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Royal Australasian College Of Surgeons



Victorian Audit of Surgical Mortality



Front cover

"Silent visitors" (2014) by Susan Begg Schurmann.



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Clinical Director's report

The death of a patient can be a learning experience.

This is the sixth annual report since data collection for the Victorian Audit of Surgical Mortality (VASM) commenced on 1 July 2007. In this report we present the outcomes of the review of 3,948 deaths from 1 July 2007 to 30 June 2013. Data from 1 July 2012 – 30 June 2013 is compared with previous financial reporting periods. From 2007, six case note review booklets have been disseminated which, together with the annual reports, have proven to be a popular tool with the surgical readership.

Audit participation has reached 100% across public and private hospitals. Exciting developments in the VASM include the inclusion of our Gynaecological colleagues into ANZASM with a steadily increasing number of participants.

A total of 1,058 (91%) of the eligible 1,162 Victorian surgical Fellows are currently participating in the audit. The increase in participation from 60% in 2007–2008 to 91% in 2012–2013 is encouraging and anticipated due to the educational component provided and the compulsory status of ANZASM for CPD compliance. Currently 215 (55%) of the 390 gynaecological specialists invited to participate in August 2012 have enrolled in the VASM audit.

The College continues to place increased emphasis on participation in VASM as part of Continuing Professional Development (CPD). As a parallel process, the Medical Board of Australia has determined that 'audits of random samples of practitioners from all professions will occur periodically throughout the year'. This will require the 'provision of evidence of the CPD activities Fellows have undertaken to meet the requirements of the Board's standard'. Through this process it is ensured that the College is discharging its CPD duties properly.

Clinical trends relating to clinical risk management show overall improvements in patient surgical care. Venous thromboembolism (VTE) prophylaxis to reduce the likelihood of pulmonary embolus, use of critical care facilities, fluid balance management and patient operative profile will remain crucial areas to monitor in order to implement educational strategies from the lessons learned in this audit.

Our stakeholder education program aims to address deficiencies in clinical management and it is encouraging to note the decrease of these as progressive reports are published.

However, along with other jurisdictions, we have consistently identified the following clinical risk management issues as ongoing areas for improvement:

- delay in implementation of definitive care,
- poor communication between health professionals, especially for coordination of patient care,
- operative management issues, and
- diagnosis-related problems.

The College encourages participating stakeholders to further improve their leadership approaches to patient care and to focus on:

- better documentation of clinical events,
- taking action on evidence of clinical deterioration,
- improving communication between health professionals,
- improving awareness of shared care requirements, and
- improved pre-, intra- and postoperative clinical patient care management.

This report contains a new section on specific diseases associated with mortality regularly encountered by clinicians. Necrotizing soft tissue infections are discussed in this report, which are important because they progress rapidly and are associated with high mortality.

The success of VASM is dependent upon participating surgeons and hospitals and a highly efficient, motivated and hard-working team at the College. Their attention to detail and adherence to protocol is the solid foundation on which the audit is built. With their help and the support we receive from many others, I remain confident about the future of the VASM, which has been so expertly nurtured from its embryonic state to the well-oiled machine it now is.

The support of the Victorian State Government, the Victorian Department of Health (DH), the Victorian Surgical Consultative Council (VSCC), the Australian Health Practitioner Regulation Agency (AHPRA), the Australian Commission on Safety and Quality in Health Care (ACSQHC), the Victorian Managed Insurance Authority (VMIA) and The Royal Australasian College of Surgeons have facilitated VASM's progress.

