



**Royal Australasian College of Surgeons
Northern Territory Audit of Surgical Mortality**

NTASM REPORT (2010-2016)



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COLLEGE OF SURGEONS



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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).

CONTENTS

Clinical Director's Report	4
NTASM Management Committee Chairman's Report	5
Executive Summary	6
Recommendations	8
1 Introduction	9
1.1 Background	9
1.2 Project governance	9
1.3 NTASM audit process	13
1.4 Reporting conventions	16
2 Audit Overview	19
3 Results	20
3.1 Clinical incidents	20
3.2 Surgeons	23
3.3 Hospitals	29
3.4 Patients	34
3.5 Aboriginal and Torres Strait Islander persons	41
3.6 Trauma	47
3.7 Infections	49
Acknowledgements	52
NTASM Management Committee	53
NTASM staff	53
Shortened forms	54
References	55

TABLES

Table 1:	Overview of NTASM cases in the audit reporting period 2010 to 2016	19
Table 2:	Participation by specialty	24
Table 3:	Grade of surgeon completing the surgical case form	24
Table 4:	Grade of NTASM surgeon deciding, operating, assisting or in theatre	25
Table 5:	Surgical specialty and number of patients admitted	26
Table 6:	Distribution of patient age within their assigned surgical specialty.	26
Table 7:	Surgeon and first-line assessor views on areas where patient management could have been improved	27
Table 8:	Days in hospital (length of stay) before death in NTASM and ANZASM	33
Table 9:	Gender distribution of NTASM patients compared with ANZASM patients	34
Table 10:	Age at death of Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons in NTASM compared with ANZASM	41
Table 11:	Comparison of serious comorbidities in Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons in NTASM and ANZASM	43
Table 12:	Age adjusted comparison of serious comorbidities in Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons in NTASM	43
Table 13:	Surgeons' perceived risk of death between Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons.	44
Table 14:	Comparison of areas requiring improvement in management of surgical care, as perceived by surgeons, between Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons in NTASM and ANZASM	45
Table 15:	Comparison of issues with postoperative care, as reported by surgeons, between Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons in NTASM and ANZASM	46

FIGURES

Figure 1:	Northern Territory Audit of Surgical Mortality (NTASM) project governance structure	10
Figure 2:	Northern Territory Audit of Surgical Mortality methodology	14
Figure 3:	Classification of incidents identified by assessors.	21
Figure 4:	Assignment of preventable areas of concern and adverse events reported in the NTASM into associations	22
Figure 5:	Consultant involvement in surgery by ANZASM region	25
Figure 6:	Frequency distribution of distance travelled by NTASM patients who required interhospital transfer .	29
Figure 7:	Distribution of NTASM patient admissions by day of the week	30
Figure 8:	Distribution of NTASM elective and emergency admissions by day of the week	30
Figure 9:	Classification of NTASM postoperative complications by type	32
Figure 10:	Median age distribution by gender of NTASM patients compared with ANZASM regions	35
Figure 11:	Comparison of the 5-year age group distribution of Aboriginal and Torres Strait Islander patients and non-Aboriginal and Torres Strait Islander patients	36
Figure 12:	Distribution of ASA class for NTASM patients.	37
Figure 13:	Distribution of 721 comorbidities in 238 patients	38
Figure 14:	Distribution of comorbidities in NTASM patients compared with ANZASM patients	39
Figure 15:	Informal reporting of alcohol abuse as an “other” comorbidity in NTASM and ANZASM patients .	39
Figure 16:	Proportion of NTASM patients at risk of death prior to surgery, as perceived by surgeons	40
Figure 17:	Comparison of diabetes, renal and hepatic disease in Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons in NTASM	42
Figure 18:	Distribution of causes of trauma	47
Figure 19:	Proportion of patients with infections acquired before and during admission by ANZASM region .	50
Figure 20:	Types of infection acquired before or during the admission	51

CLINICAL DIRECTOR'S REPORT

The Northern Territory Audit of Surgical Mortality (NTASM) contributes to surgical learning. Surgical learning is an essential art for all of us. If we cease to learn, we effectively cease to function in a professional manner.

Hospitals, surgeons and audit assessors all gain valuable insights by participating in NTASM.

The NT hospitals expect feedback from their government-funded audit, and, in part, this NTASM Annual Report fulfils that expectation. Significant deficits which the audit reveals will clearly drive appropriate and necessary change.

The NT surgeons complete a surgical case form for each surgically-related death. This provides an opportunity for self-reflection and self-directed learning. They also receive feedback from audit assessors. The de-identified peer-review system is well received by NT surgeons.

The audit assessors, particularly second-line assessors, no doubt learn from this systematic peer review too. Many respond by suggesting that they have learnt as a consequence of being a key player in this valuable audit process.

For the NTASM, learning from its processes will always be a priority.

As the NTASM Clinical Director, I would encourage and welcome your comments. In particular, we would like to know if you have changed any practices as a result of NTASM processes and feedback.

Thank you, once again, to all who play vital roles at each and every step in the audit process.

We look forward to learning more and more from this worthy audit process in the years to come.



Dr John North
NTASM Clinical Director

NTASM MANAGEMENT COMMITTEE CHAIRMAN'S REPORT

The NTASM continues to function as a respected tool in the provision of feedback and vital learning.

The audit remains peer-reviewed, systematic, routine, objective, comprehensive and clinically relevant. Its processes influence, and are being adopted by, other audit activities in all Northern Territory hospitals (public and private). Audit processes are now routinely undertaken at internal-hospital surgical morbidity and mortality meetings. Similar audit processes are also being implemented within other Northern Territory public hospital departments (intensive care, medicine, obstetrics and gynaecology, and paediatrics).

The NTASM data must be and is being used to review existing clinical activities and hospital processes. For example, the high number of deaths from bleeding oesophageal varices, as previously identified through NTASM, has led to a more comprehensive variceal screening program within the Royal Darwin Hospital (with increased collaboration between surgeons and gastroenterologists).

In addition, results from NTASM have been used to influence public policy. Recently, the identification of alcohol abuse and its impacts have been highlighted in the Northern Territory. The association of alcohol abuse with public violence and domestic violence, which together accounted for approximately one half of NTASM trauma cases, has enabled stronger pressure to be placed upon the Northern Territory Government to implement policies to reduce alcohol-related harm. For example, policy changes relating to reduced outlet sales, restriction on trading hours and mandatory closing times in the NT.

Improvements continue to occur within the audit itself, such as the new inclusion of gynaecologists and anaesthetists. However, there remains room for clinical improvement as the NTASM data demonstrates. For example, preventable clinical incidents continue to occur. These incidents related primarily to inadequate pre-operative assessment, delay to intervention (be it admission to ICU or return to theatre), and suboptimal therapy. Improvements in these areas are likely to come from increased communication and collaboration, which are part of the College's core competencies.

In this audit, serious comorbidities continue to affect Aboriginal and Torres Strait Islander persons under the age of 50, at more than twice the rate of non-Aboriginal communities. This highlights the physical disadvantages and difficulties that still exist within Aboriginal communities. As surgeons who work closely with Aboriginal people, we recognise the impacts of alcohol on liver disease, and the impacts of renal failure and diabetes. Once again, we recommended increased awareness of healthy lifestyles, by education and health management in all NT communities.



Dr John Treacy
NTASM Chairman

EXECUTIVE SUMMARY

BACKGROUND

The NTASM is an external, independent, peer-reviewed audit of the process of care associated with surgically-related deaths in the NT. The NTASM started in 2010 and is funded by the NT Government Department of Health. The NTASM has qualified privilege protection under Commonwealth legislation. This report covers surgically-related deaths that occurred from 1 July 2010 to 30 June 2016 and for which the audit process was complete at the census date of 1 July 2016.

The NTASM is principally designed as a feedback mechanism for participating surgeons to encourage reflection on surgical care and practice. The summary data for NTASM reflects a territory that is committed to surgical audit and improving surgical care.

SURGEONS

- All surgeons in the NT participated in the NTASM.
- The return rate for surgical case forms (SCFs) was 94.8% (349/368). The audit process was complete by the census date for 304 cases, and these cases form the basis of this report.

HOSPITALS

- All hospitals in the NT participated in the audit. This report comprises data from the three hospitals in which a surgically-related death occurred during the audit period.

PATIENTS

- Over the 6 year audit period there were 368 surgically-related deaths reported to NTASM.
- 65% of patients were male and 35% were female. In the Australian and New Zealand Audit of Surgical Mortality (ANZASM), 55% of patients were male.⁽¹⁾
- Serious comorbidities were present in 78.5% (238/303) of patients.
- The percentage of patients with diabetes (32.4%; 77/238) or hepatic disease (23.5%; 56/238) as comorbidities was higher in NTASM compared with ANZASM (19.7%; 3,951/20,059 and 8.3%; 1,659/20,059).
- More than half of the patients (53.3%; 121/227) were considered by surgeons to be at considerable risk of death prior to surgery.

ABORIGINAL AND TORRES STRAIT ISLANDER PERSONS

- According to the Australian Bureau of Standards, 3% of the total Australian population and 30% of the Northern Territory population are Aboriginal and Torres Strait Islander persons.⁽²⁾
- In NTASM, Aboriginal and Torres Strait Islander persons comprised 37.5% (114/304) of surgically-related deaths.
- Overall, the median age of Aboriginal and Torres Strait Islander persons was less (52 years; Interquartile range [IQR] 43 to 62) than the median age of non-Aboriginal and Torres Strait Islander persons (69 years; IQR 56 to 77).

CLINICAL INCIDENTS

- No clinical incidents were noted in 72.5% (219/302) of patients
- An area of concern or adverse event occurred in 13.8% (42/302) of patients compared with 12.4% (3,529/28,349) in ANZASM patients (RR1.11; 95% CI 0.84 to 1.47).⁽¹⁾
- Areas of concern or adverse events were considered preventable in 34 patients.
- An area for consideration occurred in 13.6 % (41/302) of patients.

OPERATIVE DEATHS

In the last admission for NTASM patients:

- at least one operation was undertaken on 75.3% (229/304) of patients.
- a total of 381 operations were performed on the 229 patients.
- multiple operations were performed on 33.2% (76/229) of patients.

POSTOPERATIVE COMPLICATIONS

- There were 68 postoperative complications. A postoperative complication occurred in 22.7% (52/229) of patients, and the number of complications ranged from one to four per patient.

USE OF INTENSIVE CARE UNIT (ICU)

- Postoperative admission to an ICU occurred in 71.8% (163/227) of patients.
- A postoperative unplanned admission to an ICU occurred in 18.3% (40/218) of patients.

TRAUMA

- Trauma was present in 30.8% (78/253) of patients.
- 55.1% (43/78) of trauma cases were associated with falls.
- 26.9% (21/78) of trauma cases were associated with road traffic accidents.
- 61.5% (48/78) of trauma cases were non-Aboriginal and Torres Strait Islander persons.

INFECTION

- Infection was reported in 36.7% (90/245) of cases.
- Of the patients with infection, 64.4% (56/87) acquired the infection prior to admission and 35.6% (31/87) acquired the infection during the admission. [data missing for three patients]
- The main types of infection were septicaemia (38.8%; 33/85) and pneumonia (29.4%; 25/85). [data missing for five patients]
- A surgical site infection was reported for one patient.

RECOMMENDATIONS

Practice and Policy

As the audit is routine, systematic, and clinically relevant it can inform hospital and clinical practice.

The audit data should be used to:

- review existing clinical activities and hospital processes.
- influence public policy.
- identify areas where clinical improvement could be made.

Learning through the audit

It is recognised that the audit provides surgeons with an alternative form of learning.

The audit should aim to:

- uphold the RACS's strategic plan to make a difference in indigenous health by collecting complete surgical data within the Northern Territory.
- identify the effect and impact of the audit outcomes and findings on changes in clinical practice and institution processes.
- continue to encourage completion of SCFs using the Fellows Interface, thereby increasing completeness of data.
- encourage surgeons to be assessors to enhance their own learnings from the audit.
- identify emerging trends and address them in educational processes such as seminars and themed case note booklets.
- include “alcohol abuse” as a comorbidity in the SCF.
- include “whether the death of the patient was preventable” as a question on both the SCF and assessment forms.

Patient management

Most of the patients admitted in NTASM were high risk patients.

- Preventable clinical incidents occurred most frequently in the categories of: patient assessment; delays and suboptimal therapy; these were most commonly associated with the surgical and clinical teams. Improved communication between surgical and clinical teams may lead to a reduction in preventable clinical incidents. Communication should be encouraged between medical disciplines and surgical staff to ensure optimal health care delivery.
- Surgeons are encouraged to feedback any evidence of changes in their practice or hospital processes which resulted from the audit.

1 INTRODUCTION

Key Points

- The NTASM is an independent peer review audit of the processes of care associated with all surgically-related deaths in the NT.
- This report covers the audit period 1 July 2010 to 30 June 2016, as at the census date of 1 July 2016.
- All NT hospitals, both public and private, are participating in the audit.
- All NT surgeons are participating in the audit.
- All obstetricians and gynaecologists are participating in the audit.
- Anaesthetists are now participating in the audit.
- The primary aim of NTASM is to provide feedback to surgeons about their practice, and to encourage learning about surgical care.

