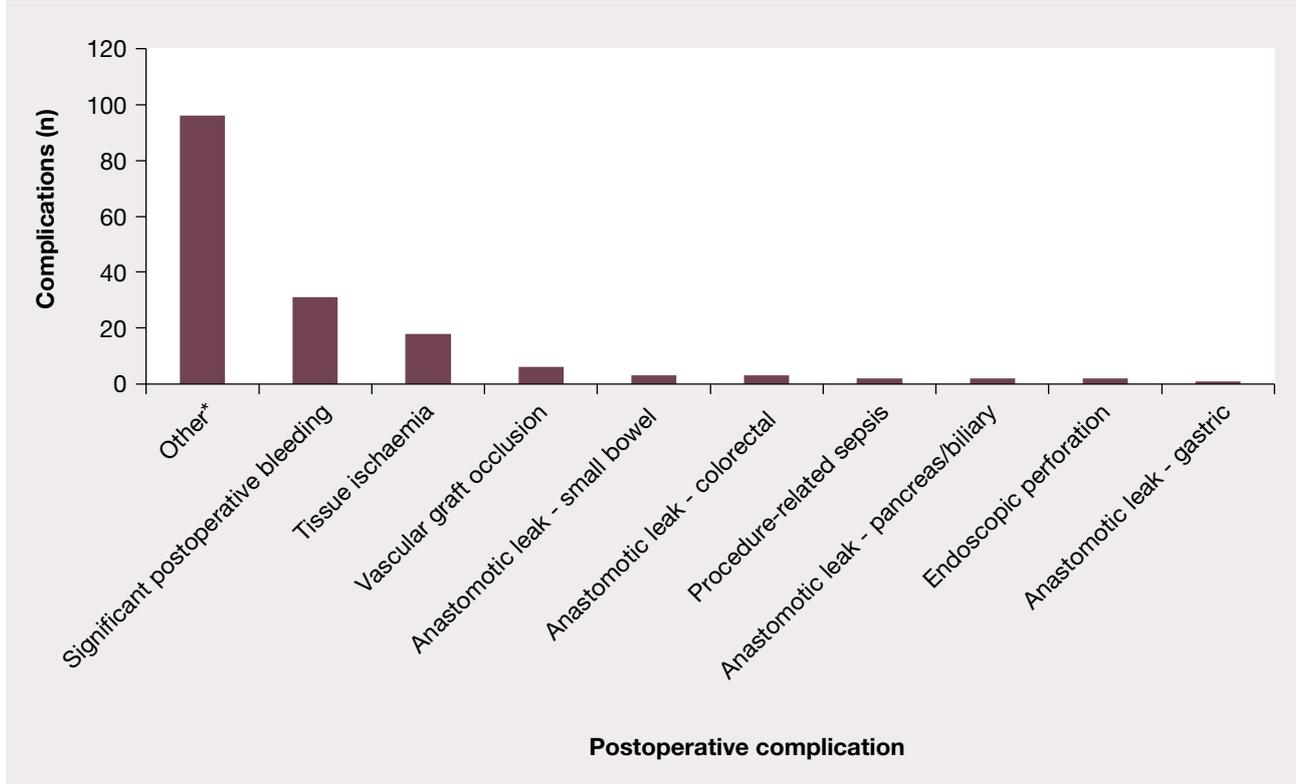
Postoperative complications are strong predictors of death. ^(6,7) NTASM surgeons reported that 24% (107/448) of patients had a postoperative complication. These patients experienced 164 complications.

This rate of complications is significantly lower than the national rate of 33.9% (8,675/25,596).⁽¹⁾ (RR 1.42; 95% CI 1.20 to 1.68)

As shown in Figure 1, the most frequent complications are:

- significant postoperative bleeding (n=31)
- tissue ischaemia (n=18)
- vascular graft occlusion (n=6)
- Anastomotic leak - small bowel (n=3)
- Anastomotic leak - colorectal (n=3)
- procedure-related sepsis (n=2)

Figure 1: Frequency of NTASM postoperative complications by type (n=164)



NTASM: Northern Territory Audit of Surgical Mortality.
 *Includes aspiration pneumonia, gastrointestinal tract bleed, hospital-acquired pneumonia, hypoglycaemia, intraoperative bleeding, intestinal obstruction with perforation, ischaemic bowel, ileus, liver failure, multi-organ infarction, myocardial infarction, pressure ulcer, pulmonary emboli, pancreatitis, stroke and wound dehiscence.
 [See data table 1 for numbers of patients with postoperative complications]

2.5.6 ICU admission and unplanned return to theatre

Essential contributors to surgical care include intensive care units (ICUs). In high-risk patients, a planned admission to the ICU may decrease the probability of postoperative mortality.⁽⁸⁾

However, both unplanned admissions to ICU and unplanned returns to theatre are strong predictors of death in surgical patients.⁽⁹⁻¹¹⁾

- 69% (307/446) of NTASM patients received care in ICU postoperatively. [data missing for 2 patients]
- NTASM surgeons believed that seven patients who did not receive support from ICU or HDU (high dependency unit) should have received that support.
- A postoperative unplanned admission to an ICU occurred in 18% (78/429) of patients. [data missing for 19 patients]
- An unplanned return to theatre occurred in 19% (83/433) of NTASM patients. [data missing for 15 patients]

2.5.7 Length of hospital stay

The length of hospital stay for surgical patients is determined by many factors, and it is a strong predictor of death.⁽⁹⁾ The median length of hospital stay for the patients who died was 8.5 days (IQR 3 days to 22 days). The longest hospital stay was 239 days.

2.6 PATIENTS

Key Points

- Most NTASM patients had comorbidities present (83%; 476/571).
- More than half of NTASM patients had cardiovascular disease (52%; 295/571).

2.6.1 Patient characteristics in audited deaths

There were 675 patient deaths notified to NTASM, and 68 of those were excluded.

Excluded patients were considered as terminal care patients (n=48) or patients that had been reported to the audit in error (n=20). NTASM inclusion and exclusion criteria are defined in Appendix 1.

Of the reported deaths, 572 have completed the full peer-review process and are included in this report (85%; 572/675).

For the completed cases, there were more males than females reported.

Nearly all patients had an emergency admission and comorbidities present.

The main characteristics of these cases are summarised in Table 7.

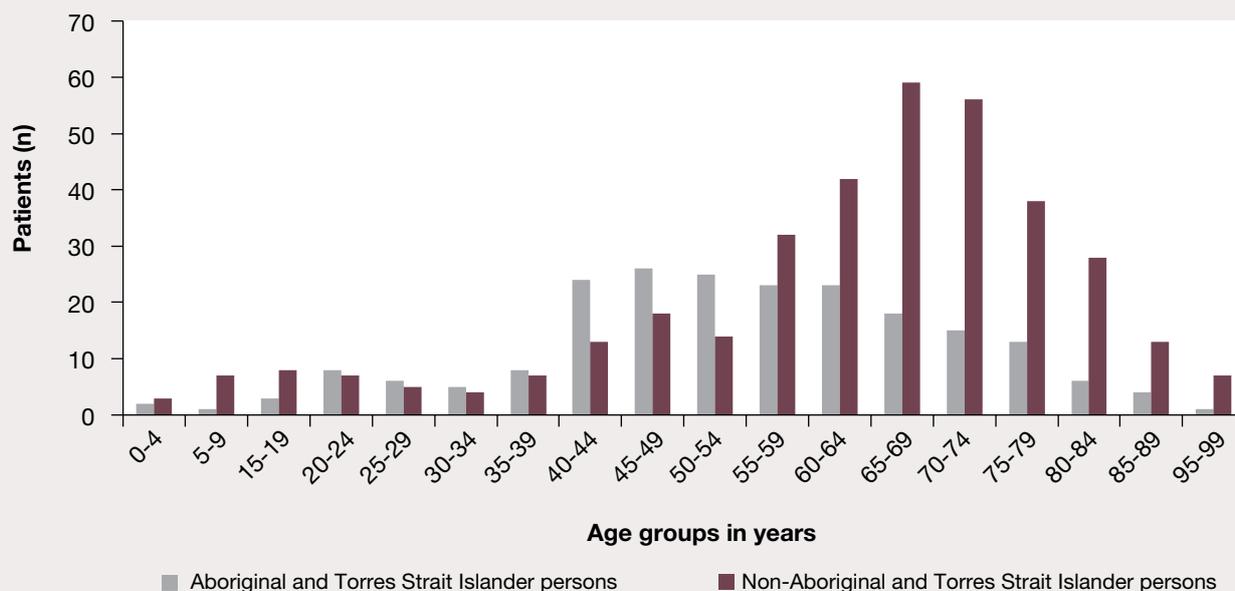
Table 7 Characteristics of NTASM patients	
Characteristics of NTASM patients	n = 572
Median age in years (IQR)	66 (50 – 76)
Male: Female	63%:37%
Aboriginal and Torres Strait Islander Persons	37%
Emergency Admission	92%
Comorbidities*	83%
Had at least one operation	78%
*Comorbidity data missing for 1 patient	

2.6.2 Age of NTASM patients

From the NTASM data, Aboriginal and Torres Strait Islander persons were, on average, younger at the time of death than non-Aboriginal and Torres Strait Islander persons.

In NTASM, there is a difference in the age distributions of the two population groups (Figure 2).

Figure 2: Comparison of Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons by age group (n=572)



[See data table 2 for numbers of patients in each age group]

- 75% (243/323) of patients aged 60 years and older were non-Aboriginal and Torres Strait Islander persons.
- 53% (131/249) of patients aged 59 years and younger were Aboriginal and Torres Strait Islander persons.
- 11 Aboriginal and Torres Strait Islander persons were older than 80 years.
- 48 non-Aboriginal and Torres Strait Islander persons were older than 80 years.