Yours sincerely,

Mr Barry Beiles MB.BCh, FRACS (Vasc)
Clinical Director, VASM



Shortened forms

AHPRA	Australian Health Practitioner Regulation Agency
AL	Anastomotic leak
ANZASM	Australian and New Zealand Audit of Surgical Mortality
ASA	American Society of Anesthesiologists
CCOPMM	Consultative Council on Obstetric and Paediatric Mortality and Morbidity
CCU	Critical care unit
CI	Confidence interval
CPD	Continuing Professional Development
DRG	Disease-related group
DH	Department of Health
DVT	Deep Vein Thrombosis
ENT	Ear Nose and Throat
FLA	First-line assessment
GI	Gastrointestinal
GP	General Practitioner
HDU	High dependency unit
ID	Identifier
IMG	International Medical Graduate
Metro	Metropolitan
OR	Operating room
PE	Pulmonary embolism
RAAS	Research, Audit and Academic Surgery Division
RANZCOG	Royal Australian and New Zealand College of Obstetricians and Gynaecologists
SCF	Surgical case record form
SD	Standard deviation
SLA	Second-line assessment
SSL	Secure sockets layer
TED	Thromboembolic deterrent
VAED	Victorian Admitted Episodes Dataset
VASM	Victorian Audit of Surgical Mortality
VSCC	Victorian Surgical Consultative Council
VTE	Venous thromboembolism
VMIA	Victorian Managed Insurance Authority



Acknowledgments

VASM would like to acknowledge the support and assistance of the many individuals and institutions that have helped in the development of this project, including:

- participating Victorian hospitals
- participating Victorian Fellows and International Medical Graduates
- assessors, in particular the dedicated and specialty-specific first-line and second-line assessors
- surgeons who have acted as assessors, for the time and effort providing detailed and valuable case note reviews
- hospital health information departments
- the Victorian Surgical Consultative Council
- Western Australian Audit of Surgical Mortality
- Australian Capital Territory Audit of Surgical Mortality
- Northern Territory Audit of Surgical Mortality
- Tasmanian Audit of Surgical Mortality
- National Coroners Information System
- South Australian Audit of Perioperative Mortality
- Queensland Audit of Surgical Mortality
- Collaborating Hospitals' Audit of Surgical Mortality
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- Royal Australasian College of Surgeons, for infrastructure and oversight of this project.





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Executive summary

Audit participation and processes

From its commencement on 1 July 2007 to the end of the current audit period (30 June 2013), VASM received 7,278 notifications of death that have been associated with surgical care. By the census date, 3,948 (54%) deaths had been fully audited. The outcomes from the peer review process are restricted to these deaths and are the focus of this report. The outcomes of the remaining 668 (9.2%) cases still pending response from the treating surgeon or an assessor should be available in the next audit report. This process backlog is the reason the most recent reporting period (2012–2013) has the highest number of pending cases (35%).

All public and private hospitals with relevant surgical activity continue to provide notifications of death associated with surgery. Full uptake of the audit in the private sector in 2012–2013 is commendable.

There has been increasing participation in the Victorian Audit of Surgical Mortality (VASM) by Victorian Fellows from 60% in 2007–2008 to 91% in 2012–2013. This appears to have reached a steady level and is similar to other jurisdictions. The submission and return of surgical case record forms (SCFs), a pivotal step in the audit process, varies between 85% and 87%. The target participation rate is 100% with completion of case records within three months of the death.

Inaccurate or incomplete clinical information will impair the quality of audit and prevent an accurate identification of trends. Compliance in completing the mandatory data fields (data quality) has improved however is still less than satisfactory. By 2015, there will be mandatory reporting via a web-based electronic Fellow's Interface in line with the College's online IT strategy. This will accelerate the VASM feedback process while improving the accuracy and completeness of clinical information reported and ultimately published by the VASM.

The treating consultant, rather than a junior member of the team, usually provides the information on the reported cases to VASM. This indicates an ongoing high level of personal involvement by participating surgeons. There has been an improvement in the quality of the sections relating to clinical risk management in the data collection forms.