1.1 BACKGROUND

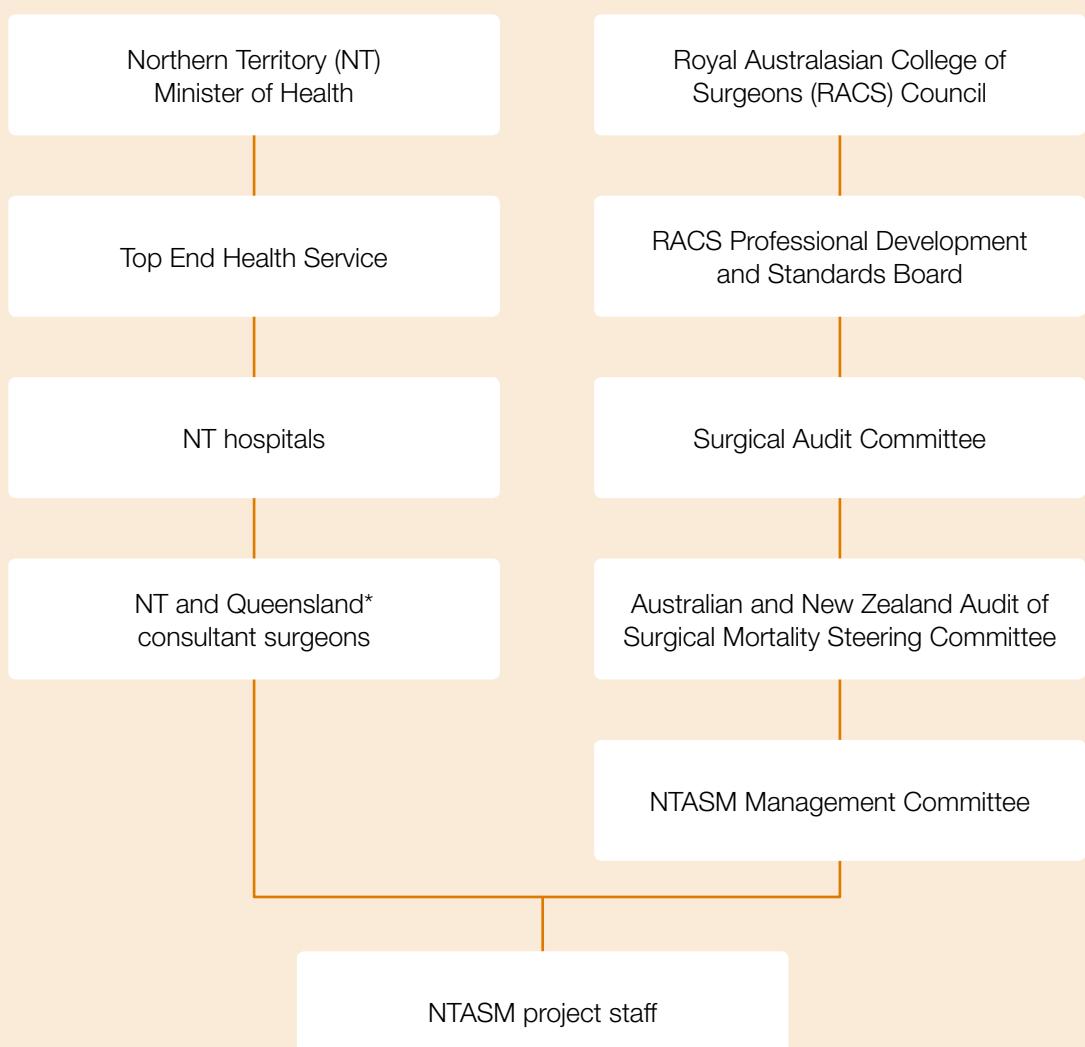
The NTASM project is funded by the NT Government Department of Health. The Royal Australasian College of Surgeons (RACS) became responsible for the management of the Western Australian Audit of Surgical Mortality in 2006. The Western Australian Audit of Surgical Mortality was modelled on the Scottish Audit of Surgical Mortality, which began in 1988. The NTASM started participating in 2010.

1.2 PROJECT GOVERNANCE

The project governance structure is illustrated in Figure 1. 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: www.surgeons.org.

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



*Consultant surgeons from Queensland also assess for NTASM

1.2.1 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 306 first-line assessment reports and 32 second-line assessment reports to NT surgeons.
- published 17 volumes of *Lessons from the Audit*, in conjunction with the Queensland Audit of Surgical Mortality. The *Lessons from the Audit* series contains case studies that highlight key issues relating to surgical practice. This publication is of interest not only to NT surgeons, but to all who are involved in patient care in the NT, from emergency department managers to hospital executive teams. A list of volumes and their titles and themes is provided below.
 - Vol 1 Cardiac
 - Vol 2 Perforated T-cell gastric lymphoma undergoing chemotherapy
 - Vol 3 Bronchial stump leak
 - Vol 4 Abdominal sepsis following elective laparoscopic ventral hernia repair
 - Vol 5 Serious multi-trauma patients demand serious measures
 - Vol 6 Multiple systems - multiple obstructions to best patient care?
 - Vol 7 Decision before incision!
 - Vol 8 Death after endoscopy - ‘surgical audit’ or not?
 - Vol 9 Not in that institution...please!
 - Vol 10 History and examination are still important for surgeons.
 - Vol 11 Communication (theme)
 - Vol 12 Preoperative management issues (theme)
 - Vol 13 The obese patient (theme)
 - Vol 14 Operation should not have been performed (theme)
 - Vol 15 Postoperative complications (theme)
 - Vol 16 Fluid balance (theme)
 - Vol 17 The elderly surgical patient (theme).

1.2.1 Presentations, publications and commendations

- Dr Jacob, a surgeon at the Alice Springs Hospital and the Alice Springs representative on the NTASM steering committee, was awarded the Aboriginal and Torres Strait Islander Health Medal by RACS in 2015.
- Dr Treacy, a NT surgeon and Chair of the NTASM Management Committee, was the lead author of an article published in the Australian and New Zealand Journal of Surgery entitled “Outcomes from the Northern Territory Audit of Surgical Mortality: Aboriginal deaths”.⁽³⁾ The article used NTASM data and showed that the standard of surgical care was the same for Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons. The article highlighted that an age gap still exists between Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons at the time of death.

Findings from the study prompted a letter from the NTASM to the federal government, and the Minister for Indigenous Affairs acknowledged the NTASM age gap and equivalency in the standard of surgical care for Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons.

- Seminars held in Brisbane, Queensland, over the audit period have been well attended by NT surgeons. One seminar was convened by an NT surgeon. The seminars have focussed on the following issues:
 - Queensland 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 & evidence based practice (2016).

- 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 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).
- 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).
- The NTASM's manager was an active member of the 2015 RACS Reconciliation Group to facilitate the integration of Aboriginal and Torres Strait Islander persons into the College workforce, including the surgical workforce. In 2016, the College formally formed the Indigenous Health Committee.

1.3 NTASM AUDIT PROCESS

1.3.1 Methodology

The NTASM is directly notified of all in-hospital surgically-related deaths via the surgical or medical records departments of participating NT hospitals. All cases in which a surgeon was responsible for, or had significant involvement in, the care of the patient are included in the audit, irrespective of whether the patient underwent a surgical procedure.

The clinical details relating to the management of each case are recorded on a standard structured questionnaire known as an SCF, which is completed by the consultant surgeon associated with the case. The completed SCF is de-identified by NTASM and sent for first-line assessment to a surgeon of the same specialty.

In NTASM, first- and second-line assessors are peer surgeons from a different state. De-identification, combined with the use of assessors from outside the NT, ensures that anonymity and impartiality are preserved, and minimises the potential for conflicts of interest. The first-line assessor will either close the case or recommend that the case undergo further assessment in the form of a second-line assessment.

Cases may be referred for second-line assessment if:

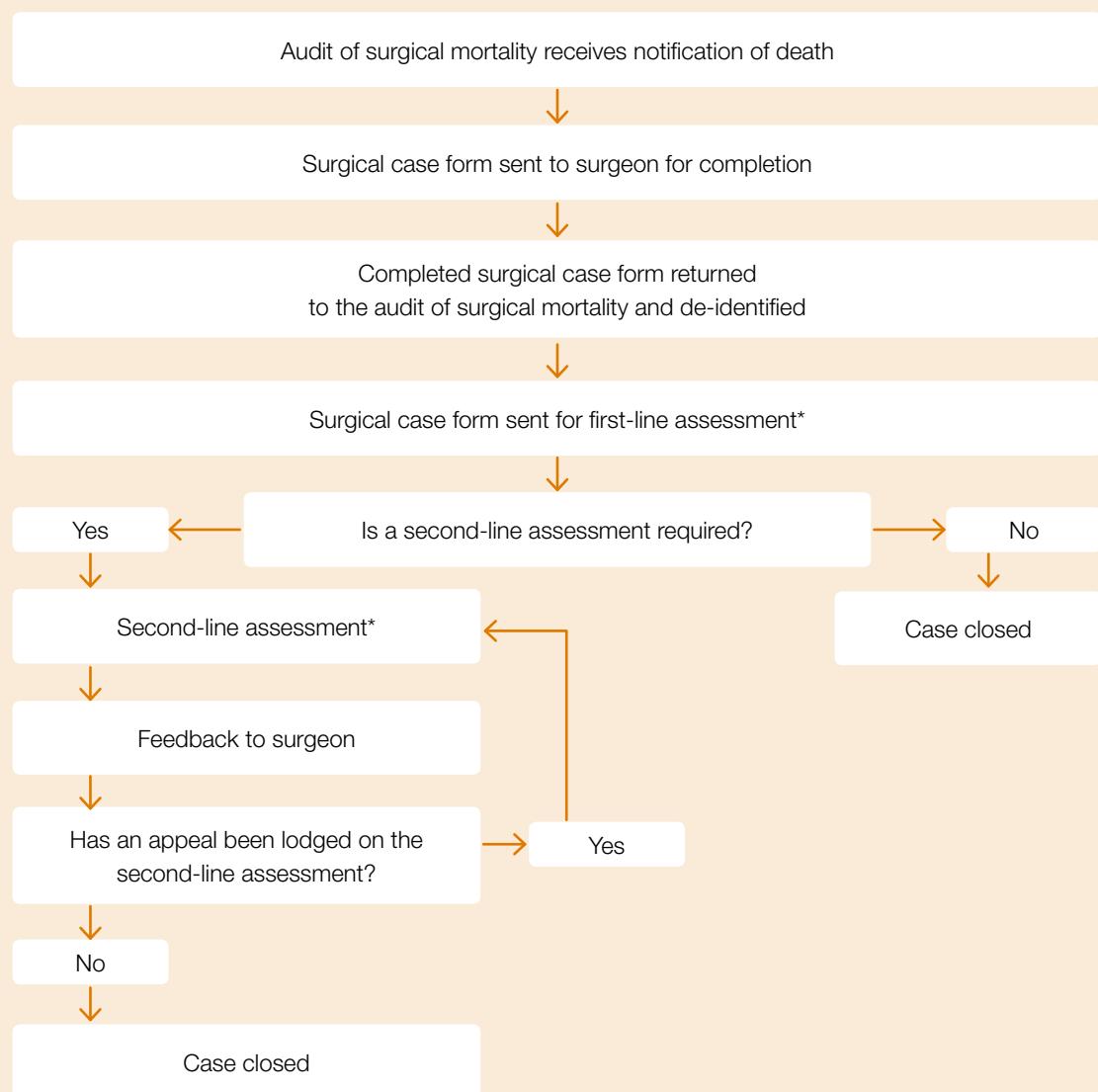
- an area of concern or adverse event is thought to have occurred during the clinical care of the patient and warrants further investigation.
- a second-line assessment report could usefully draw attention to an area of surgical practice, providing an educational opportunity for the surgeon involved in the case or for a wider audience as part of 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, based on the same criteria as for the first-line assessor. Second-line assessors are generally considered experts in the area under review.

On occasion, a surgeon may appeal the findings of the second-line assessment. In these instances the clinical director selects a third assessor to perform a second-line assessment. The same criteria raised by the first-line assessor again form the basis of the review. In NTASM, a third-line review has never been requested.

The methodology used by NTASM is outlined in Figure 2.

Figure 2: Northern Territory Audit of Surgical Mortality methodology



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

1.3.2 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, as outlined below.

- Surgeons receive written feedback from assessors regarding their cases.
- Surgeons receive the NTASM report. The report is also available from the NTASM section of the RACS website: www.surgeons.org/ntasm.
- Surgeons receive de-identified summaries of second-line assessments from cases in the form of the *Lessons from the Audit* series. Surgeons also receive the National Case Note Review Booklet, which comprises case studies from across Australia.
- Hospitals participating in NTASM receive clinical governance reports on aggregated, de-identified data comparing their hospital to the averages of other hospitals across Australia.
- Surgeons can view online reports relating to their own audit data and assessments via the Fellows Interface at: <https://asm.surgeons.org/mortaudit/>.

1.3.3 Audit inclusion and exclusion criteria

The NTASM audits all deaths that occur in NT hospitals while the patient was under the care of a surgeon. However, patients who are deemed terminal before admission and do not have operations are excluded from the full audit process.

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

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

Cases that do not meet the inclusion criteria are excluded from the audit by the notifying hospital. A case will also be excluded in instances where the NTASM is notified of a death but subsequently decides that the case does not fall within the inclusion criteria.

1.4 REPORTING CONVENTIONS

1.4.1 Reporting clinical incidents

Surgeons and assessors are asked to review the case and to determine whether there were any clinical incidents where care could have been improved. These are then classified in relation to whether the death was a direct result of the disease process alone, or if aspects of management of the patient might have contributed to that outcome. If there was a perception that the clinical management may have contributed to death, the clinical incidents were reported against the following hierarchical criteria.

- *Area for 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 death
 - may have contributed to 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.

First- and second-line assessors are asked to respond to the same matrix of questions as part of the review process. This results in a two-level peer review process for those cases which 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 medical records.

1.4.2 Assessor opinion

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

1.4.3 Analysis of clinical incidents

Reporting of clinical incident findings are expressed in terms that cannot identify the patient, the surgeon or the hospital.

The NTASM primarily focuses on areas of concern and adverse events. While data regarding areas for consideration are collected, they are considered to be minor criticisms or suggestions regarding treatment.

Cases may be associated with more than one clinical incident. Some of the clinical incident analysis is undertaken per case. For these analyses, a case with more than one clinical incident will be assigned the most serious incident.

1.4.4 Data analysis

This report covers deaths reported to the NTASM from 1 July 2010 to 30 June 2016. Six years of data collection is included in this report. All data presented in this report is from the NTASM database unless otherwise specified. The nature of the audit process means that some cases reported during this period will still be undergoing review as at the census date (1 July 2016). These cases will be included in the next report.