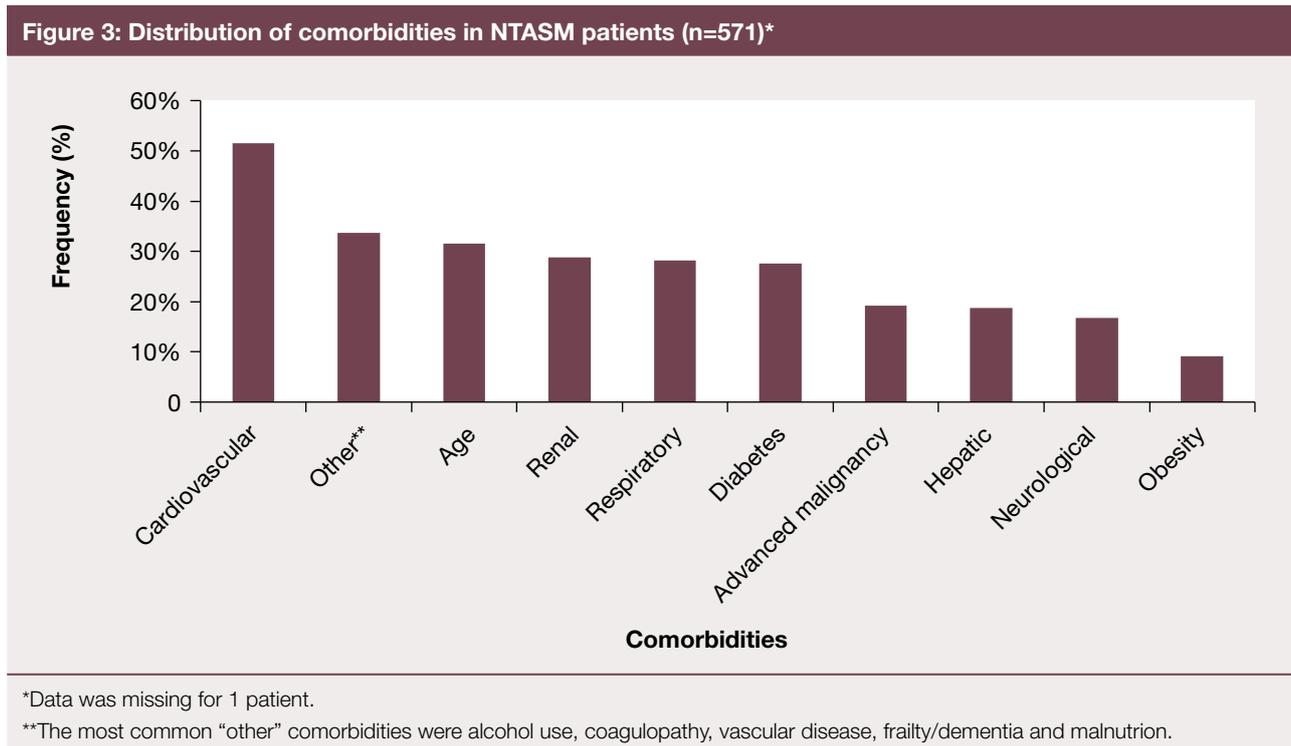
2.6.3 Comorbidities

Having more than three comorbidities is a strong predictor of mortality.⁽⁷⁾ Comorbidities were present in 83% (476/571) of NTASM patients. [data was missing for 1 patient].

There were 1,517 comorbidities in 476 patients, with 62 patients having more than one serious comorbidity.

The median number of comorbidities per patient was 5 (IQR, 2 to 8). Two patients had eight comorbidities.

- Cardiovascular disease, age, renal disease, respiratory disease and diabetes were the most common comorbidities in NTASM patients (see Figure 3).



2.6.4 Alcohol

In previous NTASM reports, alcohol-use data only came from the surgical case form. The SCF question asked: Were there significant co-existing factors increasing risk of death.

For this annual report, more extensive data analysis took place. This analysis included a search for all terms related to alcohol use (for example: alcohol, ethanol, EtOH, intoxication, drinking etc).

In the following fields; comorbidities, course to death and trauma, no distinction was made for acute intoxication compared to chronic alcohol use.

This annual report compared NTASM data to data outside of NT (excluding NSW) for alcohol use as a contributing factor to death.

Searches were performed separately on NTASM data and on data outside of NT (excluding NSW). Only unique cases were counted. If search terms appeared in more than one field a single case (for example: comorbidities AND course to death), then that case was counted once.

Table 8: Comparison of alcohol use as a contributing factor to death between NTASM and data outside of NT

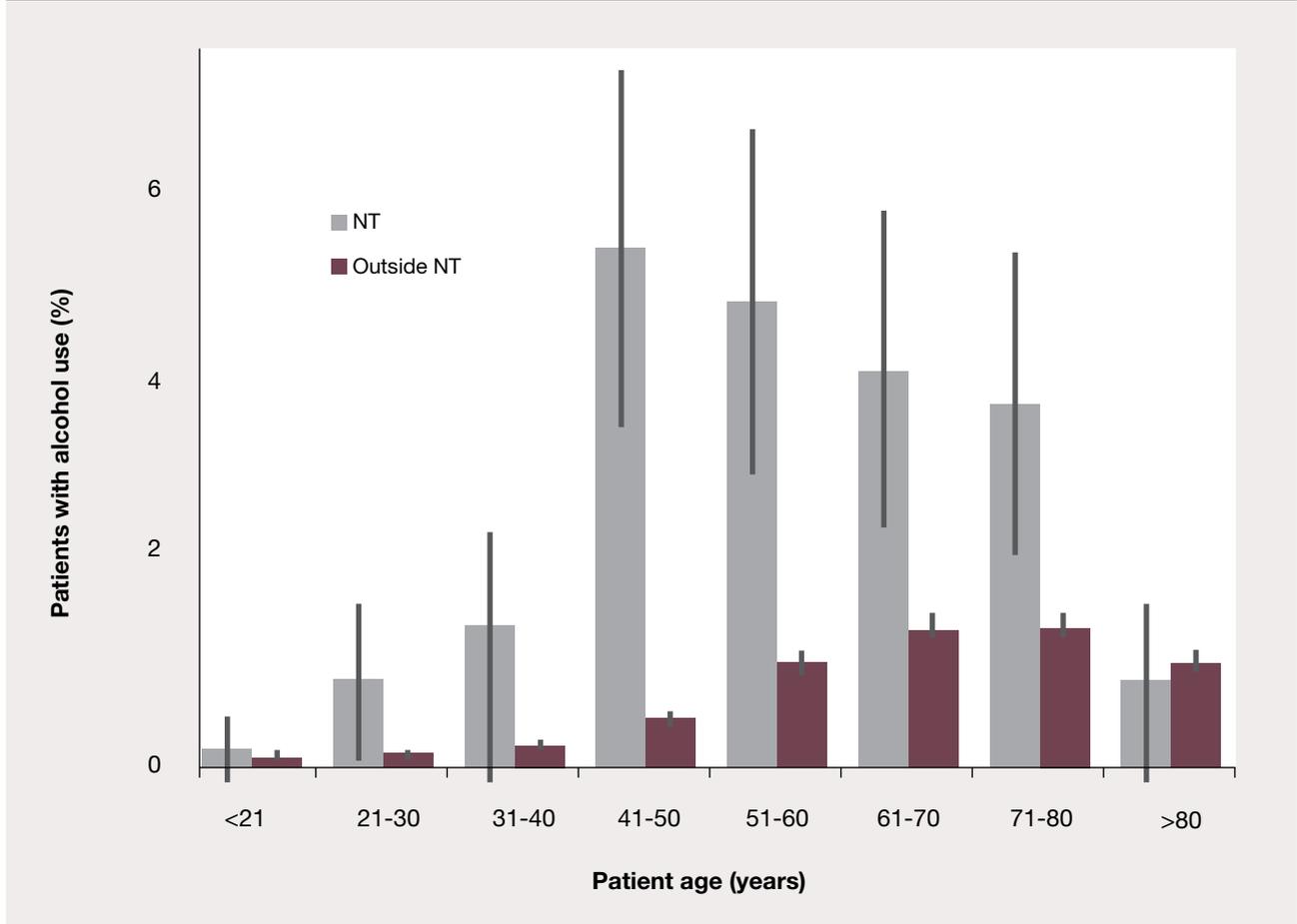
Alcohol as a factor in NT N=560 (%)	Alcohol as a factor outside of NT N= 28 245 (%)	Risk Ratio (95%CI)
120 (21.4%)	1 660 (5.9%)	5.22 (4.16—6.54%)

(Note: The rest of Australia excludes New South Wales and the NT)

Trauma contributed to the total number of cases involving alcohol use—only 1.3% (367/28 245) of unique cases outside of NT and 5.5% (31/560) of unique cases for NT. The search terms were not identified in the trauma sub-questions (e.g. in violence, falls, accidents). This suggests that wherever alcohol is a factor in trauma cases, it is being captured in the course-to-death section of the data.

NT patients aged 41 to 50 years were identified as having the highest risk of alcohol use. For those patients outside of the NT, that had the highest risk, the age group was 71 to 80 years. Alcohol use according to age can be seen in Figure 4.

Figure 4: Age of patients using alcohol.



Vertical error bars give 95% confidence intervals of the observed percentages in each age grouping.

2.7 ABORIGINAL AND TORRES STRAIT ISLANDER PERSONS

Key Points

- 37% of NTASM patients were Aboriginal and Torres Strait Islander persons.
- Aboriginal and Torres Strait Islander persons in NTASM were, on average, younger than non-Aboriginal and Torres Strait Islander persons.

2.7.1 Overview

In the NTASM, reporting on Aboriginal and Torres Strait Islander status commenced in 2010.

Almost one-third of the NT population is Aboriginal and Torres Strait Islander persons. This is the highest of any Australian state or territory ^(2,12) and is reflected in the surgical audit population.

Of the NTASM patients, 37% (211/572) were Aboriginal and Torres Strait Islander persons.

2.7.2 Aboriginal and Torres Strait Islander persons and age

In NTASM, Aboriginal and Torres Strait Islander persons who died in the perioperative period were younger than non-Aboriginal and Torres Strait Islander persons (see Figure 2).

The difference in the median age of the two population groups was 18 years (see Table 9).

Table 9: Age at death of Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons.

	NTASM (n=572)	
	Age at death of Aboriginal and Torres Strait Islander persons (n=211)	Age at death of non-Aboriginal and Torres Strait Islander persons (n=361)
Median (IQR)	53 years (44–66)	71 years (60–79)
Minimum	25 years	0 years
Maximum	88 years	99 years

Note: extreme ages are included (neonates and elderly)

NTASM: Northern Territory Audit of Surgical Mortality; IQR: interquartile range.