The Victorian Admitted Episode Dataset (VAED) indicates that from 1 July 2012 to 30 June 2013, 634,626 patients underwent surgical procedures in both the public and private sector. Of these, only 1,999 (0.3%) reported death as the outcome of the separation with a significant reduction in the mortality rate identified over the past 5 years. These findings are similar to the latest figures from the Western Australian Audit of Surgical Mortality.

It is useful to consider these deaths with some perspective by reviewing the number of surgical procedures performed in Victoria over the full audit period from 1 July 2007 to 31 June 2013. The VAED indicates that during this period, in total 3,306,147

patients received surgical care in Victorian public and private hospitals, and of these, 7,278 (0.2%) resulted in auditable mortalities reported to VASM.

When the number of deaths reported to VASM in 2012–2013 is compared with VAED figures for surgical separations resulting in mortality, VASM is currently capturing 76% of the mortality recorded in the VAED. VASM's goal is to attain 100% notification of surgical mortality.

The majority of hospital deaths do occur in the public sector. This is not a reflection on the level of care provided in the public sector; however is a result of the less complex case-mix of patients generally receiving care in the private hospital sector.

Figure 1 and 2 provide a visual representation of the VASM audit process. The VASM peer review process is a retrospective examination of the clinical management of patients who died while under the care of a surgeon. All assessors (first and second-line) must consider whether the death was a direct result of the disease process or if aspects of the management of the patient may have contributed to the outcome. First-line assessments (FLAs) were completed in 3,948 cases where a first-line assessor considered whether the treating surgeon had provided adequate information to allow a conclusion to be reached. If the information was deemed inadequate a second-line assessment (SLA) or case note review was requested.

A SLA was most commonly required because the clinical information provided by the treating surgeon was inadequate in 487 (72.5%) of 672 instances. The need for a SLA was similar among surgical specialties and between metropolitan and rural hospitals. Importantly, the rate of second-line referral has decreased from 21.1% in the 2007–2010 audit period to 10.2% in 2012–2013 and this rate is similar to other jurisdictions.⁽¹⁾

Demographic and operative profile

The demographic and surgical risk profiles of the audited cases reveals similar trends in previous reports published by the VASM. The majority of surgical deaths (85.6%) have occurred in elderly patients with underlying health problems, who have been admitted via emergency with an acute life-threatening condition. Causes of death were often linked to their pre-existing health status. In these cases death was almost always assessed by the review process to be not preventable, or to be a direct result of the disease processes involved rather than the treatment provided. The most common causes of death reported were cardiac and respiratory failure. This is congruent with the most common comorbidities in this series of patients and is similar to the national audit findings.

From the audit pool of 3,948 patients only 19.1% had no operative intervention. This was most commonly an active decision not to proceed and usually



occurred in patients admitted as an emergency for an irretrievable clinical problem. A total of 4,455 separate episodes of surgery occurred in 3,195 patients. The most frequent operative procedures described were for trauma or acute abdominal pathology. This reflects the high percentage of patients admitted as emergencies 85.6% in this series. A consultant performed the surgery in 65.9% of instances, assisted in 13.3% and made the decision to proceed to surgery in 85.6%.

Clinical risk management

Three areas of clinical priority were considered and a number of other issues relating to clinical care or management identified. These are provided to inform clinical risk management strategies as part of the continuing performance improvement cycle.

Areas of clinical priority

The audit considered three important areas of clinical priority:

1. Venous thromboembolism (VTE) prophylaxis to reduce the likelihood of pulmonary embolus,
2. Use of critical care facilities, and
3. Fluid balance management.

These areas are crucial to analyse and monitor over time in order to continue educational dissemination of findings and recommendations from the audit.

Venous thromboembolism prophylaxis

The goal was to evaluate VTE prophylaxis use and to identify whether strategies are in place for treatment against the formation of deep vein thromboses and subsequent pulmonary emboli in patients at risk.