Surgeons can complete the SCF and first-line assessment online in the Fellows Interface, while data from paper forms is entered into the system by audit staff. Data is entered and stored in a specifically designed database – a central Structured Query Language server database which includes a reporting engine.

Data is 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 is cross-checked and the resources used include medical record departments, surgeons, and coroner's reports. Data is 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 again before analysis. A total of 28 tables are downloaded into Excel and then copied across to Statistical Package for Social Sciences (IBM-SPSS version 19.0) for analysis. A key variable that is common to all tables can be used to combine tables. Generally, simple frequencies and cross tabulations are used to create the report. Graphs are produced using either SPSS or Excel.

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 cases analysed. As not all data points were completed, the total number of cases used in the analyses varies. The numbers of cases included in each analysis are 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".

1.4.5 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 with the simple range because extreme values are ignored. It represents the middle 50% of values in a rank ordered series.

Cross tabulations are used to calculate 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).

1.4.6 Data comparisons

In this report, the NTASM data is compared with the ANZASM National Report 2015⁽¹⁾ and its associated dataset. National and state-based comparisons against NTASM data provide context to the NTASM data in this report. These comparisons allow an easy assessment of health care standards overall. These comparisons may assist the NT Department of Health in future program planning for continued improvement in safety and quality of surgical care in the NT.

2 AUDIT OVERVIEW

Key Point

- There were 368 surgically-related deaths reported to NTASM over the 6 years of the audit.

2.1 OVERVIEW OF NTASM CASES

An overview of NTASM cases is provided in Table 1 below. Assessors completed 306 first-line assessments and 32 second-line assessments.

At the end of June 2016:

- 19 SCFs were pending
- 2 first-line assessments were pending
- 2 second-line assessments were pending
- 10.5% (32/304) of audited cases had undergone second-line assessment.

Table 1: Overview of NTASM cases in the audit reporting period 2010 to 2016 (n=368)

Audit report period 2010–2016	Number of cases
Closed cases	304
Surgical case forms pending	19
First-line assessments (awaiting second-line assessment)	2
First-line assessments pending	2
Excluded (terminal care case)	30
Excluded (error)*	11
Total reported deaths	368

NTASM = Northern Territory Audit of Surgical Mortality

*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.

3 RESULTS

3.1 CLINICAL INCIDENTS

Key Points

- No clinical issues were identified in 72.5% (219/302) of patients.
- An area of concern or adverse event occurred in 13.8% (42/302) of patients.
- In 34 patients the areas of concern and adverse events were considered preventable.
- An area of consideration occurred in 13.6% (41/302) of patients.

Clinical incidents, as defined by NTASM, include:

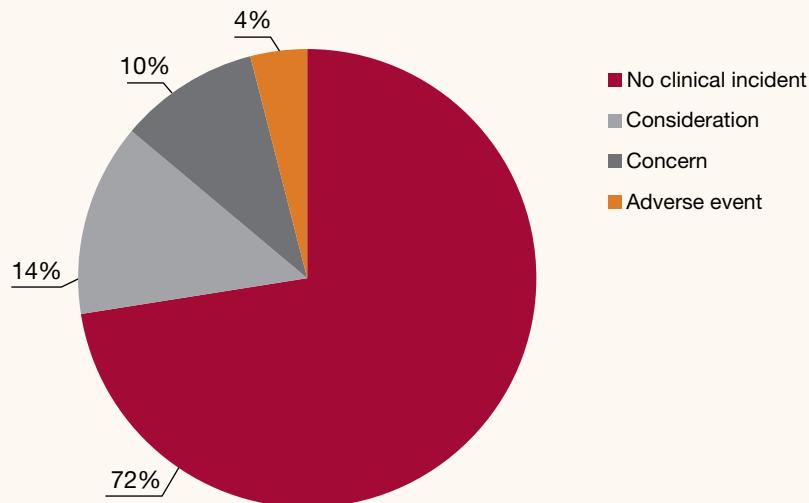
- **area for consideration** – where the clinician believes an area of care could have been improved or different but recognises that there may be debate about this
- **area of concern** – where the clinician believes that an area of care should have been better
- **adverse event** – an unintended “injury” 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.

In this report where a number of clinical incidents occurred in one case, the most severe incident has been attributed.

- Over the 6 year audit period, assessors identified no clinical incidents in 72.5% (219/302) of patients. When combined with areas of consideration, 13.6% (41/302) of patients, the total number of cases with no or minor or criticisms or suggestions regarding treatment was 86.1% (260/302).
- During the same period, assessors identified that an area of concern or an adverse event occurred in 13.8% (42/302) of patients. Areas of concern and adverse events encompass issues that are specific to surgical care and may relate to hospital or patient management issues. These are areas of care that were suboptimal and need to be improved.

Figure 3 shows the frequency of clinical incidents identified by assessors per patient. Clinical incident data was missing for 2 patients (0.7%).

Figure 3: Classification of incidents identified by assessors (n=302)



- The number of areas of concern and adverse events that occurred in NTASM patients (13.8%; 42/302) and ANZASM patients (12.4%; 3,529/28,349)⁽¹⁾ was not statistically significant (RR1.12; 95% CI 0.84 to 1.48).
- Preventable areas of concern and adverse events occurred in 34 patients.
- In the 34 patients with preventable areas of concern and adverse events, the common categories* of preventable clinical incidents were:

Patient assessment problems

- Choice of operation*
- Decision to operate*
- Delay in diagnosis*
- Preoperative preparation.*

Delays

- Delay in recognising postoperative complication*
- Delay to transfer to the ICU*
- Delay in seeing surgical input*
- Delay to operation.*

Suboptimal therapy

- Incorrect placement of tubes/drains*
- Fluid balance concerns*
- Postoperative care.*

Communication failures

- Poor communication*
- Surgical documentation.*

Diagnosis-related complication

Open surgery – organ related

Failure to use facilities

Laparoscopic surgery – technical

Radiological surgery – technical

Patient-related factors

Drugs-related factors

General complications of treatment.

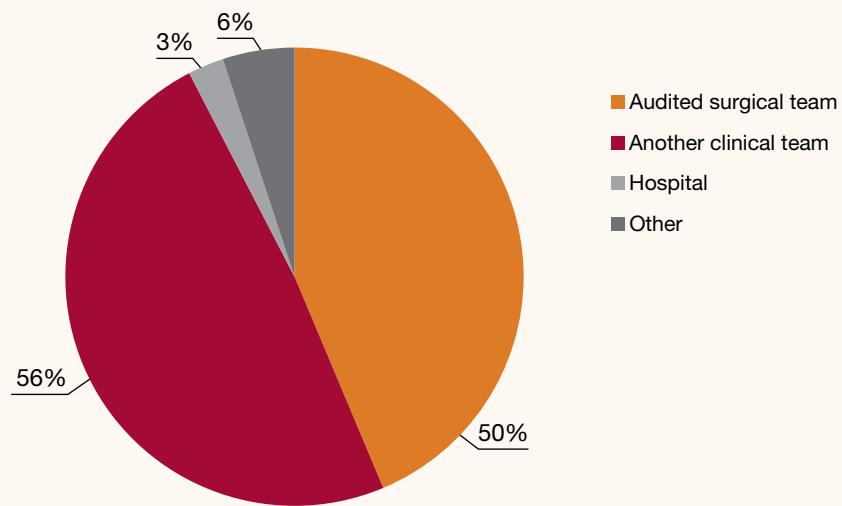
* Clinical incidents were categorised using a coded thesaurus of clinical terms (READ codes). READ codes are a clinical decision tree that contains terms, synonyms and abbreviations covering all aspects of patient care. It is a precursor to ICD9 coding: Ref: Health and Social Care Information Centre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

Preventable areas of concern and adverse events are associated with various teams and hospital departments. They may be associated with more than one team or department. Of the preventable areas of concern and adverse events. Assessors indicated that the areas of concern and adverse events were associated with the following teams and hospital departments:

- the surgical team (17 patients).
- another clinical team (19 patients).
- the hospital (1 patient).
- with other causes (ICU, radiology and an initial procedure) (2 patients).

The distribution of association of preventable clinical incidents is shown in Figure 4.

Figure 4: Assignment of preventable areas of concern and adverse events reported in the NTASM into associations (n=34)*



Note: 'Other' includes intensive care unit, radiology and an initial procedure.

*Clinical incidents may be associated with more than one team or department

3.2 SURGEONS

Key Points

- All NT surgeons participated in the audit.
- Most NT obstetricians and gynaecologists participated in the audit.
- Anaesthetists have participated in the audit since 6 June 2016.
- The NT relies on locum surgeons to supplement the surgical workforce.
- Consultant surgeon supervision in the NTASM was high.

3.2.1 Overview

- All 27 NT surgeons participate in the audit.
- Of the 15 obstetricians and gynaecologists in the NT, 8 participate in the audit. Participation is voluntary.
- Of the 44 anaesthetists in the NT, 31 have agreed to participate in the audit. Participation is voluntary.

There were also 15 locum surgeons who participated in the audit. Historically, locum surgeon involvement in the NTASM has been a challenge. With the latest enhancement to the NTASM database, locum surgeons are able to 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 surgeons when a death occurs while they are still at the hospital.

3.2.2 Audit participation

Table 2 highlights audit participation by specialty.

RACS Fellows

All of the participating surgeons are Fellows of RACS. Assessors must have their RACS Fellowship in order to do first- and second-line assessments.

RANZCOG Fellows

Participation in the audit is voluntary for obstetricians and gynaecologists. All of the participating obstetricians and gynaecologists are Fellows of Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG). Fellows of this College can participate as first- and second-line assessors for gynaecology-related cases.

ANZCA Fellows

Participation in the audit is voluntary for anaesthetists. Participating anaesthetists are Fellows of Australian and New Zealand College of Anaesthetists (ANZCA) or may be accredited GP anaesthetists. Fellows of this college can participate as first- and second-line assessors for anaesthetic-related cases.

Table 2: Participation by specialty

Specialty	Number participating*
Anaesthetists	31
General Surgery	16
Vascular Surgery	1
Urology	1
Orthopaedic Surgery	4
Otolaryngology, Head and Neck Surgery	2
Obstetrics & Gynaecology	8
Plastic and Reconstructive Surgery	2
Oral and Maxillofacial Surgery	1
Total	66

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

3.2.3 Completion of SCFs

As at the census date, 94.8% (349/368) of all SCFs had been completed and returned to the NTASM.

- The median time taken to return a SCF was 60 days, ranging from less than 1 day to 654 days.
- 9 SCFs were returned in less than 1 day, and these SCFs were completed online using the Fellows' Interface.
- 12 SCFs were returned within 1 week.
- Most SCFs were completed by the consultant in charge of the case (see Table 3 below).

Table 3: Grade of surgeon completing the surgical case form (n=304)

Surgeon grade	Number of cases (%)
Consultant	250/304 (82.2%)
SET trainee	15/304 (4.9%)
IMG	14/304 (4.6%)
Fellow	16/304 (5.3%)
Service registrar	9/304 (3.0%)

SET: Surgical Education and Training; IMG: International Medical Graduate.

3.2.4 Consultant surgeon involvement in operations

In total, 381 operations were performed on 229 patients. Two or more operations were performed on 76 patients, with the number of operations per patient ranging from 2 to 12. The level of consultant input into the surgical management of patients was high. The distribution of grades of NTASM surgeons and their roles in the operating theatre is shown in Table 4. An overview of consultant involvement in surgery by region is shown in Figure 5.

- Consultant surgeons made the decision to operate in 83.9% (320/381) of operations.
- The consultant surgeon operated in 60.4% (230/381) of operations.
- As two of the participating hospitals are teaching hospitals, it was expected that Surgical Education and Training (SET) trainees and service registrars would be deciding to operate as well as performing operations. The rate of SET trainees deciding was 4% in NTASM.

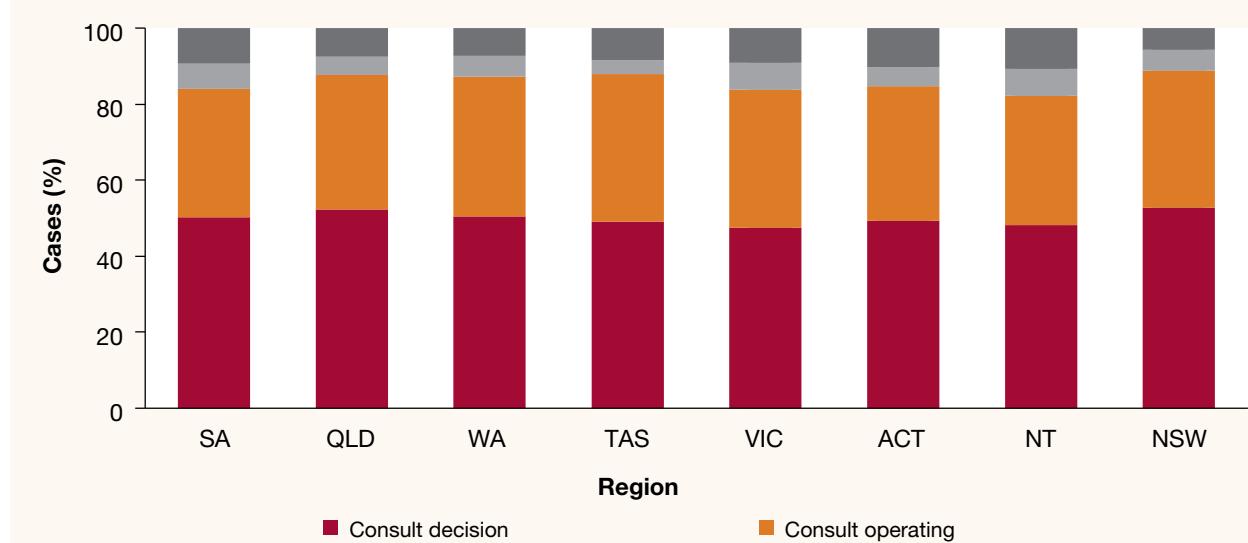
Table 4: Grade of NTASM surgeon deciding, operating, assisting or in theatre (n= 381 operations)

	Deciding	Operating	Assisting	In theatre
Consultant	84%	60%	12%	18%
SET trainee	4%	12%	20%	4%
Service registrar	1%	5%	13%	3%
IMG	2%	6%	8%	2%
Fellow	2%	13%	12%	3%
GP surgeon	0%	0%	0%	0%

Note: the column percentages do not add up to 100%. In many cases multiple surgeons were performing and assisting during the operation. In addition, surgeon's roles and involvement were not always provided for each operation.