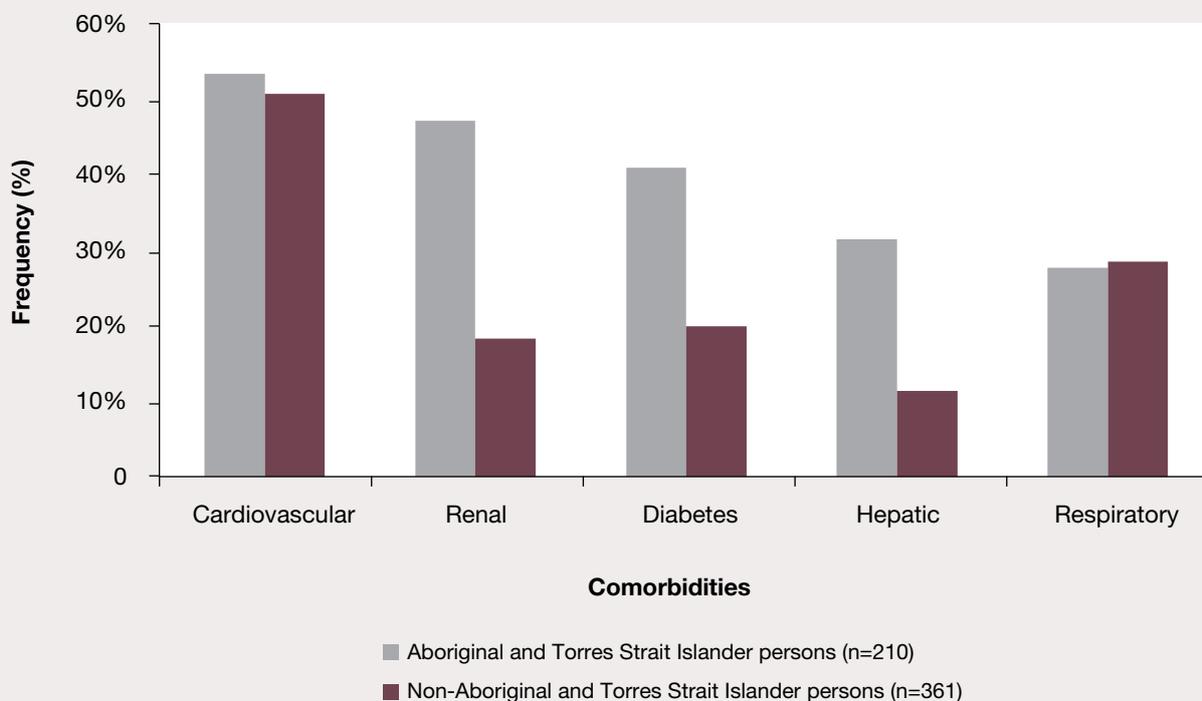
2.7.3 Aboriginal and Torres Strait Islander persons and comorbidities

The high prevalence of having comorbidities is a problem for the surgical care of Aboriginal and Torres Strait Islander persons. As in all patients, a load of comorbidities makes recovering from surgery more difficult.

The NTASM found no difference in the presence of comorbidities in Aboriginal and Torres Strait Islander persons (100%, 31/31) and non-Aboriginal and Torres Strait Islander persons (93%, 51/55) in the NTASM. [RR = 1.08; 95% CI 0.98 to 1.17]

Cardiovascular, renal, diabetes, and hepatic diseases in NTASM patients were more prevalent in Aboriginal and Torres Strait Islander persons than in non-Aboriginal and Torres Strait Islander persons (see Figure 5).

Figure 5: Comparison of diabetes, renal and hepatic disease in Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons (n=571*)



*data missing for 1 patient

[See data table 4 for numbers of the comparison of comorbidities]

Aboriginal and Torres Strait Islander persons are at greater risk of liver disease compared with non-Aboriginal and Torres Strait Islander persons.^(13,14)

2.8 TRAUMA

Key Points

- Trauma in NTASM patients was more prevalent in non-Aboriginal and Torres Strait Islander persons compared with Aboriginal and Torres Strait Islander persons.
- Trauma was most commonly due to falls.

2.8.1 Trauma overview

Trauma occurred in 27% (140/520) of NTASM patients. This is similar to ANZASM data where 27% (3,192/11,659) of patients had trauma. Data is missing for 52 NTASM patients.

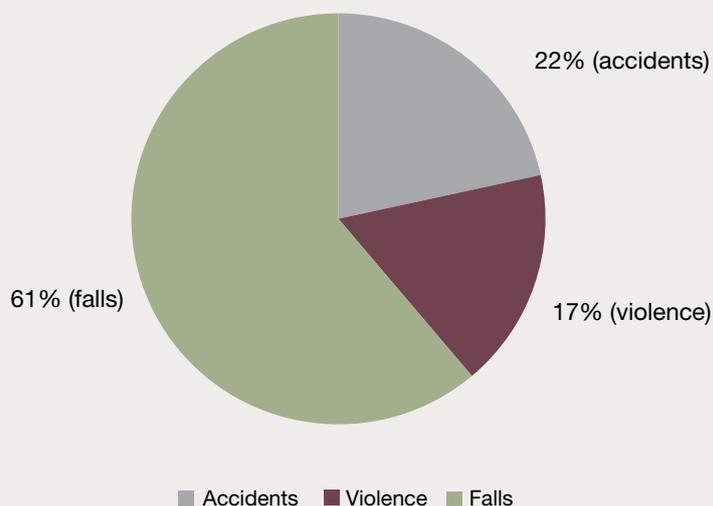
Of the NTASM trauma patients, a higher proportion were non-Aboriginal and Torres Strait Islander persons—66% (93/140) compared to Aboriginal and Torres Strait Islander persons 34%—(47/140). [RR = 1.98; 95% CI 1.52 to 2.57].

Trauma was most commonly associated with falls, 61% (85/140) (see Figure 6). The NTASM trauma patients who had falls were elderly with a median age of 72 years (IQR 60 to 84).

Road traffic accidents account for 21.4% (30/140) of trauma cases. Official statistics regarding fatalities due to motor vehicle accidents are nearly three times higher in the NT than for the rest of Australia. ⁽¹⁵⁾

Violence was associated with 17% (24/140) of NTASM trauma patients.

Figure 6: Distribution of causes of trauma (n=140)



[See data table 5 for numbers of the causes of trauma]

2.8.2 Trauma – falls

Falls were the most frequent cause of trauma, accounting for 61% (85/140) of patients with documented trauma. Of these patients, more than half (58%, 49/85) were males and 76% (65/85) were aged over 70 years.

An outline of traumatic falls:

- 57% (48/85) occurred at home
- 17% (14/85) were due to other causes (e.g. sport or recreation)
- 13% (11/85) occurred in a care facility
- 13% (11/85) occurred in hospital

2.9 INFECTIONS

Key Points

- Aboriginal and Torres Strait Islander persons were more likely than non-Aboriginal and Torres Strait Islander persons to present to hospital with an existing infection.

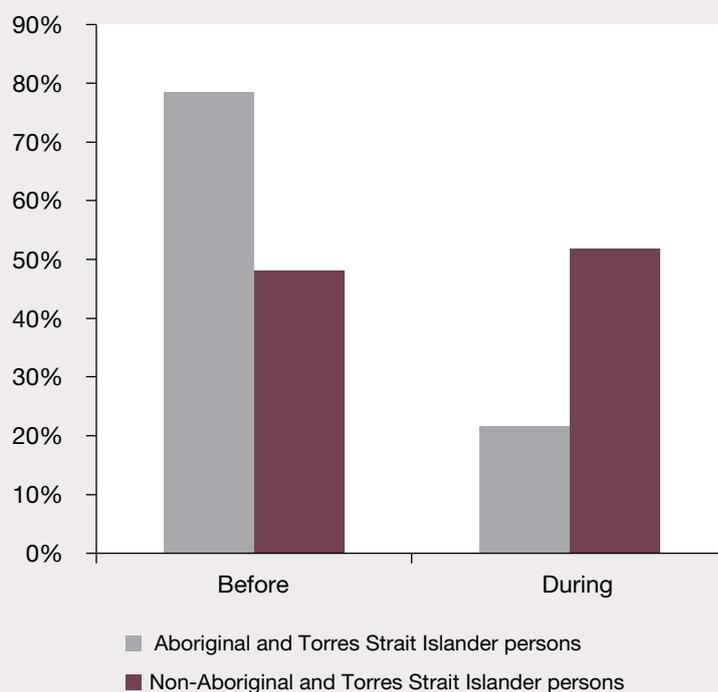
2.9.1 Overview

In NTASM, a clinically significant infection was present in 178 patients - 35% (178/511) and was not recorded for 61 patients. This is similar to the incidence of infections reported in previous years (NTASM in 2010—2017: 33% (120/335) and is similar to national data (34%, 5,267/15,404).

More than half of these infections were acquired prior to admission (59%, 104/175; data was missing for 3 patients).

In NTASM, Aboriginal and Torres Strait Islander persons (77%; 51/65) were more likely to have acquired the infection prior to admission compared with non-Aboriginal and Torres Strait Islander persons (48%, 53/110). Figure 7 provides an overview of the timing of infection acquisition for NTASM patients.

Figure 7: Proportion of Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons with infections acquired before and during admission (n=175*)



* data was missing for 3 patients.

[See data table 6 for numbers of patients when an infection was acquired]

2.9.2 Infections and operations

Operations were performed on 86% (153/178) of NTASM patients who died with a clinically significant infection.