Prophylaxis was provided in over two-thirds of audited deaths. A conscious decision to withhold prophylaxis was the reason given for non-provision for most of the remaining cases. This was generally necessitated by some clinical contraindication to prophylaxis. Inadvertent omission of prophylaxis was rare, only occurring in 4.4% of audited cases. When the appropriateness of withholding prophylaxis was reviewed, there was generally agreement by assessors that the decision was correct. However, in 2.5% of cases where it was withheld, assessors felt the decision was questionable, although the decision did not affect the final outcome. Close working relationships between the surgical and critical care teams is essential to reduce omission rates further.

Use of critical care facilities

Critical care is essential to support acute medical admissions that are typical of VASM patient characteristics, as they represent the most seriously ill group of patients. During the audited period 2007–2013 a total of 64.4% of cases (2,058 of 3,195) received critical care support during the course of their hospital stay. There was a rise in the utilisation of critical care support that increased steadily from 45% in 2007–2008 to 67% in 2011–2012. However, the 2012–2013 data results require further investigation due to the drop in trends. In only a small

percentage of cases not receiving critical care (2.5%) did assessors feel that this may have been inappropriate. VASM would like to encourage hospitals to monitor their critical care support for acute medical admissions and aim for all appropriate referrals in this group of most seriously ill patients.

Fluid balance during treatment

There was a perception that fluid balance may have been an issue of management in only 224 (5.7%) of cases reviewed. Deciding on the optimal amount of IV fluids to be administered to surgical patients and the best rate at which to give them can be complex. The surgical consultants and clinical teams should be able to optimise fluid management.

Clinical care and system management factors

Assessors use a standard 'spectrum of criticism' to identify appropriateness of surgical care. In 3,320 (84.3%) of the 3,948 audited cases, no or only minor issues of patient management were perceived. Areas of concern were identified in 378 (9.6%) patients. In 239 (6.1%) patients, assessors felt the clinical issues were serious enough to be categorised as adverse events. The incidence of more major criticisms of clinical care is similar among the surgical specialties. These results are consistent with the national audit findings.⁽¹⁾

There is no clear evidence that specific hospitals or surgical specialties attract higher rates of criticism than others. Criticisms of clinical care are not always attributable to the surgical team, with one third of all identified issues attributed to other specialty areas.

VASM monitors trends of commonly avoidable factors to ensure adequate education programs are delivered to stakeholders. The most common avoidable factors among the 2,956 issues identified were;

- operation inappropriate in 652 (22.1%),
- delay in definitive treatment in 592 (20%),
- preoperative care issues in 389 (13.5%),
- management or protocol issues in 370 (12.5%), and
- postoperative care issues in 316 (10.7%).

VASM encourages participating stakeholders to improve their leadership approach in patient care, to focus on better documentation of clinical events and take action upon evidence of clinical deterioration, communication and improve awareness for shared care requirements and on improved pre-, intra- and postoperative management as outlined in the "Recommendations for VASM clinical stakeholders" section of this report.

Audited cases in Victoria are assessed further by the Victorian Surgical Consultative Council (VSCC) to classify cases with a focus on potentially preventable outcomes. Based on the VSCC classification the VASM mortality outcomes are classified as avoidable or unavoidable. Investigating the VASM data the treating surgeon identified 690 (17.5%) cases where the outcome was avoidable versus 1,303 (33%) cases



identified by first-line assessors as avoidable events, and a further gap of avoidable factors (20%) was established by the second-line assessors.

Return to operating room (OR)

Some complications following complex surgery are to be expected due to a patient's pre-existing comorbidity profile, surgical risk status and the nature of the disease being treated. However, a high rate of return to the operating room (OR) indicates that the care provided could be improved. VASM's goal is to see this trend decreasing in the future. Consultant involvement in such cases is therefore highly desirable.

There was an unplanned return to the OR in 490 (15.4%) of the 3,195 patients who underwent a surgical procedure. However, direct consultant involvement in such cases has risen consistently during the audited period and VASM would like to see a continuation of this trend, which is to be commended.