SET: Surgical Education and Training; IMG: International Medical Graduate; GP: general practice

Figure 5: Consultant involvement in surgery by ANZASM region * (n=31,962 operations in 22,506 patients)



*ANZASM regions are: SA: South Australia; QLD: Queensland; WA: Western Australia; TAS: Tasmania; VIC: Victoria; ACT: Australian Capital Territory; NT: Northern Territory; NSW: New South Wales.

3.2.5 Surgeon supervision in theatre

Consultant surgeon supervision in theatre is high in the NT. This supervision covers all SET trainees, IMGs and service registrars.

- SET trainees performed 47 operations, and in 87.2% (41/47) of these operations the consultant made the decision to operate.
 - The SET trainee was assisted by the consultant in 8.5% (4/47) of these operations.
 - The consultant was present in the operating theatre for 14.9% (7/47) of the operations.
- IMGs performed 20 operations, and in 65% (13/20) of these operations the consultant made the decision to operate.
 - The IMG was assisted by the consultant in 10% (2/20) of these operations.
 - The consultant was present in the operating theatre for 20% (4/20) of the operations.
- Service registrars performed 22 operations, and in 72.7% (16/22) of these operations the consultant made the decision to operate.
 - The service registrar was assisted by the consultant in 18.2% (4/22) of these operations.
 - The consultant was present in the operating theatre for 22.7% (5/22) of the operations.

3.2.6 Specialty of surgeon

An overview of the number of patients admitted for each surgical specialty is provided in Table 5. Although there are surgeons of various specialties working in the NT, surgically-related deaths primarily occurred in three specialties: General Surgery, Orthopaedic Surgery and Vascular Surgery.

Table 5: Surgical specialty and number of patients admitted (n=304)

Specialty	Number of patients	Percentage of patients
General Surgery	245	80%
Orthopaedic Surgery	31	10%
Vascular Surgery	16	6%
Other*	12	4%
Total	304	100%

*Surgical specialties include Neurosurgery, Otolaryngology Head and Neck and Oral/Maxillofacial surgery.

There were no patient deaths reported for Urology, Obstetrics and Gynaecology, Plastic and Reconstructive Surgery and Anaesthetics.

3.2.7 Surgeon specialty and age distribution of patients

Orthopaedic Surgery patients who died were older than General Surgery and Vascular Surgery patients, as can be seen in Table 6.

Table 6: Distribution of patient age within their assigned surgical specialty (n=304)

Specialty	Median age (years)	Interquartile range (years)
General Surgery (n=245)	61	45–73
Orthopaedic Surgery (n=31)	74	61–84
Vascular Surgery (n=16)	68	61–75
Other* (n=12)	58	44–67

*Surgical specialties include Neurosurgery, Otolaryngology Head and Neck and Oral/Maxillofacial surgery.

3.2.8 Treating surgeon and assessor views on patient management

A comparison of surgeon and assessor views on the areas in which patient management could have been improved is provided in Table 7. The surgeon's views for each case are compared with those of the first-line assessor.

Surgeons considered the decision to operate as an area requiring improvement. Assessors reviewing cases considered preoperative management to be the area requiring the most improvement.

Table 7: Surgeon and first-line assessor views on areas where patient management could have been improved

Area in which patient management could have been improved	Surgeons' views (n=243)	First-line assessors' views (n=289)
Preoperative management	7%	11%
Decision to operate	8%	7%
Choice of operation	3%	5%
Timing of operation	7%	8%
Intraoperative management	4%	5%
Grade of surgeon operating	1%	1%
Postoperative care	4%	4%

Note: more assessors than surgeons completed this part of the form.

3.2.9 Operation duration

Duration of operation is an important predictor of adverse events in surgical admissions. According to Kable et al.,⁽⁴⁾ as the duration of the operation increases so too does the risk of an adverse event.

In the NTASM, operation duration was recorded for 81.1% (309/381) of operations. In the NTASM there was substantial variation in the time spent in theatre for patients who died in the perioperative period.

- The median operation duration was 72 minutes (IQR 60 to 120 minutes).
- The minimum operation duration was less than 10 minutes.
- The maximum operation duration was 540 minutes.
- Of the operations performed, 15.2% (47/309) exceeded 180 minutes.

Clinical incidents were twice as likely to occur in NTASM patients when the operation duration exceeded 180 minutes than those with shorter operation durations (36.2%; 17/47 vs 19.1%; 50/262 - RR 1.90 (95% CI 1.20 to 2.99)).

3.2.10 Surgeon views in retrospect

Surgeons and different actions

Surgeons were asked whether, in retrospect, they would have done anything differently in terms of patient management.

- In 18.9% (46/243) of cases, the surgeon answered that they would have done something differently. This question was not answered for 15 cases.

The areas of care identified for improvement by the surgeons covered all aspects of patient management.

A sample of comments is provided below.

Delay in presentation

- *Earlier transfer from community.*
- *Keep records of all patients referred to specialist units to prevent them being lost to follow-up.*

Preoperative care

- *It may have been worthwhile him having pre-operative chest physiotherapy and respiratory review.*
- *Screened for presence of urinary tract infection prior to proceeding with surgery (i.e. at the time of preadmission clinic).*
- *I think the patient should have had either a coronary computed tomography angiography or digital subtraction angiography prior to the aortic procedure and coronary intervention if indicated.*
- *Prepared a detailed road map for the operation identifying possible points of abandoning safely.*

Choice of procedure

- *I would have put more pressure on the patient to have an amputation in preference to a graft.*
- *Would have liked to have had the option of performing a laparotomy; or at least have had this discussed with the patient prior to the second endoscopy.*
- *At the initial debridement maybe an aggressive debridement or even a below knee amputation to remove the focus of sepsis in retrospect.*

Decision to perform the operation

- *Not have done the operation... The decision to operate was based on the age; good pre-accident functional status and reported Glasgow Coma Scale at the scene.*
- *Probably left the above ankle stump alone and not revised to below knee amputation.*
- *Reconsidered the percutaneous procedure but may not have made any difference to the patient's ultimate outcome.*

Postoperative care

- *I would have proactively discussed the management of anticoagulation/pulmonary embolism prophylaxis at the debrief at the end of the operation.*
- *Added a computed tomography scan day 4 or 5; may have given a clue regarding leak. Consultant bedside review day 4 or 5 may have led to more aggressive management. Liaised with palliative care.*
- *Reoperation 6 hours sooner; despite all clinical; radiological and biochemical evidence to the contrary.*

3.3 HOSPITALS

Key Points

- All NT hospitals participated in the NTASM, including a day surgery facility.
- Interhospital transfer was required for 13.2% (39/296) of patients.
- A delay in obtaining the main surgical diagnosis occurred in 12.4% (28/225) of cases.

3.3.1 Hospital participation

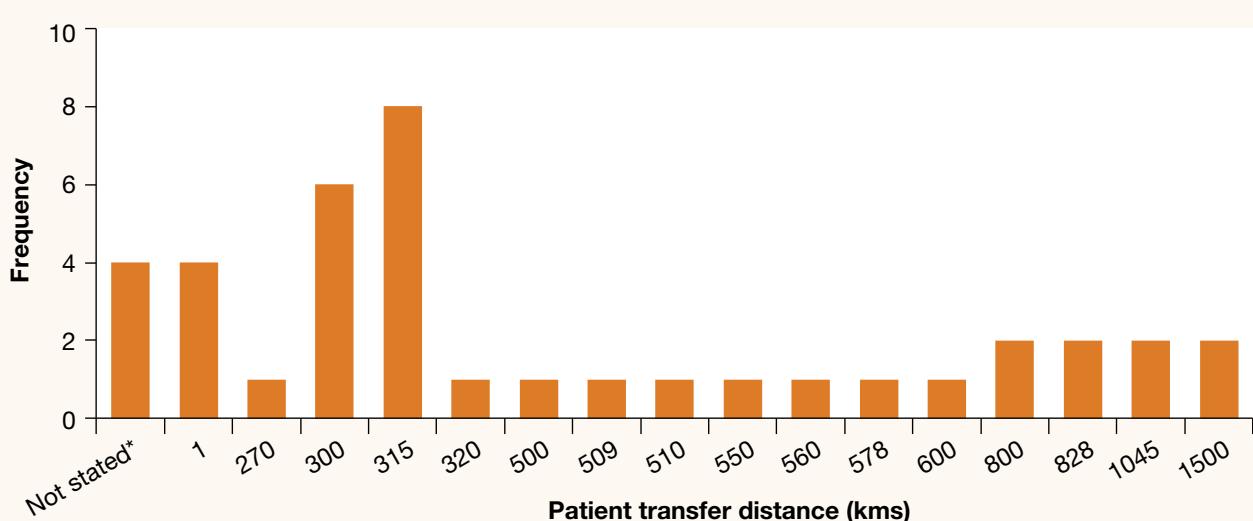
All hospitals in the NT and one day surgery participated in NTASM. Data in this report is from three hospitals that service Central Australia and the whole Top End of the NT. Nearly all of the reported deaths (98%; 298/304) occurred in the main NT referral hospital.

3.3.2 Hospital admissions

The majority of hospital admissions were emergencies. Emergency admissions comprised 91.2% (269/295) of all hospital admissions. Elective admissions comprised 8.8% (26/295). [Data not available: n= 9]

- Operations were performed on 92.3% (24/26) of elective admission patients.
- Operations were performed on 72.9% (196/269) of emergency admission patients.
- Interhospital transfers occurred in 13.2% (39/296) of patients. [Data not available, n= 8]
- Transfer was considered appropriate in 94.6% (35/37) of patients and delayed in 5.6% (2/36) of patients.
- Of the patients who were transferred, 94.9% (37/39) had appropriate levels of care during the transfer and sufficient information was provided by the transferring hospital to the receiving hospital. [Data not available: n= 2]
- The geographical location of tertiary hospitals in the NT results in long distance interhospital transfers. The median distance was 315 km (IQR 300 to 578), see Figure 6.

Figure 6: Frequency distribution of distance travelled by NTASM patients who required interhospital transfer (n=39)

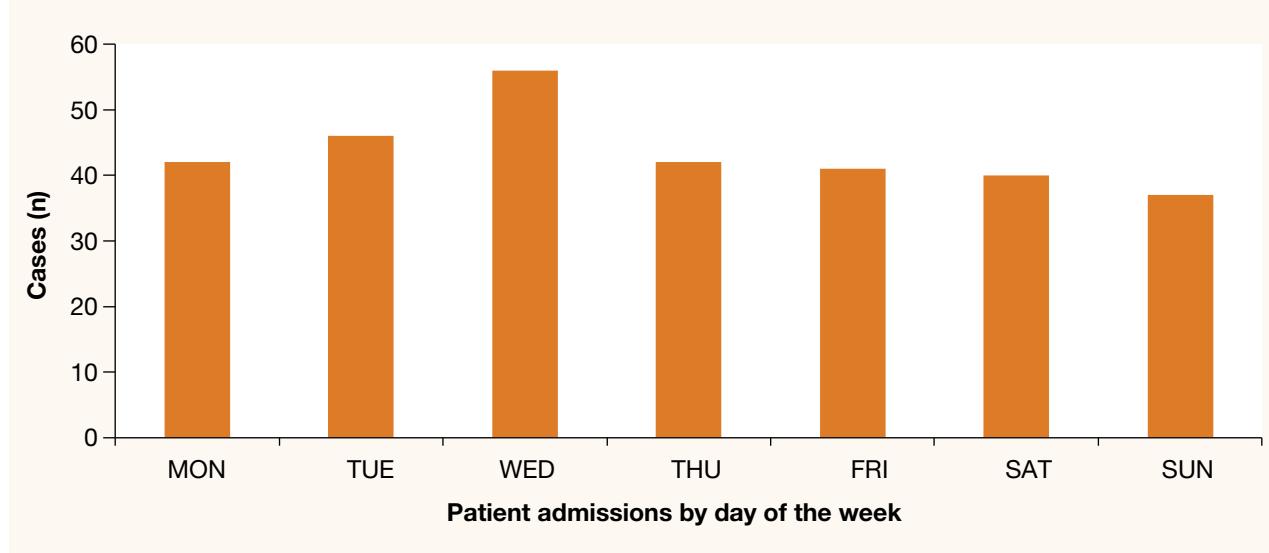


*All cases that did not have a distance stated were careflight transfers.

3.3.3 Hospital admissions by day of the week.

The number of patients admitted increased from Monday through Wednesday. Patient admissions peaked in the middle of the week. Sunday had the least admissions. The number of patients admitted on Mondays, Thursdays, Fridays and Saturdays was similar (see Figure 7).