Of these patients:

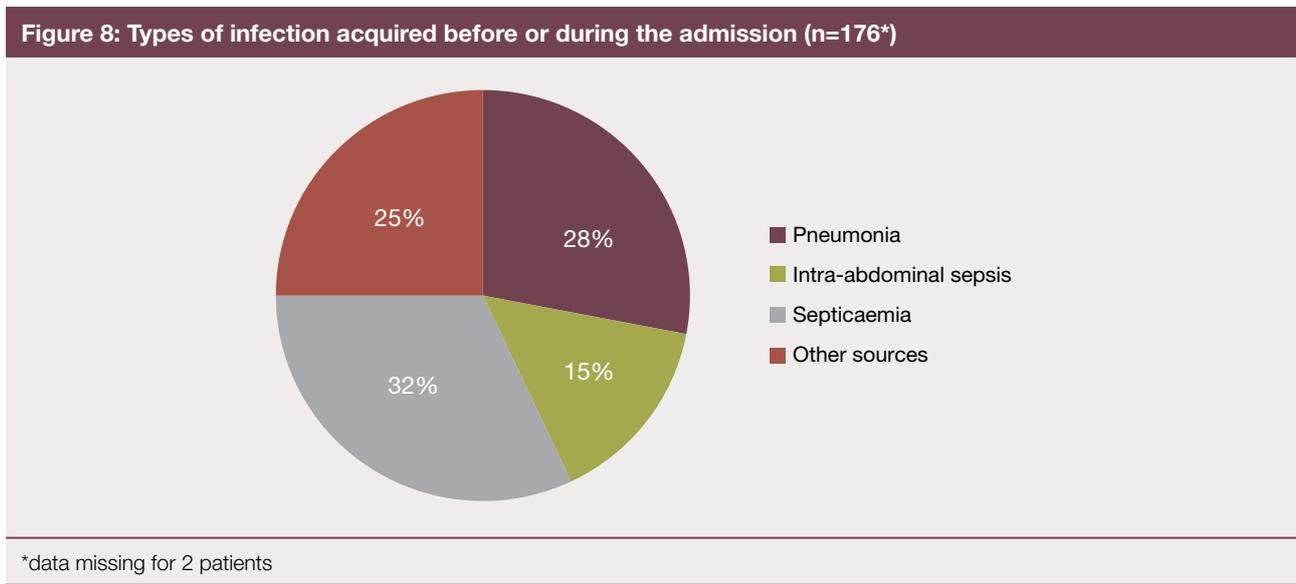
- 6 had a surgical-site infection
- 6 had an invasive-site infection
- 10 acquired an infection preoperatively
- 40 acquired an infection postoperatively

[data missing for 91 patients]

2.9.3 Infection

Of the 178 patients, sources of infections were recorded for 176 patients.

Septicaemia, pneumonia and “other sources” were the most common types of infection (see Figure 8).



3 NT BASELINE INPATIENT DATA COMPARED WITH NTASM PATIENT DATA

This section includes patients admitted to NT public hospitals from January 2018 to December 2018 who had a surgical procedure and were discharged from hospital. These patients are referred to as baseline inpatients. Some patients had multiple admissions and only the first admission is included in the analysis. These baseline inpatients will be compared with NTASM patients admitted during the same period (January 2018 to December 2018).

For the baseline inpatients, (n=16,742), the gender ratio (Male 47%: Female 53%) was different compared to the NTASM patients (56% Male: Female 44%).

For the baseline inpatients, the proportion of emergency admissions (38%; 6,323/16,742) was different compared to the NTASM patients (95%; 82/86).

The baseline inpatients and the NTASM patients have similar proportions of Aboriginal and Torres Strait Islander patients. This indicates that the patients in the NTASM dataset are representative of the general surgical population in the Northern Territory.

Of the baseline inpatients, 57% (957/16,733) of patients have comorbidities present compared to 85% (73/86) of NTASM patients. Diabetes and obesity were similar in both populations.

The baseline inpatients included lower numbers of patients where alcohol and trauma were recorded.

For the baseline inpatients, the median length of hospital stay was one day compared to 12 days for the NTASM patients.

For the baseline inpatients, more than half were healthy or had mild systemic disease compared to the NTASM patients that had severe disease.

Table 10 shows the differences between the NT baseline inpatients and the NTASM patients.

Table 10: NT baseline inpatients compared with NTASM patients		
Characteristics	Baseline inpatients (n=16,742)	NTASM patients (n=86)
Gender		
Male	7,836 (47%)	48 (56%)
Female	8,906 (53%)	38 (44%)
Admission status		
Emergency	6,323 (38%)	82 (95%)
Elective	8,234 (49%)	4 (5%)
Not assigned	2,170 (13%)	-
Unknown/not reported	6 (<1)	-
Indigenous Status		
Aboriginal and Torres Strait Islander persons	6,574 (39%)	33 (38%)
Non-Aboriginal and Torres Strait Islander persons	10,154 (61%)	53 (62%)
Unknown	14 (<1%)	-
Comorbidities present*		
Diabetes	3,560 (21%)	25 (29%)
Cardiovascular	889 (5%)	49 (57%)
Renal	1,071 (6%)	23 (27%)
Obesity	880 (5%)	5 (6%)
Respiratory	562 (3%)	26 (30%)
Hepatic disease	587 (4%)	10 (12%)
Alcoholic hepatic disease	117 (0.7%)	-
Dementia**	103 (0.6%)	18 (21%)
Smoking	5,936 (35%)	-
History of alcohol use		
	880 (5%)	18 (21%)
Trauma		
	1,464 (8%)	23 (27%)
Length of hospital stay, days (median, IQR)		
	1 (1 – 3)	12 (4 – 28)
ASA Class		
I – healthy patient	4,911 (22%)	1 (1%)
II – patient with mild systemic disease	8,396 (37%)	1 (1%)
III – patient with severe systemic disease	3,717 (16%)	29 (39%)
IV – patient with incapacitating disease, that is a constant threat to life	655 (3%)	31 (42%)
V – moribund patient, not expected to survive	54 (0%)	11 (15%)
VI – brain dead patient for organ donation		1(1%)
Unknown/Not stated	4,865 (22%)	12 (14%)
Note: ICD-10 coding was used to describe comorbidities for the baseline inpatients		
*Comorbidities were recorded for 16,733 baseline inpatients and 86 NTASM inpatients		
**Dementia in NTASM patients is recorded as Neurological		

For the baseline inpatients, the distribution of ages show that these patients are younger than the NTASM patients (see Figure 9 and Figure 10).

Figure 9: Distribution of ages of baseline inpatients by age groups (n=16,733)

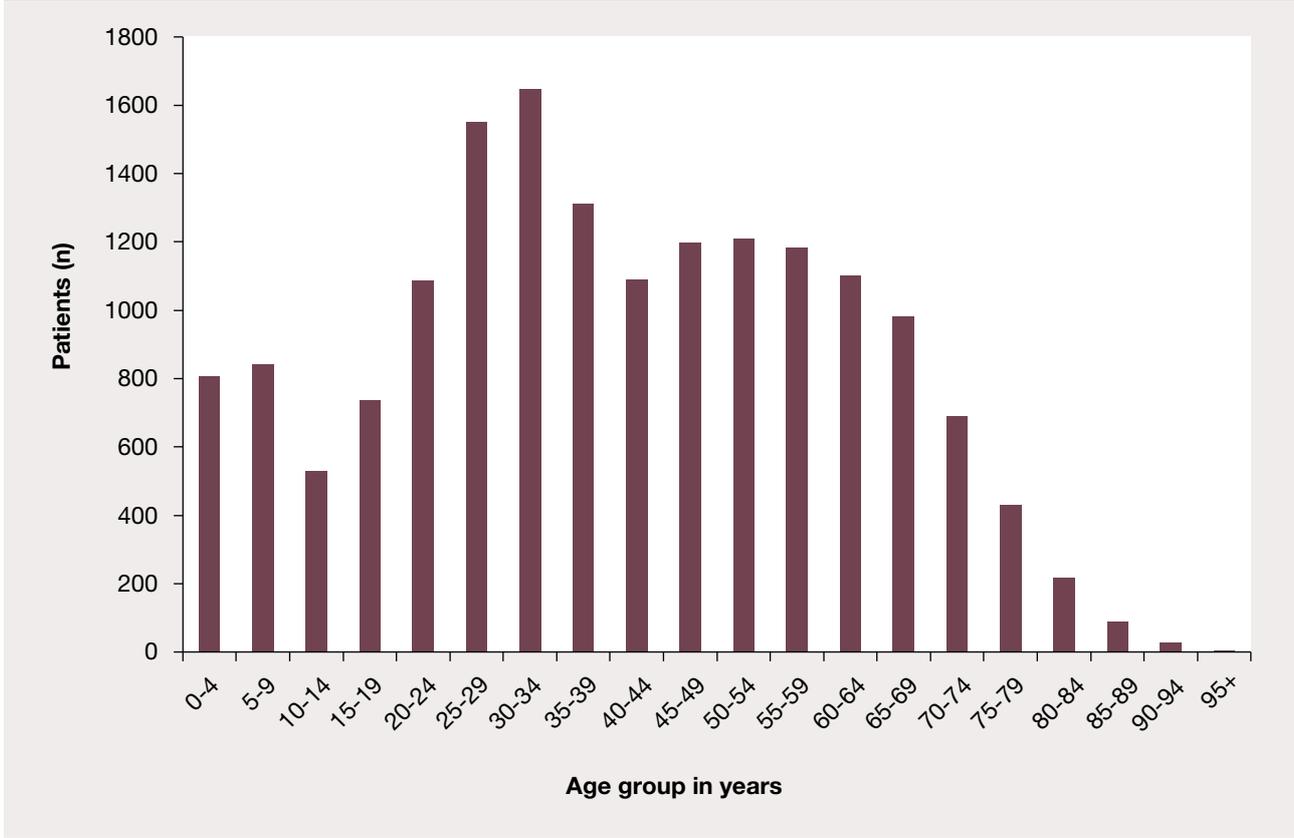
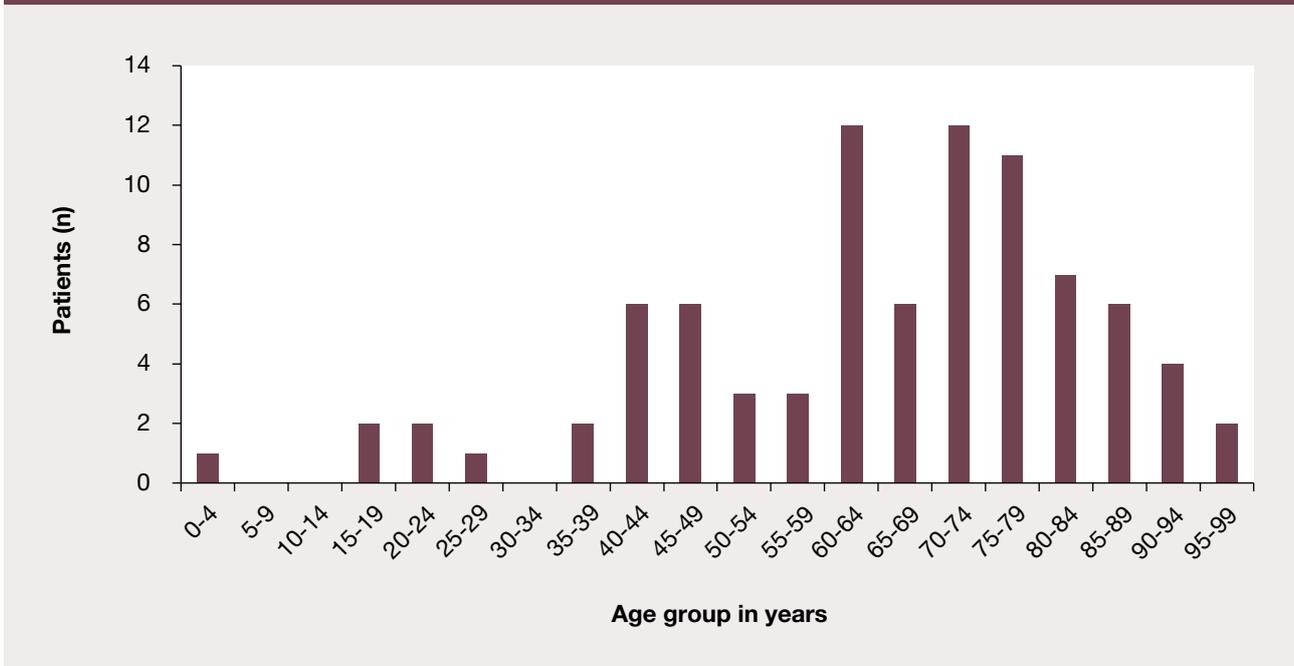