Managing demand for emergency surgery

A significant factor for the hospital system is managing the demand for emergency surgery.

The demand for time in the OR relating to emergency cases remains a significant problem. Despite this, a low rate of postoperative complications reported by treating surgeons has remained constant throughout the audit period. Of the 3,195 operative cases audited, 2,096 (65.6%) had no complications and a single complication was recorded in 926 (29%) patients.

Delay in inter-hospital transfers

Inter-hospital transfers are a crucial part of the high risk surgical care treatment plan, which includes timeliness and appropriateness of patient transfer. There were 23% of cases in the audited series which required inter-hospital transfer. Such transfers were usually necessitated by the need for higher levels of care. The level of care provided during transfer was deemed appropriate in 705 (96.1%) of the 734 cases. However, delay in transfer was identified in 49 (6.7%) cases. Delays in inter-hospital transfers carry greater risks and challenges for the patient and clinical teams. There is a need to improve the safety of patient care during the inter-hospital transfers including improved communication and coordination of patient care.





Recommendations for VASM clinical stakeholders

1. *Improved leadership in patient care*

- In complex cases there must be clear demonstrate leadership in patient management.
- The treatment plan for each patient should be understood by all involved in their care.
- The lead clinician must be accountable, responsive, prepared for challenges and must focus on optimal patient care.
- During lengthy operations there should be a low threshold for seeking assistance from colleagues to avoid fatigue.

2. *Better documentation of care plans and clinical events*

- The case record is an essential tool for identifying clinical sequence and an appropriate clinical management plan. As such, the case record must contain clear and accurate documentation of events and plans.
- A repeated issue identified by reviewers is the lack of adequate and legible documentation.

3. *Action on evidence of clinical deterioration*

- Clinical deterioration is an issue that is recognised throughout Australia and internationally.
- When clinical deterioration occurs and no clear cause is identified, consideration should be given to causes outside the treating surgeon's specialty or expertise.
- Clinical findings must be considered alongside the results of investigations.
- Clinical deterioration must be acted upon as well as recorded.

4. *Improved preoperative management*

- Appropriate preoperative preparation and management aims to decrease operative complications and promote successful recovery. Delay in or unnecessary preoperative investigations can have fatal consequences.
- Preparation and management should include:
 - evaluation of both physical and psychological preparation,
 - complete medical history and physical examination procedures,
 - consent for the surgery and discussion of potential outcomes, and
 - appropriate documentation and communication of findings with clinical and surgical teams.

5. *Improved postoperative management*

- The patient should be discharged to the ward with comprehensive orders.
- Preventative measures should be implemented for reducing complications.
- Instructions must be given about further management when discharged from a clinical or surgical team.
- The potential outcomes from the probable clinical diagnosis must be considered when developing a treatment plan.
- The patient should be transferred to a medical unit if elderly, high-risk and if medical issues are assessed as being the prominent clinical factor during the admission episode, providing that the surgical postoperative care can be performed appropriately in that setting.

6. *Improved awareness of surgical emergencies and sharing of care*

- The audit revealed that patients admitted as surgical emergencies are at greater risk where care is shared. All health professionals should increase their awareness of this risk to improve the quality and safety of patient care.

7. *Improved communication*

- All health professionals and institutions should actively collaborate and communicate to effectively support an appropriate interchange of information and coordination of patient care at all stages during the admission episode.



VASM objectives for 2014

Many of the prior VASM goals have been implemented as outlined in the performance review section of this report. Collaboration between the DH, VSCC, Coroner's Office and health services continue to facilitate VASM's progress.