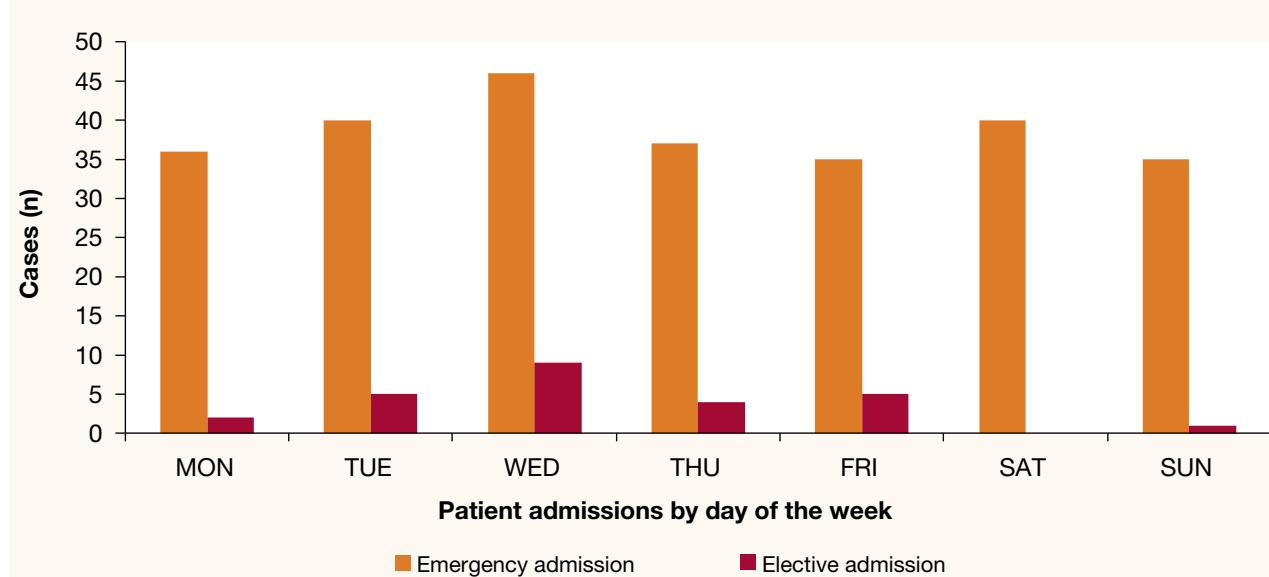
Figure 7: Distribution of NTASM patient admissions by day of the week (n=304)



3.3.4 Elective and emergency admissions by day of the week

Elective admissions (34.6%; 9/26) were highest on a Wednesday. Elective admissions were less than a quarter of all admissions for each day (see Figure 8).

Figure 8: Distribution of NTASM elective and emergency admissions by day of the week (n=295)



Elective/emergency admission data not available: Monday, n=4; Tuesday, n=1; Wednesday, n=1; Thursday, n=1; Friday, n=1 and Sunday, n=1.

3.3.5 Delays in main surgical diagnosis

Delays and errors in diagnosis are important factors that contribute to deaths in perioperative care.⁽⁵⁾ There was a delay in obtaining the main surgical diagnoses in 12.4% (28/225) of cases.

These delays, which can be attributed to more than one department, were associated with the following areas:

- surgical unit (n=12)
- medical unit (n=6)
- other departments or causes (n=13).

Delays in the main surgical diagnosis were primarily due to unavoidable causes (n=10), inexperienced staff (n=6), and misinterpretation of results (n=3). Other reasons for delay were related to disease pathology (unusual, rare or atypical disease), patient (transfer, optimisation and delayed presentation) and the hospital.

3.3.6 Surgical diagnosis

For the patients who had an operation (n=229), the most frequent surgical diagnoses on admission were:

- malignancy (n=43)
- ischaemic bowel and/or intestinal obstruction or perforation (n=33)
- peripheral vascular disease and/or leg ulcers or cellulitis (n=24)
- severe head injury and/or hypoxic brain injury, traumatic subdural haemorrhage (n=23)
- fractured neck of femur (n=18)
- septicaemia or septic shock (n=13)
- cerebral haemorrhage (intracerebral, subarachnoid)(n=9)
- septicaemia or septic shock (n=13)
- upper gastrointestinal bleeding, haematemesis and/or bleeding oesophageal varices (n=11)
- necrotising fasciitis (n=10)

3.3.7 Cases with operations

During this reporting period, three quarters of the NTASM patients had an operation (75.3%; 229/304).

- A total of 381 operations were performed on 229 patients.
- Males were more likely to have an operation than females (150 males compared with 79 females).
- More than one operation was performed on 33.2% (76/229) of patients.

The high rate of return to theatre may be explained by debridement of skin or muscle being the most common operation. Debridement of skin or muscle often requires repeat operations.

3.3.8 Cases with postoperative complications

Postoperative complications are strong predictors of death.^(6,7) NTASM surgeons reported that 22.7% (52/229) of patients had a postoperative complication. However, the NTASM numbers are low and this data should be interpreted with caution.

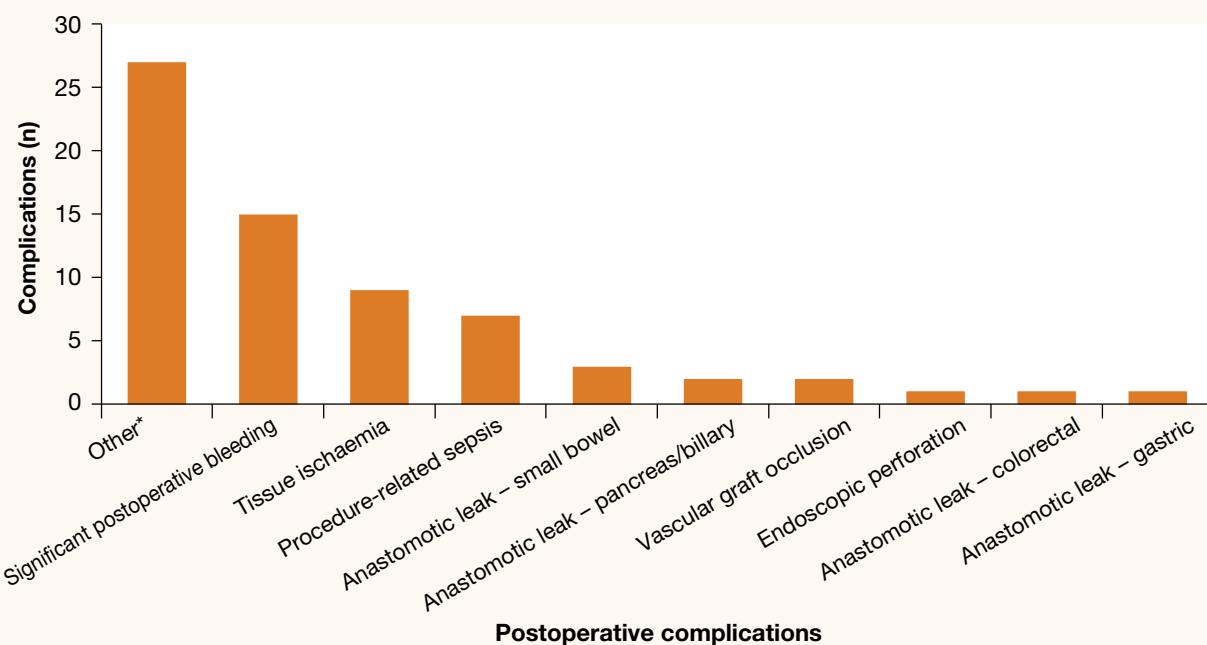
This is significantly lower than the ANZASM rate of 34.6% (7,617/22,020); RR 0.66 (95% CI 0.52 to 0.83).⁽¹⁾

In the NTASM, 52 patients experienced 68 complications. The number of complications per patient ranged from one to four. More than half the patients (69.2%; 36/52) had one complication and 28.8% (15/52) of patients had two complications. Half the patients (53.3%; 8/15) with two or more complications had a significant postoperative bleed. More than half the patients (60%; 9/15) with two or more complications had more than one operation (range, 2 to 6 operations).

As shown in Figure 9, the most frequent complications were:

- significant postoperative bleeding (n=15)
- tissue ischaemia (n=9)
- anastomotic leak, including small bowel, gastric, colorectal and pancreas/biliary (n=9)
- procedure-related sepsis (n=7)
- vascular graft occlusion (n=2)
- endoscopic perforation (n=1)

Figure 9: Classification of NTASM postoperative complications by type (n=68)



*Other: This includes acute myocardial infarction, alleged pulmonary embolism and bleeding from drain site, anastomotic leak of small bowel, aspiration pneumonia, bleeding after second operation, disseminated intravascular coagulation, extensive gastric cancer infiltration, failure to heal, failure of adhesion and collapse of mucous fistula, lung collapse and infection, necrotising fasciitis of abdominal wall, perforated peptic ulcer, pneumonia, pneumothorax after insertion of portacath, postoperative ileus, prolonged ileus and respiratory failure, respiratory failure with pulmonary embolism, secondary brain injury, small bowel ischaemia, tongue swelling, wound haematoma and wound dehiscence.

3.3.9 ICU Admission

ICUs are essential contributors to surgical care. In high-risk patients, a planned admission to the ICU may effectively decrease postoperative mortality.⁽⁹⁾

- Care in an ICU was received postoperatively by 71.8% (163/227) of patients.
- A postoperative unplanned admission to an ICU occurred in 18.3% (40/218) of NTASM patients, compared with 19.9% (3,024/15,230) of ANZASM patients.⁽¹⁾
- In 15.4% (8/52) of cases in which the patient did not receive support from an ICU or high dependency unit, the assessors believed that the patient should have received such support.

3.3.10 Unplanned returns to theatre

Unplanned returns to theatre and unplanned admissions to an ICU are each strong predictors of death in surgical patients.⁽⁹⁻¹¹⁾ The rate of unplanned returns to theatre was higher for NTASM patients compared with ANZASM patients.

An unplanned return to theatre occurred in 17.9% (39/218) of the NTASM cases, compared with 16.1% (3,484/21,603) of ANZASM cases.⁽¹⁾

- The difference between the NTASM cases and ANZASM cases is not significant RR 1.11 (95% CI 0.83 to 1.48) and numbers remain too low for definitive comparison.

3.3.11 Length of hospital stay

The length of stay for surgical patients is determined by many factors.⁽⁹⁾ The majority of patients had been in hospital for a short time, with 22.4% (68/304) of patients admitted to hospital for one day or less (see Table 8) before they died.

Table 8: Days in hospital (length of stay) before death in NTASM and ANZASM

Length of hospital stay	NTASM n=304	ANZASM n=32,168
Median (IQR)	6 days (2–16)	8 days (3–19)
Minimum	<1 day	<1 day
Maximum	125 days	902 days

NTASM: Northern Territory Audit of Surgical Mortality; ANZASM: Australian and New Zealand Audit of Surgical Mortality;
 IQR: interquartile range.

3.4 PATIENTS

Key Points

- NTASM patients were younger than those in other regions of Australia.
- The profile of NTASM patients was similar to the national profile in the following areas: significant comorbidities, emergency admissions and gender distribution.
- The proportion of the NTASM patients with hepatic disease was three times higher than that for ANZASM patients.
- The proportion of the NTASM patients with diabetes mellitus was twice that of ANZASM patients.

3.4.1 Overview of patients

During the 6 years of the audit, 368 patient deaths have been reported, of which 41 were excluded. The excluded cases were either terminal care cases ($n=30$) or cases that were reported to the audit in error ($n=11$). Of these reported deaths, 327 have completed the full peer review process (93.0%; 304/327)

A total of 381 operations were performed in 229 patients.

3.4.2 Gender

Overall there were more males than females in both NTASM and ANZASM. But in NTASM there were 10% more males than in ANZASM. An overview of the gender distribution of the NTASM patients compared with ANZASM patients is shown in Table 9.

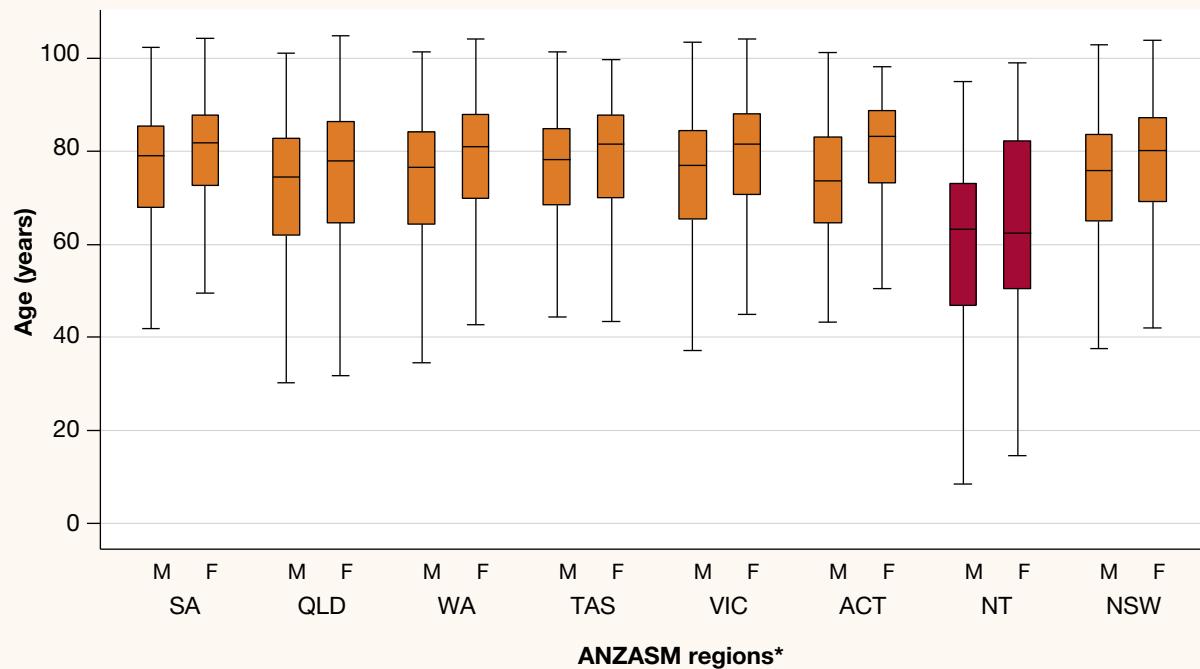
Table 9: Gender distribution of NTASM patients compared with ANZASM patients

	Males	Females
NTASM	65%	35%
ANZASM	55%	45%

NTASM: Northern Territory Audit of Surgical Mortality ($n=304$).

ANZASM: Australian and New Zealand Audit of Surgical Mortality ($n=28,434$)

Figure 10: Median age distribution by gender of NTASM patients compared with ANZASM regions (n=28,429)



Note: neonates excluded; Data not available: n=5.

M: male; F: female.

*ANZASM regions are: SA: South Australia; QLD: Queensland; WA: Western Australia; TAS: Tasmania; VIC: Victoria; ACT: Australian Capital Territory; NT: Northern Territory; NSW: New South Wales.