Figure 10: Distribution of NTASM patients by age group (n=86)



In both the baseline inpatients and the NTASM patients, Aboriginal and Torres Strait Islander persons were, on average, younger than Non-Aboriginal and Torres Strait Islander persons. Although Aboriginal and Torres Strait Islander persons in the baseline inpatients group were represented in the age groups from 75 – 84 years, but not in NTASM. (See Figure 11 and 12).

Figure 11: Distribution of baseline inpatients in Aboriginal and Torres Strait Islander persons by age group

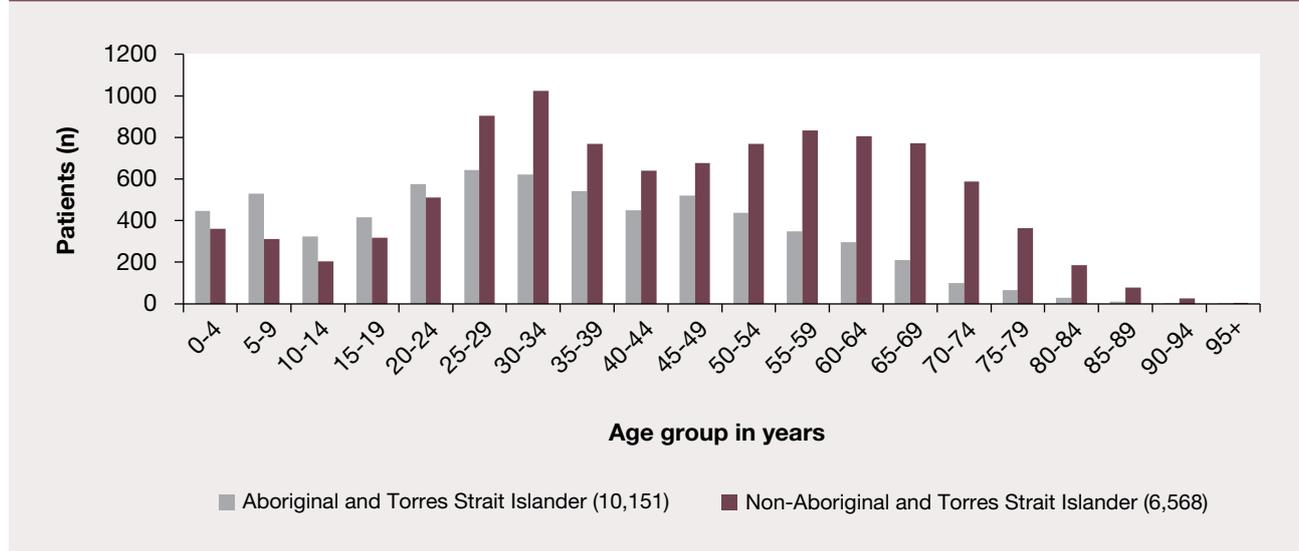


Figure 12: Distribution of ages of NTASM patients in Aboriginal and Torres Strait Islander persons



For the baseline inpatients, the principal diagnosis for their admission was mainly for obstetric deliveries, cataracts, gastrointestinal haemorrhage and cutaneous abscesses (see data table 8).

In NTASM patients, the main admission diagnosis was severe head/brain injury - traumatic, sepsis and necrotising fasciitis.

4 DATA TABLES

Data Table 1: Distribution of postoperative complications in patients who had complications (n=164)

Complication	Number	Percent
Other	96	59%
Significant postoperative bleeding	31	19%
Tissue ischaemia	18	11%
Vascular graft occlusion	6	4%
Anastomotic leak - small bowel	3	2%
Anastomotic leak - colorectal	3	2%
Procedure related sepsis	2	1%
Anastomotic leak - pancreas/biliary	2	1%
Endoscopic perforation	2	1%
Anastomotic leak - gastric	1	1%

Data Table 2: Distribution of patient groups by Aboriginal and Torres Strait Islander status and age group (n=572)

Age Group (years)	Aboriginal and Torres Strait Islander persons (n=211)		Non-Aboriginal and Torres Strait Islander persons (n=361)	
	Number	Percent	Number	Percent
0-4	2	0.9%	3	0.8%
5-9	1	0.5%	7	1.9%
15-19	3	1.4%	8	2.2%
20-24	8	3.8%	7	1.9%
25-29	6	2.8%	5	1.4%
30-34	5	2.4%	4	1.1%
35-39	8	3.8%	7	1.9%
40-44	24	11.4%	13	3.6%
45-49	26	12.3%	18	5.0%
50-54	25	11.8%	14	3.9%
55-59	23	10.9%	32	8.9%
60-64	23	10.9%	42	11.6%
65-69	18	8.5%	59	16.3%
70-74	15	7.1%	56	15.5%
75-79	13	6.2%	38	10.5%
80-84	6	2.8%	28	7.8%
85-89	4	1.9%	13	3.6%
95-99	1	0.5%	7	1.9%

Comorbidity	Number	Percent
Cardiovascular	295	52%
Other	193	34%
Age	180	31%
Renal	165	29%
Respiratory	161	28%
Diabetes	158	28%
Advanced malignancy	110	19%
Hepatic	107	19%
Neurological	96	17%
Obesity	52	9%
Data missing for 1 patient		

Comorbidities	Aboriginal and Torres Strait Islander persons (n=210)		Non-Aboriginal and Torres Strait Islander persons (n=361)	
	Number	Percent	Number	Percent
Cardiovascular	112	53%	183	51%
Renal	99	47%	66	18%
Diabetes	86	41%	72	20%
Hepatic	66	31%	41	11%
Respiratory	58	28%	103	29%
Other	54	26%	108	30%
Age	40	19%	140	39%
Neurological	35	17%	61	17%
Advanced malignancy	22	10%	88	24%
Obesity	13	6%	39	11%
*Data missing for 1 patient				

Cause of trauma	Number	Percent
Falls	85	61%
Accidents	30	22%
Violence	24	17%
*Data missing for 1 patient		

When infection was acquired	Aboriginal and Torres Strait Islander persons (n=65)		Non-Aboriginal and Torres Strait Islander persons (n=110)	
	Number	Percent	Number	Percent
Before admission	51	79%	53	48%
During admission	14	22%	57	52%
*Data missing for 3 patients				

Complication	Number	Percent
Septicaemia	57	32%
Pneumonia	49	28%
Other source	44	25%
Intra-abdominal sepsis	26	15%
*Data missing for 3 patients		

Principal diagnosis	Number	Percent
Single delivery by caesarean section	876	5%
Cataract, unspecified	500	3%
Single spontaneous delivery	328	2%
Gastrointestinal haemorrhage, unspecified	281	2%
Dental caries, unspecified	275	2%
Cutaneous abscess, furuncle and carbuncle of upper limb	245	2%
Cutaneous abscess, furuncle and carbuncle of lower limb	218	1%
Acute appendicitis, other and unspecified	211	1%
Cutaneous abscess, furuncle and carbuncle of buttock	194	1%
Single delivery by forceps and vacuum extractor	185	1%
Other faecal abnormalities	172	1%
Cutaneous abscess, furuncle and carbuncle of trunk	168	1%
Medical abortion, complete or unspecified, without complication	150	0.9%
Chronic gastritis, unspecified, without mention of haemorrhage	127	0.8%
Chronic tonsillitis	109	0.7%
Excessive and frequent menstruation with regular cycle	107	0.6%
Gastro-oesophageal reflux disease without oesophagitis	106	0.6%
Fracture of lower end of radius with dorsal angulation	105	0.6%
Acute subendocardial myocardial infarction	104	0.6%
Iron deficiency anaemia, unspecified	102	0.6%
Calculus of gallbladder with other cholecystitis, without mention of obstruction	99	0.6%
Missed abortion	97	0.6%
Acute appendicitis with localised peritonitis	95	0.6%
Open wound of finger(s) without damage to nail	94	0.6%
Gastro-oesophageal reflux disease with oesophagitis	92	0.5%
Unilateral or unspecified inguinal hernia, without obstruction or gangrene, not specified as recurrent	92	0.5%
Routine and ritual circumcision	90	0.5%
Cutaneous abscess, furuncle and carbuncle of foot	86	0.5%

Data Table 9: Most frequent admission diagnosis for NTASM patients (n=572)		
Admission diagnosis	Number	Percent
Cerebral haemorrhage	38	6.6%
Fractured neck of femur	34	5.9%
Severe traumatic head/brain injury	32	5.6%
Sepsis	25	4.4%
Necrotizing fasciitis	21	3.7%
Small bowel obstruction	18	3.1%
Diabetic foot bilateral heel ulcers	16	2.8%
Multi-trauma	15	2.6%
Malignancy	14	2.4%
Ischaemic bowel	13	2.3%
Large bowel obstruction	11	1.9%
Cellulitis - both lower limbs	11	1.9%
Acute pancreatitis	10	1.7%
Abdominal aortic aneurysm	10	1.7%
Gastro-intestinal bleeding	9	1.6%
Septic arthritis left shoulder and left knee in septic shock	9	1.6%
Ischaemic limb	9	1.6%
Upper gastro-intestinal bleed	8	1.4%
Bleeding oesophageal varices	8	1.4%
Peritonitis	7	1.2%
Septic shock	6	1.0%
Acute cholecystitis	6	1.0%
Stroke	6	1.0%
Diverticulitis	6	1.0%
Gangrene left foot	4	0.9%
Gastric cancer	4	0.9%
Carcinoma of oesophagus	4	0.9%
Drowning	3	0.7%
Asphyxia after attempted hanging	3	0.7%
Liver failure	3	0.7%
Urosepsis	3	0.5%
Hypovolemic shock	3	0.5%

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Thank you to the NTASM management committee for its wisdom and counsel.