The VASM objectives for the coming year are:

- continue to improve the return rate of surgical case record forms (currently 85-87%) and increase surgeon participation (currently at 91%),
- continue to collaborate with VSCC and other agencies such as the Coroner's Office to ensure no gaps in mortality reporting and the peer-review process,
- continue to disseminate important messages emanating from the audit via publications, workshops and seminars,
- continue to improve the data collection forms and processes,
- continue to coordinate and collaborate in educational seminars,
- contribute to the development of a national mortality audit report,
- implement recommendations resulting from the external evaluation of the audit program,
- attain complete uptake via the Fellows electronic interface,
- facilitate communication and information sharing with other state mortality audits,
- enhance analysis techniques, and
- enhance reporting methods for hospital accreditation processes.





1. Introduction

1.1 Background

The Victorian Audit of Surgical Mortality (VASM) is part of the Australian and New Zealand Audit of Surgical Mortality (ANZASM); a bi-national network of regionally-based audits of surgical mortality that aim to ensure the highest standard of safe and comprehensive surgical care. VASM is collaboration between the Victorian Government's Department of Health, the Victorian Surgical Consultative Council and the Royal Australasian College of Surgeons. The VASM project is funded by the Health Service Programs Branch of the Victorian Department of Health to review all deaths associated with surgical care and ascertain adverse outcomes which are preventable.

1.2 Objectives

The objective of the audit is to identify preventable or contributing factors associated with surgical mortality through a peer-review process of all deaths associated with surgical care. The audit process is a patient safety and quality initiative designed to highlight trends in deficiencies of care and system issues, with a focus on education and performance improvement.

This audit includes deaths that occur in a Victorian hospital where:

- An operation was performed by a surgeon, regardless of who admitted the patient.
- The patient was under the care of a surgeon and no operation was performed.

If a case does not fulfil either of the above-listed criteria, it is excluded from the audit by the notifying hospital or by the audit staff. Deaths that are identified by the reporting surgeon as terminal care cases are recorded, but these are excluded from further assessment in the audit. Terminal care is nominated by the surgeon on the surgical case form and cannot be identified from the notification of death information received by the ASM office.

VASM reviews notifications of deaths that have occurred within 30 days of discharge from hospital

following a procedure or inpatient stay under a surgical unit. The VASM audit does not include morbidity cases. Emerging issues identified through the review of mortality cases are also applicable to the morbidity patient pool. The volume of morbidity cases is also prohibitive to a feasible audit process.

1.3 VASM structure and governance

ANZASM is managed by the Research, Audit and Academic Surgery Division (RAAS) of the Royal Australasian College of Surgeons, being supported and funded by state and territory governments. ANZASM oversees the implementation and standardisation of each regional (jurisdictional) audit to ensure consistency in audit processes and governance across all the jurisdictions involved.