In the above box-and-whisker plots figure; the central box represents the values from the lower to upper quartile (25th to 75th percentile). The middle line represents the median value. The vertical line extends from the minimum to the maximum value, excluding extreme values.

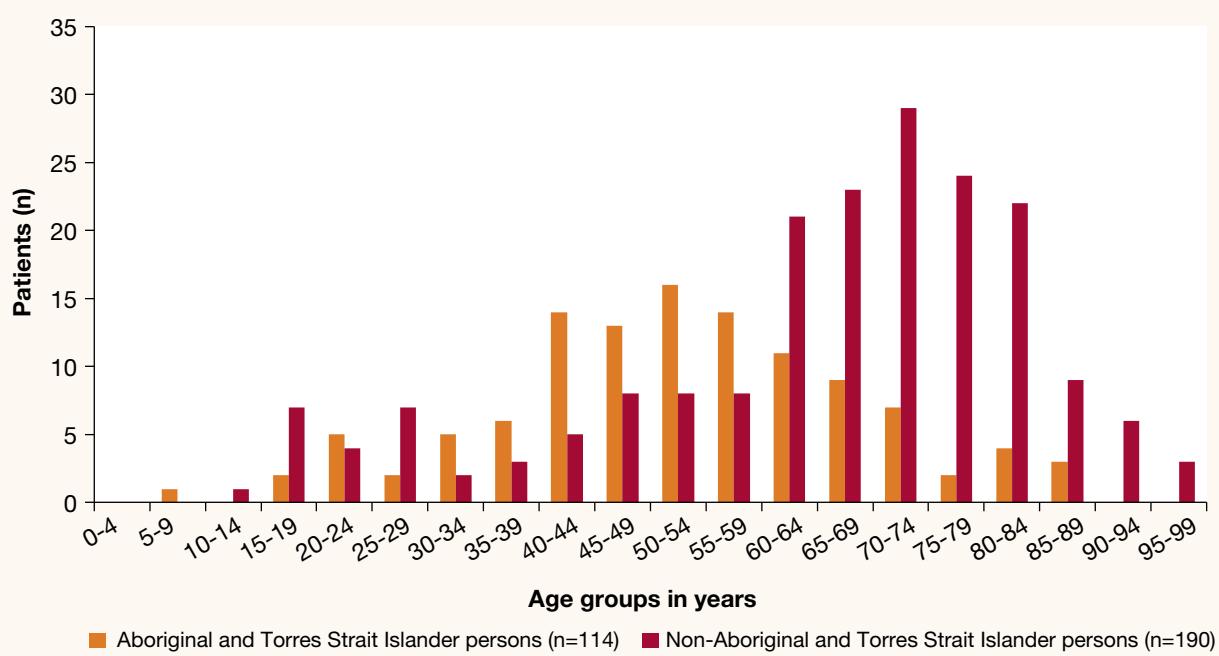
The median age distribution by gender in the box-and-wisker plot of Figure 10 shows that for NT patients:

- the minimum age was lower compared with other regions, for both males and females.
- the middle 50% of ages was lower than that for other regions.
- males were younger than females, which was similar to the other regions.

3.4.3 Age of NTASM patients

An overview of the age distribution (in 5 year intervals) of NTASM patients is shown in Figure 11.

Figure 11: Comparison of the 5-year age group distribution of Aboriginal and Torres Strait Islander patients and non-Aboriginal and Torres Strait Islander patients (n=304)



- 79.2% (137/173) of patients in the age groups 60 years and older were non-Aboriginal and Torres Strait Islander persons.
- In the age groups 60 years and younger, 58.7% (81/138) of the patients were Aboriginal and Torres Strait Islander persons.
- There were seven Aboriginal and Torres Strait Islander persons older than 80 years, but none were older than 89 years.

3.4.4 American Society of Anesthesiologists class

The American Society of Anesthesiologists (ASA) class is an international measure of patient risk used by anesthetists.⁽¹²⁾ In the NT, an ASA class is assigned to the patient by the assisting anaesthetist prior to a procedure being undertaken.

An ASA class indicating the presence of severe disease (ASA class 3 to 6) was assigned to 90.2% (203/225) of patients prior to the patient going to theatre. This is similar to the number of patients in ANZASM who were assigned an ASA class of 3 to 6 (89.9%; 19,372/21,544).⁽¹⁾ Figure 12 shows the distribution of ASA class for NTASM patients.

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.⁽¹²⁾

Figure 12: Distribution of ASA class for NTASM patients (n=229)



Data not available: n=4.

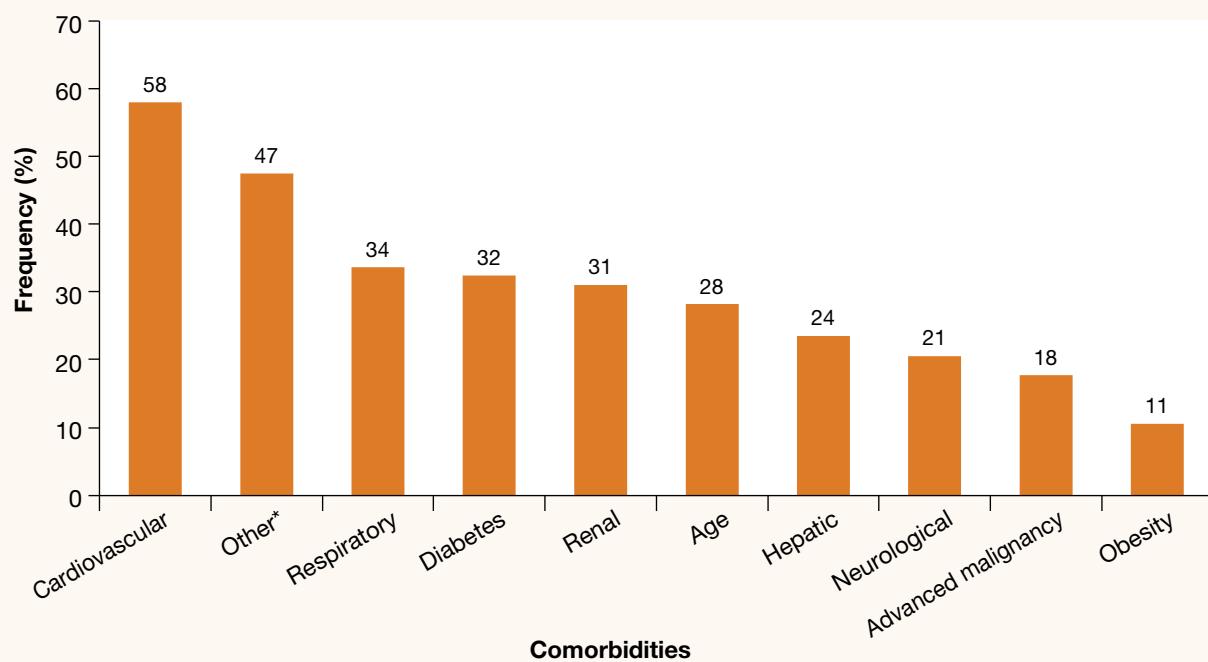
ASA: American Society of Anesthesiologists; NTASM: Northern Territory Audit of Surgical Mortality.

3.4.5 Comorbidities

According to the literature, comorbidities are a stronger predictor of mortality than the type of surgery.⁽⁷⁾ Serious comorbidities were present in 78.5% (238/303) of the NTASM patients and 204 patients had more than one serious comorbidity. The distribution of comorbidities is shown in Figure 13.

- The median number of comorbidities per patient in the NTASM was 3 (range, 1 to 6).
- The median number of comorbidities for the ANZASM patients⁽¹⁾ was also 3 but the range was different (range, 1 to 9).
- Cardiovascular disease, respiratory disease, diabetes and renal disease were the most common comorbidities in NTASM patients (see Figure 13).

Figure 13: Distribution of 721 comorbidities in 238 patients**



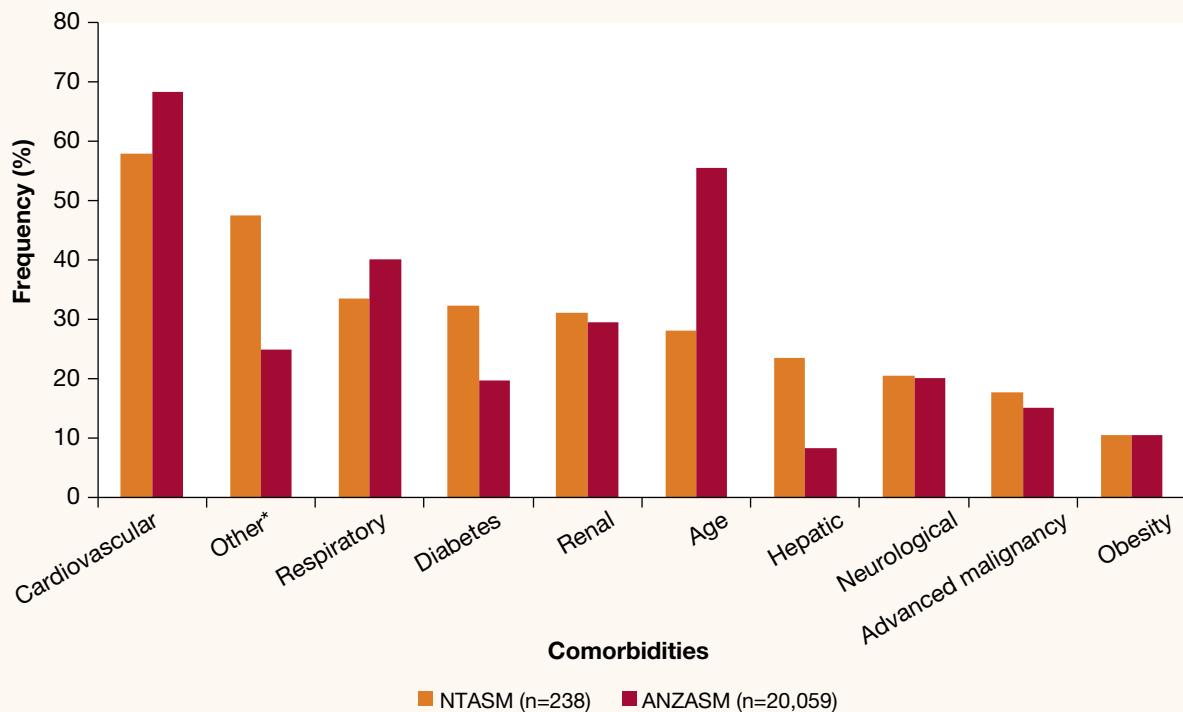
**The percentages do not total 100 as the median number of comorbidities per patient was 3 (range 1-6)

*Note: the most common ‘other’ comorbidities were: alcohol abuse, vascular disease, mental health/dementia, coagulopathy, heavy smoking, malnutrition and hypertension.

The distribution of comorbidities in NTASM patients compared with ANZASM patients is shown in Figure 14.

- The proportion of NTASM patients with hepatic disease (23.5%; 56/238) was significantly higher than the proportion of ANZASM patients with hepatic disease (8.3%; 1,659/20,059),⁽¹⁾ RR 2.84 (95% CI 2.25 to 3.56).
- The proportion of NTASM patients with diabetes mellitus (32.4%; 77/238) was significantly higher than the proportion of ANZASM patients with diabetes mellitus (19.7%; 3,951/20,059),⁽¹⁾ RR 1.64 (95% CI 1.36 to 1.98).
- NTASM patients had a reduced risk of cardiovascular disease (58.0%; 138/238) compared with ANZASM patients (68.3%; 13,699/20,059),⁽¹⁾ RR 0.85 (95% CI 0.76 to 0.95). This may be an effect of the younger age of NTASM patients.

Figure 14: Distribution of comorbidities in NTASM patients compared with ANZASM patients



NTASM: Northern Territory Audit of Surgical Mortality; ANZASM: Australian and New Zealand Audit of Surgical Mortality

*Other comorbidities in both NTASM and ANZASM patients covered a wide range.

In NTASM patients these included: active smoking, alcohol abuse, anaemia, anticoagulation, chronic alcoholism, Child B cirrhosis, Child C cirrhosis, coagulopathy, dementia, hepatitis C, human immunodeficiency virus, ischaemic heart disease, malnutrition, peripheral vascular disease and sepsis.

In ANZASM patients these included: alcohol abuse, anaemia, anticoagulation, bowel ischaemia, cachexia, cellulitis, coagulopathy, dementia, human immunodeficiency virus/acquired immunodeficiency syndrome, malnutrition, motor neurone disease, polymyalgia rheumatic, rheumatoid arthritis, sepsis and systemic lupus erythematosus.

3.4.5.1 Alcohol abuse

Based on the informal reporting of alcohol abuse, NTASM patients were three time more likely to have it reported than ANZASM patients (see Figure 15). Some surgeons choose to report alcohol abuse as an “other” comorbidity, although it is not a formal comorbidity question. Evidence of alcohol abuse is based on professional opinion and judgement.

The reported rate in NTASM patients may be related to the hepatic disease comorbidity.

Figure 15: Informal reporting of alcohol abuse as an “other” comorbidity in NTASM and ANZASM patients

	NTASM (n= 113)	ANZASM (n= 4 986)	Risk Ratio (95% CI)
Alcohol abuse	29.2%	8.8%	3.29 (2.43 - 4.44)*

* Statistically significant

NTASM: Northern Territory Audit of Surgical Mortality; ANZASM: Australian and New Zealand Audit of Surgical Mortality

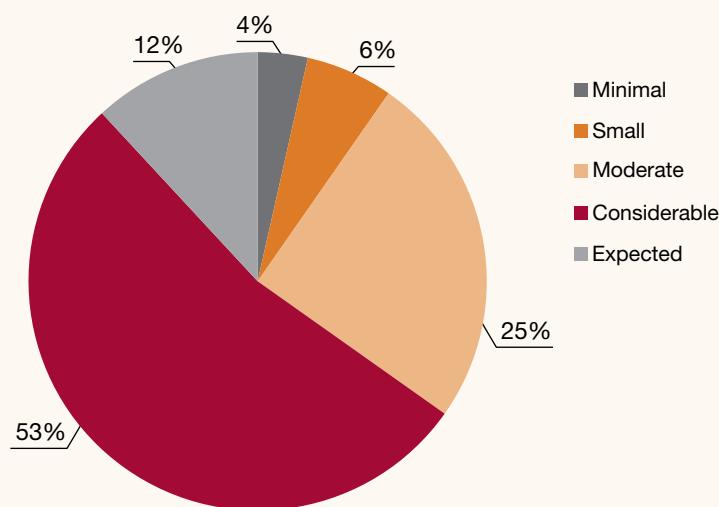
3.4.6 Risk of death

While the risk of surgical mortality is generally low, there are patients who are at a higher risk.⁽¹³⁾

Surgeons were asked to rate the overall risk of death, prior to surgery, for each patient. The distribution of the risk of death is shown in Figure 16.