Thank you to the NTASM staff who manage the process in a systematic way.

Dr John North FRACS

NTASM Clinical Director

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Dr John North	Clinical Director, NTASM
Dr Mahiban Thomas	Director of Surgical Services, Top End Health Service
Dr Philip Toonson	Supervisor Surgical Training, Royal Darwin Hospital
Dr Sanjay Kalgutkar	General Surgeon, Royal Darwin Hospital
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Dr Alison Maclean	Director Safety & Quality, Top End Health Service
Dr Sara Watson	Acting Chief Medical Officer, Senior Director Clinical Excellence and Patient Safety, Department of Health.
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Anaesthesia representatives	
Dr Phil Blum	Deputy Director, Department of Anaesthesia, Top End Health Service and NT representative for the ANZCA mortality subcommittee
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SHORTENED FORMS

ANZASM	Australian and New Zealand Audit of Surgical Mortality
ANZCA	Australian and New Zealand College of Anaesthetists
ASA	American Society of Anaesthesiologists
CI	confidence interval, usually at 95%
CVD	cardiovascular disease
HDU	high dependency unit
km	kilometres
ICD-10 coding	International Classification of Disease 10th revision
ICU	intensive care unit
IMG	International Medical Graduate
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 ratio
SCF	surgical case form
SET	Surgical Education and Training
WAASM	Western Australian Audit of Surgical Mortality

REFERENCES

1. The Royal Australasian College of Surgeons. Australian and New Zealand Audit of Surgical Mortality national report 2016. Adelaide: Royal Australasian College of Surgeons; [2017] [Cited 2019 Nov 07]. 53p. Available from: https://umbraco.surgeons.org/media/3610/2017-10-05_rpt_racs_anzasm_national_report_2016.pdf
2. Australian Bureau of Statistics. 3238.0.55.001-Estimates of Aboriginal and Torres Strait Islander Australians. 30 August 2014. [cited 2019 Nov 07]; Available from <https://www.abs.gov.au/ausstats/abs@.nsf/mf/3238.0.55.001>
3. NHS Digital. Read Codes. 2018 [cited 2018 January 12]; Available from: <https://digital.nhs.uk/article/1104/Read-Codes>
4. Kable A, Gibberd R, Spigelman, A. Predictors of adverse events in surgical admissions in Australia. *Int J Qual Health C.* 2008; 20: 406-411. Available from: DOI: <http://intqhc.oxfordjournals.org/content/20/6/406.long>. DOI: 10.1093/intqhc/mzn032
5. North JB, Blackford FJ, Wall, D et al. Analysis of the causes and effects of delay before diagnosis using surgical mortality data. *Br J Surg.* 2013; 100: 419-425. Available from: <http://dx.doi.org/10.1002/bjs.8986> DOI: 10.1002/bjs.8986
6. Fevang BT, Fevang J, Stangeland L, Soreide O, Svanes K, Viste A. Complications and death after surgical treatment of small bowel obstruction: A 35-year institutional experience. *Ann Surg.* 2000; 231: 529-537. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1421029/> PMID: PMC1421029
7. McNicol L, Story DA, Leslie K et al. Postoperative complications and mortality in older patients having non-cardiac surgery at three Melbourne teaching hospitals. *MJ Aust.* 2007; 186(9): 447-52. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/17484705> DOI: mcn10566_fm [pii]
8. Cavaliere F, Conti G, Costa R, Masieri S, Antonelli M, Proietti R. Intensive care after elective surgery: a survey on 30-day postoperative mortality and morbidity. *Minerva Anestesiologica.* 2008; 74:459-468. Available from: <https://www.minervamedica.it/en/journals/minerva-anestesiologica/article.php?cod=R02Y2008N09A0459>
9. Lefavre KA, Macadam SA, Davidson DJ, Gandhi R, Chan H, Broekhuysen HM. Length of stay, mortality, morbidity and delay to surgery in hip fractures. *Bone Joint Surg Br.* 2009; 91: 922-927. Available from: <http://www.jbjs.boneandjoint.org.uk/content/91-B/7/922.abstract> DOI: 10.1302/0301-620x.91b7.22446
10. Vogel TR., Dombrovskiy VY, Lowry SF. In-hospital delay of elective surgery for high volume procedures: the impact on infectious complications. *J Am Coll Surg.* 2010; 211: 784-790. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/20980170> DOI: 10.1016/j.jamcollsurg.2010.08.009
11. Ehsani JP, Jackson T, Duckett SJ. The incidence and cost of adverse events in Victorian hospitals 2003-04. *MJ Aust.* 2006; 184: 551-555. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/16768660> DOI: ehs11107_fm [pii]
12. Australian Bureau of Statistics. Population and people. Northern Territory. [cited 2018 Nov 14]; Available from http://stat.abs.gov.au/itt/r.jsp?RegionSummary®ion=7&dataset=ABS_REGIONAL_ASGS&geoconcept=REGION&datasetASGS=ABS_REGIONAL_ASGS
13. Australian Institute of Health and Welfare 2015. Leading cause of premature mortality in Australia fact sheet: liver disease. Cat. no. PHE 199. Canberra: AIHW. [cited 2019 Nov 07]; Available from: <https://www.aihw.gov.au/getmedia/a088f80f-fcdb-4c5d-aa00-ca776bd7f792/phe199-liver.pdf.aspx>

14. Burke V, Zhao Y, Lee AH et al., Health-related behaviours as predictors of mortality and morbidity in Australian Aborigines. *J Prev Med.* 2007; 44: 135-142.
Available from: <https://www.sciencedirect.com/science/article/pii/S0091743506003781> DOI: <http://dx.doi.org/10.1016/j.ypmed.2006.09.008>
15. Australian Government, Bureau of Infrastructure, Transport and Regional Economics. Road deaths Australia: June 2018 statistical summary. Canberra: Department of Infrastructure and Regional Development, 2013. [cited 2019 Nov 27]; Available from: <https://www.bitre.gov.au/sites/default/files/Road%20trauma%20Australia%202018%20statistical%20summary.pdf>
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; 85:11-15.
Available from: <https://onlinelibrary.wiley.com/doi/full/10.1111/ans.12896>. DOI:10.1111/ans.12896
17. American Society of Anesthesiologists. Quality and practice management: standards, guidelines and practice parameters. ASA physical status classification system 2104 [updated 23 October 2019: cited 27 November 2019]. Available from: <https://www.asahq.org/standards-and-guidelines/asa-physical-status-classification-system>.

APPENDIX 1: NTASM PROJECT GOVERNANCE

Background

The Royal Australasian College of Surgeons (RACS) became responsible for the management of the Western Australian Audit of Surgical Mortality (WAASM) in 2006. The WAASM was modelled on the Scottish Audit of Surgical Mortality, which began in 1988. The RACS has expanded the program to all other states and territories under the umbrella of the Australian and New Zealand Audits of Surgical Mortality (ANZASM). The NTASM started participating in 2010. It is funded by the NT Government Department of Health.

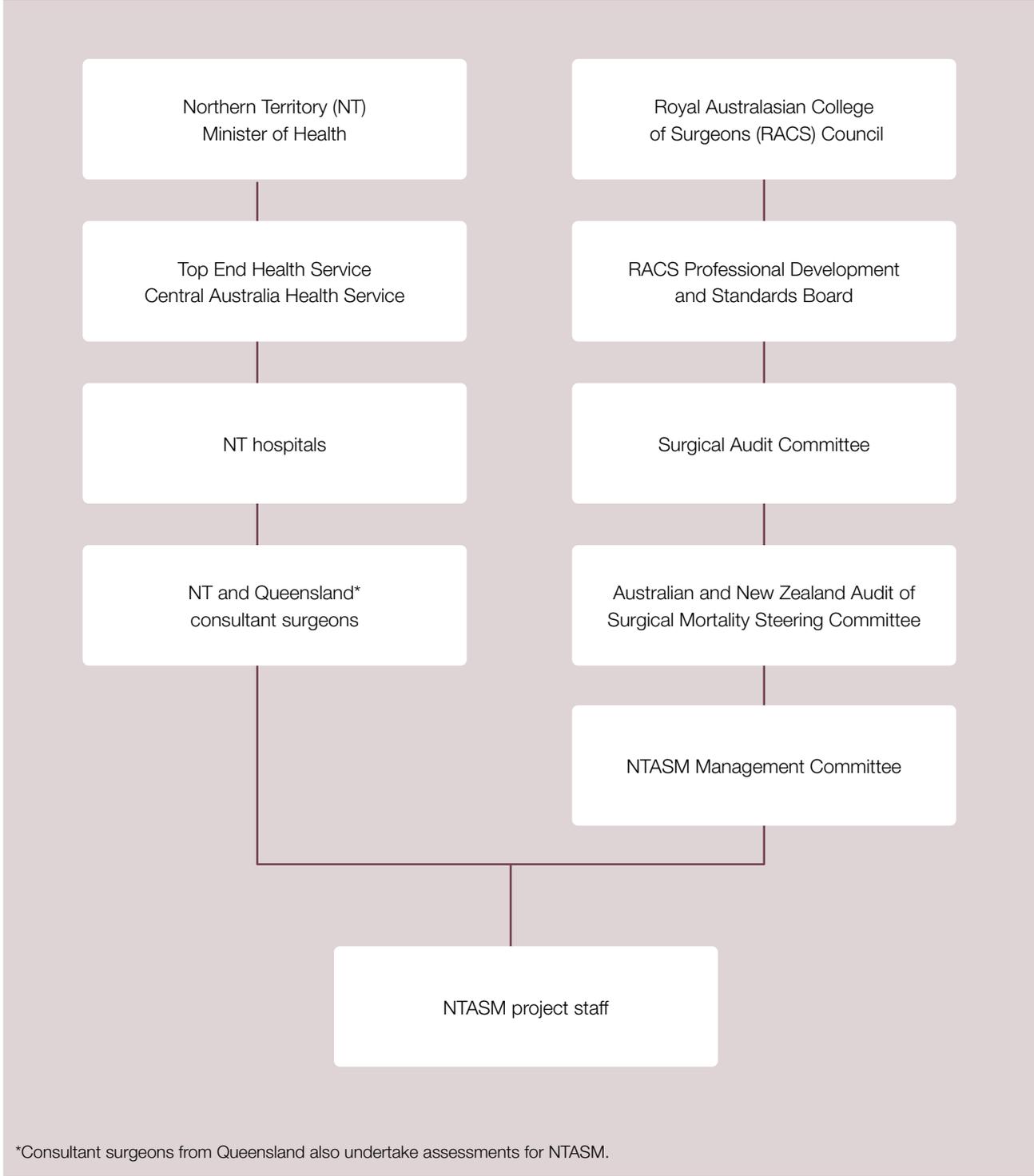
Project governance

The project governance structure is illustrated in Figure 13. As part of the ANZASM, NTASM has protection under the Commonwealth Qualified Privilege Scheme, under Part VC of the Health Insurance Act 1973 (gazetted 25th July 2016).