- The risk of death was considerable or expected in 65.2% (148/227) of patients, similar to the risk reported in ANZASM patients (62.7%; 13,734/21,902).⁽¹⁾

Figure 16: Proportion of NTASM patients at risk of death prior to surgery, as perceived by surgeons (n=227)



Data not available: n=2.

3.5 ABORIGINAL AND TORRES STRAIT ISLANDER PERSONS

Key Points

- One-third of the NTASM patients were Aboriginal and Torres Strait Islander persons.
- Aboriginal and Torres Strait Islander persons were younger than non-Aboriginal and Torres Strait Islander persons.
- No differences in clinical management issues were noted between Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons.

3.5.1 Overview

Data reporting for Aboriginal and Torres Strait Islander persons in the NTASM has occurred since July 2010. Reporting in other ANZASM regions began in January 2011 and has not been uniform. Due to the difference in the collecting system, ANZASM has no data from New South Wales and limited data from both Western Australia and Tasmania. ANZASM cases since 2011 are compared with all NTASM cases in this section.

Almost a third of the population in the NT are Aboriginal and Torres Strait Islander persons, the highest of any Australian state or territory.⁽²⁾ This was reflected in the surgical audit population, with the NTASM having a higher percentage of Aboriginal and Torres Strait Islander persons than the ANZASM.

- 37.5% (114/304) of the NTASM patients were Aboriginal and Torres Strait Islander persons.
- 2.9% (324/11,291) of the ANZASM patients were Aboriginal and Torres Strait Islander persons.⁽¹⁾

3.5.2 Aboriginal and Torres Strait Islander persons and age

Aboriginal and Torres Strait Islander persons who died in the perioperative period were younger than non-Aboriginal and Torres Strait Islander persons. This was also seen in the ANZASM patients, as shown in Table 10.

The difference in the median age of Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons was 17 years in the NTASM and 25 years in the ANZASM.

The age distribution of Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons is shown in Table 10.

Table 10: Age at death of Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons in NTASM compared with ANZASM

	NTASM n=304		ANZASM n=11,291	
	Age at death of Aboriginal and Torres Strait Islander persons (n=114)	Age at death of non-Aboriginal and Torres Strait Islander persons (n=190)	Age at death of Aboriginal and Torres Strait Islander persons (n=324)	Age at death of non-Aboriginal and Torres Strait Islander persons (n=10,967)
Median (IQR)	52 years (43–62)	69 years (56–77)	53 years (43–65)	78 years (66–86)
Minimum	8 years	14 years	0 years	0 years
Maximum	88 years	99 years	94 years	104 years

Note: neonates and elderly included

NTASM: Northern Territory Audit of Surgical Mortality; ANZASM: Australian and New Zealand Audit of Surgical Mortality. IQR: interquartile range.

3.5.3 Aboriginal and Torres Strait Islander persons and ASA class

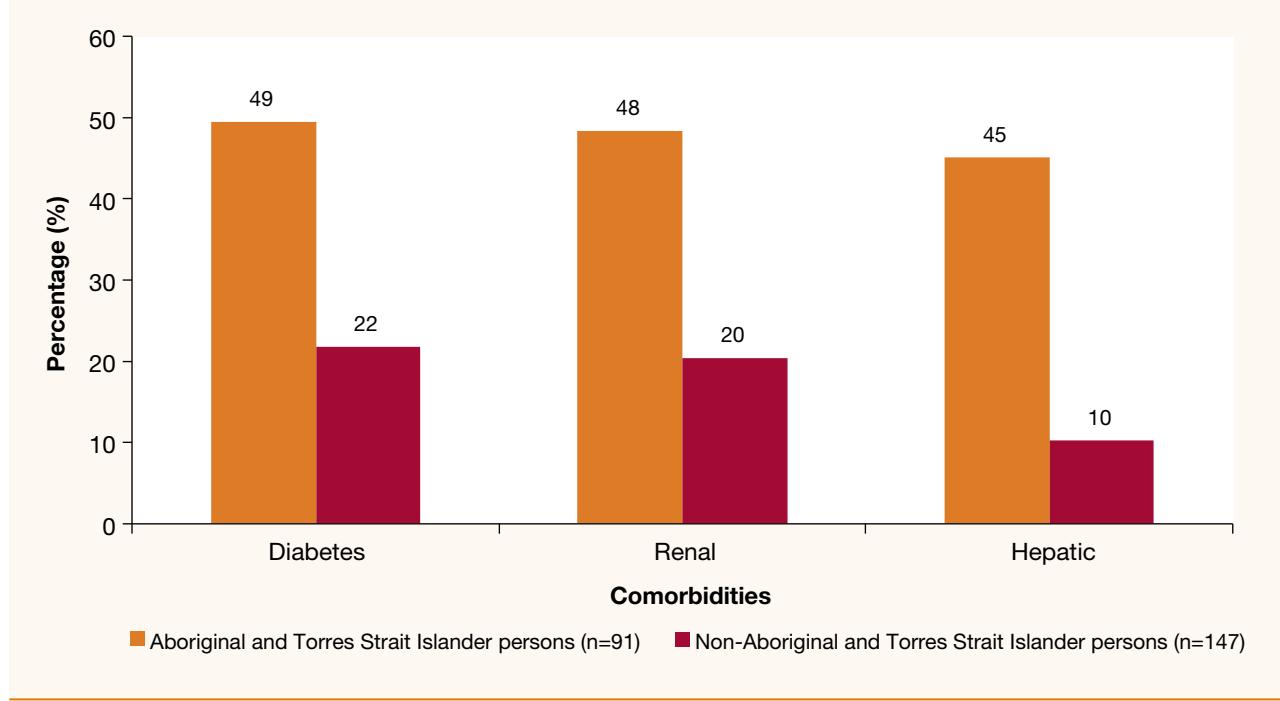
- An ASA class of 3 or higher was recorded for 88.2% (97/110) of Aboriginal and Torres Strait Islander persons. At a minimum, these patients presented with severe disease prior to undergoing surgery. Figure 12 shows the distribution of ASA class for Aboriginal and Torres Strait Islander persons. This data is not age adjusted.
- In ANZASM, an ASA class of 3 or higher was present in 88.6% (210/237) of Aboriginal and Torres Strait Islander persons who had an operation.⁽¹⁾ This data is not age adjusted.
- In NTASM, six Aboriginal and Torres Strait Islander persons considered ASA class 1 (a healthy patient) were admitted due to:
 - multisystem trauma (pedestrian in motor vehicle accident) (n=2)
 - subarachnoid haemorrhage (n=2)
 - massive bleed from stab wound (n=1)
 - drowning (n=1).

3.5.4 Aboriginal and Torres Strait Islander persons and comorbidities

In NTASM patients, diabetes, renal and hepatic diseases were more prevalent in Aboriginal and Torres Strait Islander persons than non-Aboriginal and Torres Strait Islander persons (see Figure 17).

The prevalence of comorbidities is a problem for the surgical care of Aboriginal and Torres Strait Islander persons. Aboriginal and Torres Strait Islander persons are at greater risk of liver disease than non-Aboriginal and Torres Strait Islander persons.⁽¹⁴⁾

Figure 17: Comparison of diabetes, renal and hepatic disease in Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons in NTASM



Audit data shows that when age was not adjusted, there was no statistical difference in the presence of serious comorbidities in Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons in both the NTASM and the ANZASM (see Table 11)

Table 11: Comparison of serious comorbidities in Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons in NTASM and ANZASM

	NTASM patients with serious comorbidities present n (%) [*]	ANZASM patients with serious comorbidities present n (%) [*]
Aboriginal and Torres Strait Islander persons	91/113 (81%)	279/323 (86%)
Non-Aboriginal and Torres Strait Islander persons	147/190 (77%)	9,848/10,933 (90%)
Risk ratio (95% CI)	1.04 (0.92 - 1.17)	0.96 (0.92 - 1.00)

*Note: comorbidity data missing NTASM (n=1) and ANZASM (n=35)

NTASM: Northern Territory Audit of Surgical Mortality; ANZASM: Australian and New Zealand Audit of Surgical Mortality. 95% CI: 95 % confidence interval.

When patient age in NTASM was capped at 50 years or younger, a considerable difference emerged between Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons. Younger Aboriginal and Torres Strait Islander persons were twice as likely to have serious comorbidities than compared with younger non-Aboriginal and Torres Strait Islander persons RR of 2.10 (95% CI 1.34 to 4.27). (See Table 12).

Similar findings were reported in a publication exploring health-related behaviours as predictors of mortality and morbidity in Australian Aboriginal persons.⁽¹⁵⁾

Table 12: Age adjusted comparison of serious comorbidities in Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons in NTASM

	50 years or younger n (%)	50 years or older n (%)
Aboriginal and Torres Strait Islander persons	44/63 (70%)	61/66 (92%)
Non-Aboriginal and Torres Strait Islander persons	15/45 (33%)	139/153 (91%)
Risk ratio (95% CI)	2.10 (1.34 - 3.27)*	1.02 (0.93 - 1.11)

NTASM: Northern Territory Audit of Surgical Mortality; ANZASM: Australian and New Zealand Audit of Surgical Mortality.

95% CI: 95 % confidence interval.

* Statistically significant

3.5.5 Aboriginal and Torres Strait Islander persons and risk of death

Based on surgeon perception, a higher proportion of Aboriginal and Torres Strait Islander persons were at considerable or expected risk of death (73.6%; 64/87) compared with non-Aboriginal and Torres Strait Islander persons (59.2%; 84/142). An overview of the risk of death is shown in Table 13.

Table 13: Surgeons' perceived risk of death between Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons (n=229)

Risk of death	Aboriginal and Torres Strait Islander persons (n=87)	Non-Aboriginal and Torres Strait Islander persons (n=140)*
Minimal	1.1%	5.0%
Small	3.4%	7.9%
Moderate	21.8%	27.1%
Considerable	64.4%	46.4%
Expected	9.2%	13.6%

* data not available = 2 (1.2%)

3.5.6 Aboriginal and Torres Strait Islander persons and clinical management

In patients who had an operation, there was no difference in the clinical management indicators with regards to the care provided to Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons (see Table 14 and Table 15).

A 2013 publication showed that surgical care in the NTASM patients, as measured by accepted indicators, was equivalent in both groups.⁽³⁾ This is similar to what was reflected in the ANZASM.⁽¹⁾

Table 14: Comparison of areas requiring improvement in management of surgical care, as perceived by surgeons, between Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons in NTASM and ANZASM

Areas for improvement in management of surgical care	NTASM (n=229)			ANZASM (n=8,877)		
	Aboriginal and Torres Strait Islander persons (n=87)*	Non-Aboriginal and Torres Strait Islander persons (n=142)*	Risk ratio (95% CI)	Aboriginal and Torres Strait Islander persons (n=240)*	Non-Aboriginal and Torres Strait Islander persons (n=8,637)*	Risk ratio (95% CI)
Preoperative management	7% (6/86)	9% (12/138)	0.8 (0.31 - 2.06)	10% (24/236)	7% (590/8,447)	1.46 (0.99 - 2.14)
Choice of operation	4% (3/85)	2% (3/137)	1.61 (0.33 - 7.80)	3% (6/232)	2% (183/8,433)	1.19 (0.53 - 2.66)
Timing of operation	7% (6/86)	8% (11/136)	0.86 (0.33 - 2.25)	8% (18/234)	5% (455/8,439)	1.43 (0.91 - 2.24)
Decision to operate	8% (7/86)	9% (13/139)	0.87 (0.36 - 2.10)	8% (18/249)	7% (593/8,430)	1.03 (0.65 - 1.61)
Intraoperative	6% (4/68)	4% (6/138)	1.07 (0.31 - 3.68)	3% (7/234)	3% (249/8,412)	1.01 (0.48 - 2.12)
Postoperative care	2% (2/85)	5% (7/136)	0.46 (0.10 - 2.15)	3% (8/231)	5% (434/8,363)	0.67 (0.34 - 1.33)

NTASM: Northern Territory Audit of Surgical Mortality; ANZASM: Australian and New Zealand Audit of Surgical Mortality.

95% CI: 95 % confidence interval.

*Note: not all questions are answered for each case resulting in denominator variation.

Table 15: Comparison of issues with postoperative care, as reported by surgeons, between Aboriginal and Torres Strait Islander persons and non-Aboriginal and Torres Strait Islander persons in NTASM and ANZASM

Postoperative care	NTASM (n=229)		ANZASM (n=8,877)	
	Aboriginal and Torres Strait Islander persons (n=87)*	Non-Aboriginal and Torres Strait Islander persons (n=142)*	Aboriginal and Torres Strait Islander persons (n=240)*	Non-Aboriginal and Torres Strait Islander persons (n=8,637)*
Postoperative complications detected	18% (16/87)	25% (36/142)	29% (69/239)	52% (2,932/5,650)
Use of DVT prophylaxis	69% (59/85)	85% (116/137)	75% (178/236)	83% (7,110/8,532)
Unplanned return to theatre	18% (15/82)	18% (24/136)	20% (48/236)	16% (1,347/8,520)
Unplanned readmission	2% (2/82)	3% (4/135)	2% (5/235)	3% (279/8,157)
Fluid balance alterations	7% (6/81)	10% (13/132)	9% (21/235)	9% (775/8,456)
Communication	7% (6/81)	10% (13/136)	6% (15/234)	5% (385/7,962)
Treated in critical care unit	72% (61/85)	72% (102/142)	76% (181/237)	68% (5,864/8,609)
Unplanned ICU admission	17% (14/82)	19% (26/136)	20% (47/236)	25% (1,669/6,786)
Different action by surgeon	20% (16/82)	19% (26/137)	20% (47/235)	16% (1,394/8,637)

NTASM: Northern Territory Audit of Surgical Mortality; ANZASM: Australian and New Zealand Audit of Surgical Mortality; DVT: deep vein thrombosis; ICU: intensive care unit.

*Note: not all questions are answered for each case resulting in denominator variation.

3.6 TRAUMA

Key Points

- Trauma prevalence was similar in the NTASM patients and the ANZASM patients.
- Trauma 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.
- The data relating to trauma should be interpreted with care because the numbers are low.

3.6.1 Trauma overview

Trauma has a similar prevalence in the NTASM patients compared with ANZASM. Currently only the NT, Queensland, Western Australia and Victoria provide trauma data to ANZASM.

In ANZASM, the prevalence of trauma was 28% (2,581/9,212).⁽¹⁾ In the NTASM, the prevalence of trauma was 30.8% (78/253) of patients. The difference in trauma presentations for NTASM patients and ANZASM patients was not significant (RR 1.00; 95% CI 0.91 to 1.33).

In the NTASM patients, a higher proportion of non-Aboriginal and Torres Strait Islander persons (61.5%; 48/78) presented with trauma compared with Aboriginal and Torres Strait Islander persons.

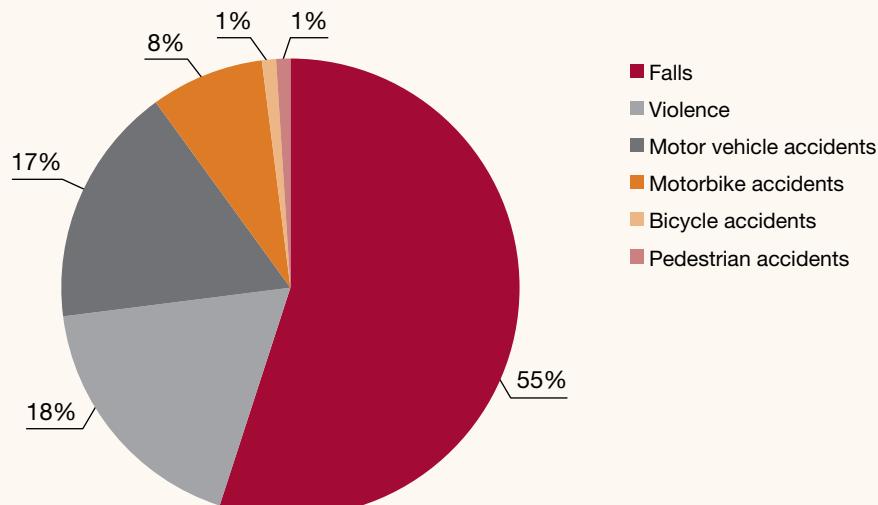
Trauma was most commonly associated with falls, both in the NTASM patients (55.1%; 43/78) and ANZASM patients (81.1%; 2,077/2,560).⁽¹⁾ However, the NTASM trauma patients who had falls were younger (median 62 years; IQR 53 to 77) than the ANZASM patients (median 85 years; IQR 77 to 90) as seen in Figure 18.

One-quarter of NTASM trauma cases were associated with motor vehicle accidents (26.9%; 21/78). Published trauma data shows that fatalities in the NT, due to motor vehicle accidents, are nearly three times higher than for the rest of Australia.⁽¹⁶⁾ This difference is most likely due to death occurring at the accident scene rather than in hospital.

Trauma due to violence is 17.9% (14/78). The numbers for accidents and violence are too low to compare with national data.

The distribution of trauma in NTASM is seen in Figure 18.

Figure 18: Distribution of causes of trauma (n=78)



3.6.2 Trauma - Falls

Falls were the most frequent cause of trauma, accounting for 55.1% (43/78) of patients with documented trauma.

- 48.8% (21/43) of the falls occurred at home.
- 11.6% (5/43) of the falls occurred in hospital.
- 11.6% (5/43) of the falls occurred in a care facility.
- 25.6% (11/43) of falls were due to other causes, such as sport or recreation.
- 2.3 % (1/43) of falls where the fall occurred was unknown

Falls occurred in a considerably higher proportion of the ANZASM trauma patients (81.1%; 2,077/2,560).

The median age of the NTASM patients who experienced a fall was 62 years (IQR 53 to 77).

The median age of the ANZASM patients who experienced a fall was considerably older at 85 years (IQR 77 to 90).⁽¹⁾

3.6.3 Trauma – Road traffic accidents

Road traffic accidents were the cause of 21 trauma cases (13 motor vehicle accidents, 6 motorbike accidents, 1 bicycle accident and 1 pedestrian). The median age of patients who were involved in a traffic accident was 28 years. Ages for this group ranged from 19 years to 44 years.

3.6.4 Trauma – Violence

The median age of the 14 patients who experienced violence was 39 years (ranging from 19 years to 70 years).

Public violence and domestic violence each accounted for approximately one quarter of the cases (public violence: 3/14; domestic violence: 3/14).

3.7 INFECTIONS

Key Points

- Infection rates in the NTASM patients were higher than those in the ANZASM patients. This rate is statistically significant.
- Of the NTASM patients who died with an infection present, more than half presented to hospital with an existing infection.
- The data relating to infections should be interpreted with care because the numbers are low.

3.7.1 Overview

All ANZASM regions, except for New South Wales, started collecting infection data in 2012. The infection rate in the NTASM patients was not significantly different to that in ANZASM. However, there was a difference in when the infections were acquired. Most infections in the NTASM patients were acquired prior to admission while in the ANZASM patients, the majority of infections were acquired during the admission (see Figure 19).

3.7.2 Infections and operations

In NTASM patients who died with a clinically significant infection, 85.6% (77/90) had operations. Of these patients:

- 1 patient had a surgical site infection.
- 6 patients acquired an infection preoperatively.
- 16 patients acquired an infection postoperatively.
- 4 patients had an invasive site infection.

(Note: data not available: n=50 cases)

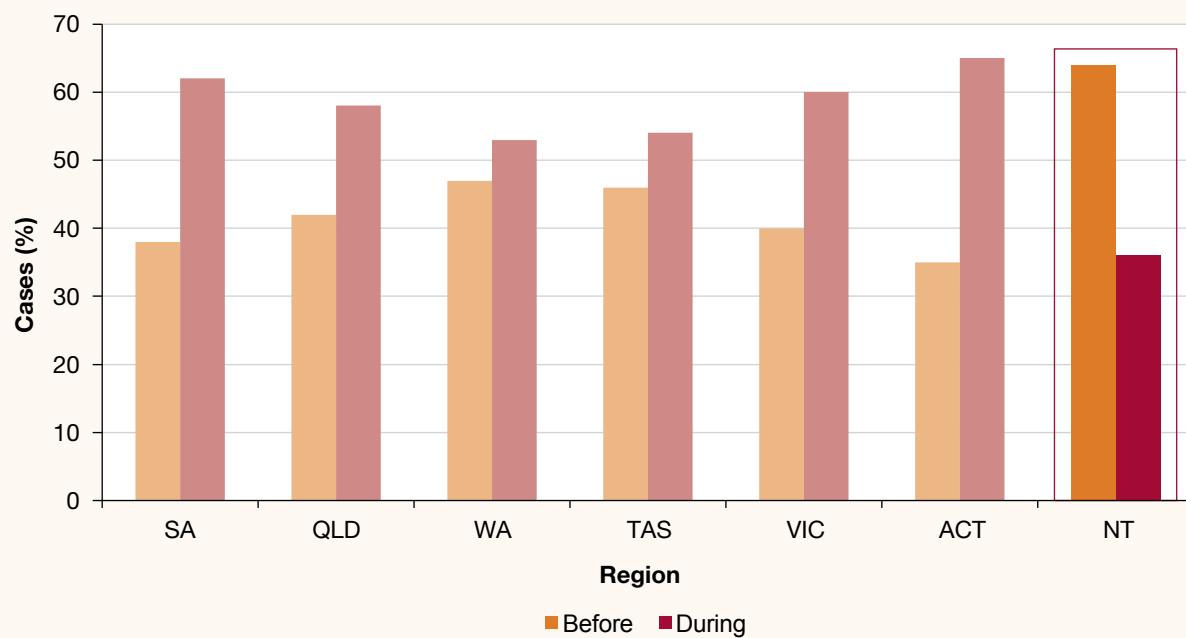
3.7.3 Infections and time of acquisition

In NTASM, 36.7% (90/245) of patients died with a clinically significant infection present, compared with 34.3% (4,291/12,524) of ANZASM patients.⁽¹⁾ This result was not significant, RR 1.07 (95% CI 0.91 to 1.27).

(Note: NTASM data was not available for three patients regarding when the infection was acquired and for two patients regarding type of infections.)

- Of the NTASM patients with infection, 64.4% (56/87) acquired the infection prior to admission and 35.6% (31/87) acquired the infection during this admission.
- NTASM patients were statistically more likely to have acquired the infection prior to admission (64.4%; 56/87) compared with ANZASM patients (41.5%; 1,712/4,124). RR 1.55 (95% CI 1.32 to 1.82).⁽¹⁾ An overview of when patients acquired infections, by ANZASM region, is provided in Figure 19.
- In NTASM, Aboriginal and Torres Strait Islander persons (81.2%; 26/32) were statistically more likely to have acquired the infection prior to admission than non-Aboriginal and Torres Strait Islander persons (54.5%; 30/55). RR 1.48 (95% CI 1.11 to 2.00).

Figure 19: Proportion of patients with infections acquired before and during admission by ANZASM region (n=4,124)



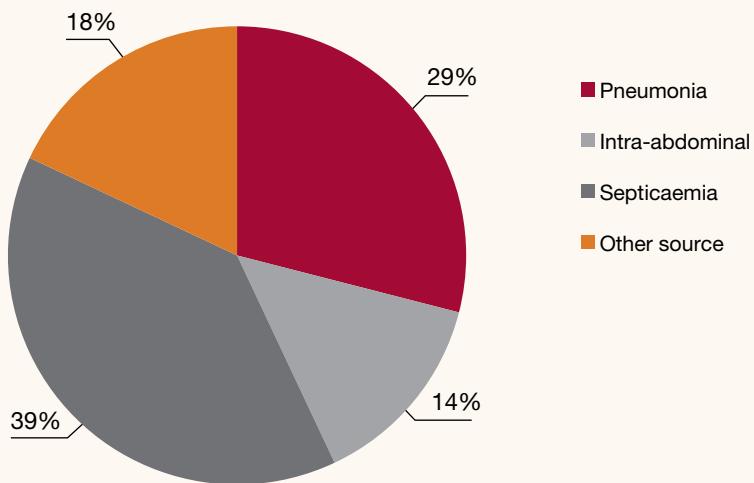
Data not available: n=167 (4%)

ANZASM regions are: SA: South Australia; QLD: Queensland; WA: Western Australia; TAS: Tasmania; VIC: Victoria; ACT: Australian Capital Territory; NT: Northern Territory;

3.7.4 Types of infection

A clinically significant infection was present at death in 90 patients. For five of these patients the type of infection was not stated. Of the patients with an infection acquired prior to or during admission septicaemia (38.8%; 33/85) and pneumonia (29.4%; 25/85) were most frequent. While other-source infections (17.6%; 15/85) and intra-abdominal sepsis (14.1%; 12/85) were less frequent (Figure 20).

Figure 20: Types of infection acquired before or during the admission (n=85)



Note: of the 90 patients who died with a clinically significant infection, the type of infection was not stated for five patients.

3.7.5 Types of infection positively identified

The types of infections with organisms positively identified in the NTASM patients were different to those identified in the ANZASM patients. This is possibly due to the increased number of soft tissue infections and necrotising fasciitis seen in the NT.

Methicillin-resistant *Staphylococcus aureus* (MRSA) and *Pseudomonas aeruginosa* were the most frequently identified species of organism in NTASM patients, with both identified in 19% (10/54) of cases. *Pseudomonas* infections are considered hospital acquired infections.⁽¹⁷⁾ Serious *Pseudomonas* infections usually occur in immune-compromised or hospitalised patients. Hospital patients with the highest risk are those on ventilators or who have catheters, surgical wounds or burns. This organism is found in non-chlorinated swimming water and has been identified in necrotising fasciitis in the NT.⁽¹⁸⁾

In NTASM, there were 5 non-Aboriginal and Torres Strait Islander persons and 5 Aboriginal and Torres Strait Islander persons with MRSA identified (9.3%; 5/54). MRSA was isolated at similar rates in the NTASM (18.5%; 10/54) and ANZASM (11.9%; 198/1,666).⁽¹⁾ MRSA has been well documented as a community-acquired infection in the NT.⁽¹⁹⁻²¹⁾

While *Pseudomonas* and MRSA were the most frequently identified infective organisms in the NTASM, the most frequently identified infective organism in ANZASM patients was *Staphylococcus aureus*. *Staphylococcus aureus* was isolated in only 9.3% (5/54) of the NTASM cases, lower than the ANZASM rate of (22.7%; 378/1,666).⁽¹⁾

Group A Streptococcus was isolated in 9.3% (5/54) of NTASM cases. This organism is often associated with necrotising fasciitis (type II) infections.^(18,22)

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Thank you to the steering committee for their wisdom and counsel.

Thank you to the staff for managing the process professionally and systematically.

Dr John North

NTASM Clinical Director

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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 Anesthesiologists
CI	confidence interval
ICU	intensive care unit
IMG	International Medical Graduate
IQR	interquartile range
MRSA	Methicillin-resistant <i>Staphylococcus aureus</i>
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

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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).