All Australian states and territories participate in the national ANZASM process. Information about the state and territory audits is available on the RACS website:
<https://www.surgeons.org/research-audit/surgical-mortality-audits>

The NTASM web page can be found at:
<https://www.surgeons.org/research-audit/surgical-mortality-audits/regional-audits/ntasm>

Figure 13: Northern Territory Audit of Surgical Mortality (NTASM) project governance structure



*Consultant surgeons from Queensland also undertake assessments for NTASM.

EDUCATION FOR SURGEONS

The NTASM has contributed to the surgical education process in the NT. In particular, the NTASM has:

- managed the audit process for the NT, including the provision of 386 first-line assessment reports and 42 second-line assessment reports to NT surgeons since 2010.
- published 20 volumes of *Lessons from the Audit* in collaboration with the Queensland Audit of Surgical Mortality. The *Lessons from the Audit* series contains case studies that highlight key issues relating to surgical practice. These publications are of interest not only to NT surgeons, but to all who are involved in patient care in the NT. A list of the volumes, their titles and/or themes is provided in Appendix 3.
- published an article in the Australia and New Zealand Journal of Surgery entitled Outcomes from the Northern Territory Audit of Surgical Mortality: Aboriginal deaths. ⁽¹⁶⁾

PRESENTATIONS

- Seminars held in Brisbane and the Gold Coast (Queensland) over the audit period have been attended by some NT surgeons. One seminar was convened by an NT surgeon. The themes for the seminars were:
 - Dilemmas: distance, delay, deteriorating patient (2011)
 - Complex surgical decision making in modern surgical practice (2012)
 - Adverse events – systems or surgeons? (2013)
 - Situational awareness and the surgeon (2014)
 - Operating on the obese patient (2015)
 - The elderly surgical patient and evidence based practice (2016)
 - Captain of the Ship? – a surgeon’s role in safety and quality (2017)
 - Infections in surgical patients (2018)
 - Distance delays and deterioration: improving surgical care in Queensland (2019).
- Presentations made at the Joint Western Australia/South Australia/NT Annual Scientific meetings during the audit period include:
 - From Scotland to Shoal Bay (2010)
 - Northern Territory surgical patient population differences compared with the rest of Australia and review of new mortality questions (2012)
 - A glimpse at the Northern Territory (2012)
 - Is quality assurance important for surgeons? (2013)
 - Audit is about learning (2014)
 - Improving care for rural and remote communities (2015)
 - Learning from the audits of surgical mortality (2015)
 - Feedback in adult learning (2016)
 - Infections (2018).

- Meetings attended by NTASM staff (Clinical Director, Manager and Project Officer) include:
 - Neville Taylor Research Day, Royal Darwin Hospital (2013)
 - Neville Taylor Research Day, Royal Darwin Hospital (2014)
 - Presentation to the Royal Darwin Hospital surgeons, Royal Darwin Hospital (2014)
 - RACS Northern Territory Trauma Seminar, Darwin (2015)
 - Presentation to the Royal Darwin Hospital surgeons, Royal Darwin Hospital (2016)
 - Presentation to the Royal Darwin Hospital and Darwin Private Hospital obstetricians and gynaecologists, Royal Darwin Hospital (2016)
 - Presentation to the Royal Darwin Hospital and Darwin Private Hospital anaesthetists, Royal Darwin Hospital (2016).
 - Qualified Privilege strategy meeting, ANZASM, Melbourne (2018).
 - Department of the Prime Minister and Cabinet meeting about new data sharing and release legislation (2018).
 - Presentation from the Queensland Health Data Linkage Symposium (2018).

REPORTS, LETTERS AND MEDIA RELEASES

- An NTASM infections report titled “Infections and NTASM patients” was published and widely distributed amongst NT surgeons and health professionals. The report included NTASM infection data from July 2010 to June 2017 and a case study.
- Dr John Treacy, Chair of the NTASM Management Committee and a NT surgeon, submitted a letter to the NT Minister for Health noting that clinical management issues reported in the NTASM Hospital Report (2017) are within acceptable limits compared with similar hospitals across Australia.
- The NTASM’s manager has been an active member since 2015 in the RACS Reconciliation Group to facilitate the integration of Aboriginal and Torres Strait Islander persons into the RACS workforce, including the surgical workforce. In 2016 the RACS formally formed the Indigenous Health Committee.
- The RACS Foundation for Surgery is supportive of two projects:
 - supporting Aboriginal and Torres Strait Australians aspiring to a career in surgery, and
 - providing essential Trauma Management (EMST) training in Timor Leste.
- Dr Mahiban Thomas, Director of Surgical Services, Top End Health, presented at the QASM seminar held in Townsville, Queensland on 18 October 2019. This presentation highlighted complex transfer issues faced in the Northern Territory when trying to provide “best care” to patients.

NTASM IN THE MEDIA

An article on page 22 in the Surgical News : Advocating for positive change in the Northern Territory highlights the 2017 Riley Review that was commissioned by the NT Government. This review highlighted the alcohol issues in the Northern Territory. The RACS representative driving this review included Dr Mahiban Thomas and Associate Professor Patrick Bade. Access the article in the Surgical News with the following link: https://umbraco.surgeons.org/media/4569/surgical-news_september-october-web.pdf

NTASM AUDIT PROCESS

Methodology

Surgical or medical records departments in hospitals notify NTASM of all surgical deaths. All patient cases in which a surgeon was responsible for, or had significant involvement in the patient's care are included in the audit, even when the patient did not have a surgical procedure.

The clinical details relating to each case's management are recorded on a standard structured questionnaire known as a Surgical Case Form (SCF), which is completed by the consultant surgeon associated with the case. The completed SCF is de-identified by NTASM staff and sent for first-line assessment to a surgeon from the same specialty.

In NTASM, first- and second-line assessors are peer surgeons from a different state. De-identification, combined with the assessors from outside the NT, ensures that anonymity and impartiality are preserved. The first-line assessor will either provide feedback and close the case, or recommend that the case undergo further assessment as a second-line assessment.

Patient's cases may be referred for second-line assessment if:

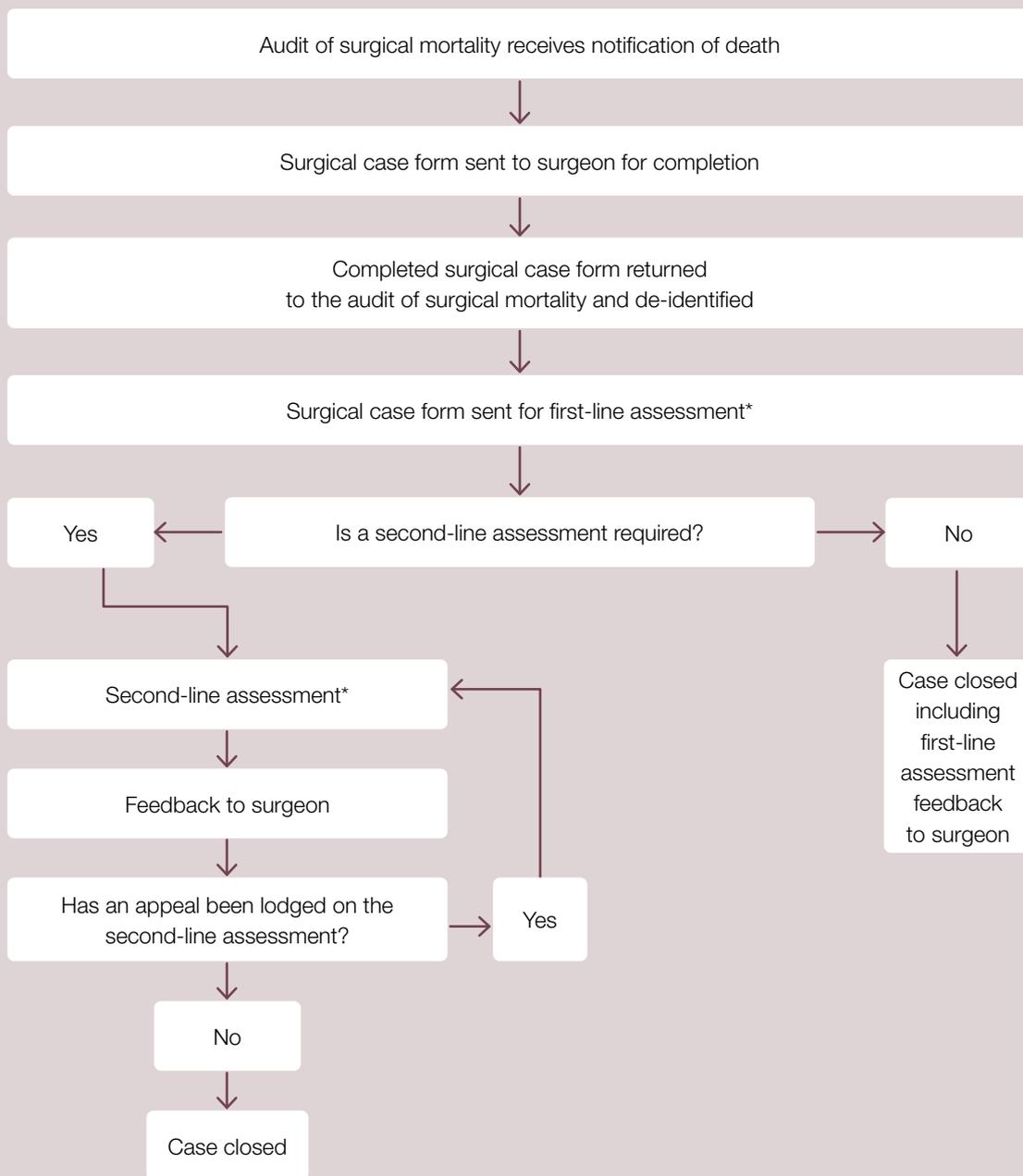
- an area of concern or adverse event is thought to have occurred during the patient's clinical care and warrants further investigation.
- a second-line assessment report could usefully draw attention to surgical practice, providing an educational opportunity for the surgeon involved in the case or for a wider audience by using it in a case note review publication.
- the information provided by the consultant surgeon was insufficient and did not allow the first-line assessor to reach a conclusion about the case.

If a second-line assessment is deemed necessary, the second-line assessor is selected by the Clinical Director using the same criteria as used for the first-line assessor. Second-line assessors are generally considered experts in the area under review.

Occasionally a surgeon may appeal the findings from the second-line assessment. In these instances the Clinical Director selects a third assessor to perform another second-line assessment. To date, there have been no third-line reviews in NTASM.

The methodology used by NTASM is outlined in Figure 14.

Figure 14: Northern Territory Audit of Surgical Mortality methodology



*First-line and second-line assessors for NTASM are peer surgeons from a different state.

PROVIDING FEEDBACK

The role of the NTASM is to inform, educate, facilitate change and improve practice by providing feedback. The NTASM provides feedback to surgeons and hospitals in a variety of ways:

- surgeons receive written feedback from assessors about their patient's cases.
- surgeons receive an electronic copy of the NTASM annual report, also available from the RACS website: www.surgeons.org/ntasm.
- surgeons receive de-identified summaries of second-line assessments in "Lessons from the Audit". They also receive the National Case Note Review Booklet, using patient cases from across Australia.
- hospitals participating in NTASM receive clinical governance reports on aggregated, de-identified data. These compare their hospitals to other hospitals across Australia.
- surgeons have online reports relating to their own audit data via the NTASM online at: <https://asm.surgeons.org/mortaudit/>.

AUDIT INCLUSION AND EXCLUSION CRITERIA

The NTASM includes all deaths that occur in NT hospitals while a patient is under the care of a surgeon. Patients who are deemed terminal upon admission and do not have operations are excluded from the audit process.

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

- the patient was under surgical care (surgical admission), whether or not an operation was performed
- the patient was under a physician's care (medical admission) and subsequently underwent a surgical procedure
- the patient was a gynaecology-related surgical patient
- the patient was possibly or definitely an anaesthetic-related surgical death, or a death that occurred within 48 hours of surgery.

NTASM excludes cases that do not meet the above inclusion criteria.

REPORTING CONVENTIONS

Reporting clinical incidents

NTASM asks surgeons and assessors to review patient cases and determine if there were any clinical incidents where care could have been better. These are then coded by whether the death was a direct result of the disease process alone, or if aspects of management contributed to the death. If there was a perception that the clinical management may have contributed to death, the clinical incidents are reported against the following criteria.

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

The surgeon is also asked to:

- report the impact of the incident on the outcome, that is, whether the incident:
 - 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 as to whether the incident was preventable, using the following categories:
 - definitely
 - probably
 - probably not
 - definitely not.
- indicate who the incident was associated with:
 - audited surgical team
 - another clinical team
 - hospital
 - other.

Both first-line and second-line assessors are asked to respond to the same set of questions. This results in a two-level peer-review process for those cases that undergo second-line assessment. The second-line assessment is more in-depth and more forensic, as second-line assessors have access to all available patient information through the medical records.

Assessor opinion

The areas of consideration, areas of concern and adverse events contained within this report are events ascribed to the patient by either the first-line or second-line assessor. Throughout the report, first-line and second-line assessors are both referred to as 'assessors'.

Assessors are asked for their opinions on the following:

- the categorisation of the severity of the clinical incident (area of consideration, area of concern or adverse event)
- the effect on outcomes
- the preventability of the clinical incident
- with whom the clinical incident was associated.

Analysis of clinical incidents

All information from NTASM is de-identified. Clinical incident findings are expressed in terms that cannot identify the patient, the surgeon or the hospital.

The NTASM report focuses on areas of concern and adverse events. While data regarding areas of consideration are collected, they are considered to be minor issues regarding treatment.

A patient's case may be associated with more than one clinical incident. For the analyses, a patient will be assigned the most serious incident.

Data management

This report covers deaths reported to the NTASM from 1st July 2010 to 30th June 2019. All data presented in this report is from the NTASM database. The nature of the audit process means that some patient's cases reported during this period will still be undergoing review as at the census date (31 July 2019). These patient cases will be included in the next report.

Surgeons complete the SCF and first-line assessment online. Data are entered and stored in a specifically designed database - a central Structured Query Language server database that includes a reporting engine.

Data are encrypted in the database with Secure Sockets Layer Certificates. All transactions are time stamped and all changes to audit data are written to an archive table, enabling a complete audit trail for each case. Security for this system is high. An integrated workflow rules engine supports the creation of letters, reminders and management reports.

To maintain data integrity, all data are routinely checked against the original SCF and assessment forms by the project manager or another project officer. Data are cleaned using logic testing and manually reviewed before analysis. Variables are checked for extreme or illogical values and corrections are made to the original data.

Once cleaned, the data are downloaded and copied to Statistical Package for Social Sciences (IBM-SPSS version 24.0) for analysis. A key variable that is common to all tables can be used to combine tables. Generally, frequencies and cross tabulations are used to create the report.

Qualitative analysis is performed using standard techniques. The NTASM project manager and Clinical Director independently classify all qualitative information into groups. These groupings are then compared and any differences discussed until consensus is reached.

In this report the numbers in parentheses (n) in the figures and tables represent the number of patients analysed. The numbers of patients included in each analysis is provided for all tables and figures in the report. Low case numbers for some surgical specialties may compromise confidentiality and the de-identification process. In these circumstances the surgical specialty will not be listed and all deaths will be aggregated under the specialty "Other".

Denominator variation

Denominator variation exists throughout this report, as not all data points were completed in both the surgical case forms and/or assessment forms. When denominator variation exists, this is noted in the relevant section, and the total number of patients used in the analyses.

Statistical analysis

Continuous variables are summarised using medians together with the interquartile range (IQR). The IQR shows the values for the data within the 25% and 75% limits. It overcomes the problems that arise when reporting the range because extreme values are ignored. It represents the middle 50% of values in a rank-ordered series.

The association between two variables: when the outcome is dichotomous, it is calculated using risk ratios (RRs). The RR is an intuitive way to compare the risks for two groups (i.e. it is the ratio of the probability of an event occurring [e.g. developing a disease] in an exposed group compared to the probability of the event occurring in a non-exposed group. If the RR is 1 (or close to 1), it suggests no difference or little difference in risk (incidence in each group is the same). A $RR > 1$ suggests an increased risk of that outcome in the exposed group. A $RR < 1$ suggests a reduced risk in the exposed group.

All RRs are reported with a 95% confidence interval (CI).

Statistical analysis is performed using Statistical Package for Social Sciences (IBM-SPSS version 24.0). Graphs are produced using either SPSS or Microsoft Office Excel (2010).

Data comparisons

In this report, the NTASM data is compared with the national ANZASM Report. ⁽¹⁾ National comparisons against NTASM data provide context to the NTASM data. These comparisons allow an easy assessment of healthcare standards overall, and may assist the NT Department of Health with future program planning aimed at improving the safety and quality of surgical care in the NT.

Northern Territory baseline inpatient data

The Northern Territory baseline inpatient data includes patients admitted to all NT public hospitals during 2018, who had a surgical procedure or operation performed by a surgeon that required a general anaesthetic. These patients may have been admitted by either a physician or a surgeon. The data reported is the last admission for each patient and excludes those patients reported to NTASM.

The data has been used in this report where appropriate.

The baseline inpatient data were provided by the Northern Territory Government's Data Management & System Reporting, Governance and Business Services (Approval number *DMSR-13143*). NTASM acknowledges Peta Archer, Kerry Gregory, Emidio Coccetti and Thuy Fong in the Northern Territory Department of Health for their work in eliciting data requirements, and development and delivery of data for this project.

APPENDIX 2: ASA CLASS DEFINITIONS

ASA class definitions*

1. A normal healthy patient.
2. A patient with mild systemic disease.
3. A patient with severe systemic disease which limits activity, but is not incapacitating.
4. A patient with an incapacitating systemic disease that is a constant threat to life.
5. A moribund patient who is not expected to survive 24 hours, with or without an operation.
6. A brain dead patient for organ donation.

*The American Society of Anesthesiologists (ASA) class. ⁽¹⁷⁾

APPENDIX 3: LESSONS FROM THE AUDIT

Volume	Year	Title/Theme
1	2008	Cardiac
2	2008	Perforated T-cell gastric lymphoma undergoing chemotherapy
3	2009	Bronchial stump leak
4	2009	Abdominal sepsis following elective laparoscopic ventral hernia repair
5	2010	Serious multi-trauma patients demand serious measures
6	2011	Multiple systems - multiple obstructions to best patient care?
7	2011	Decision before incision!
8	2011	Death after endoscopy - 'surgical audit' or not?
9	2012	Not in that institution...please!
10	2012	History and examination are still important for surgeons.
11	2013	Communication (theme)
12	2013	Preoperative management issues (theme)
13	2014	The obese patient (theme)
14	2014	Operation should not have been performed (theme)
15	2015	Postoperative complications (theme)
16	2016	Fluid balance (theme)
17	2016	The elderly surgical patient (theme)
18	2017	Infections (theme)
19	2018	General Surgery (theme)
20	2019	Vascular Surgery (theme)
21	2019	Urology Surgery (theme)



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The information contained in this Annual Report has been prepared by the Royal Australasian College of Surgeons Northern Territory Audit of Surgical Mortality Management Committee, which 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 25th July 2016).