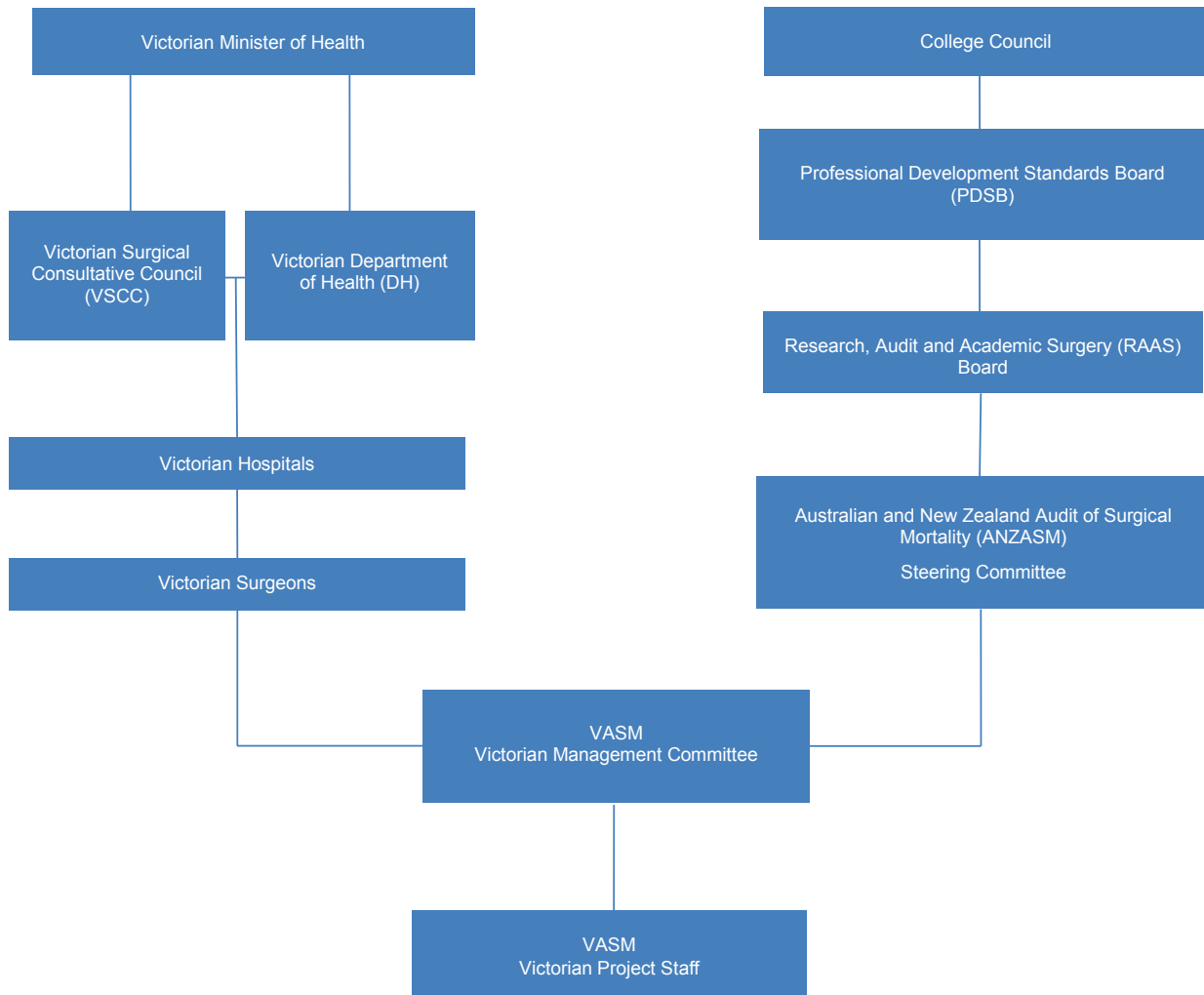
Figure 1 represents the governance structure of VASM and ANZASM. The College manages VASM on behalf of the Victorian Department of Health. The College provides infrastructure support and conducts the oversight of the project. VASM works closely with the Victorian Surgical Consultative Council (VSCC) and provides regular reports to ANZASM, VSCC, health services, surgeons and the Victorian Department of Health.

The VSCC, established by the Victorian government in 2001 to review causes of avoidable mortality and morbidity associated with surgery, provides feedback and recommendations to the medical profession and health service system. The VASM project team informs the VSCC of trends in surgical mortality and assists with the development of strategies to enable the surgical community and other healthcare providers to address system issues.

The VSCC receives de-identified second-line assessment (SLA) and aggregate reports from VASM that summarise all cases reviewed. The VSCC informs the surgical community about important issues arising from the collection and analysis of mortality and morbidity data. Along with the VSCC, VASM aims to support further improvements in patient care in Victoria.



Figure 1: Victorian Audit of Surgical Mortality (VASM) project governance structure.





1.4 Audit process

Individual regional audits of surgical mortality are notified of in-hospital deaths associated with surgical care. The mortality notifications in Victoria are submitted by hospitals, coroner e-depositions directly from the treating surgeon. All cases in which a surgeon was responsible for, or had significant involvement in, the care of a patient are within the scope of the audit, whether or not the patient underwent a surgical procedure.

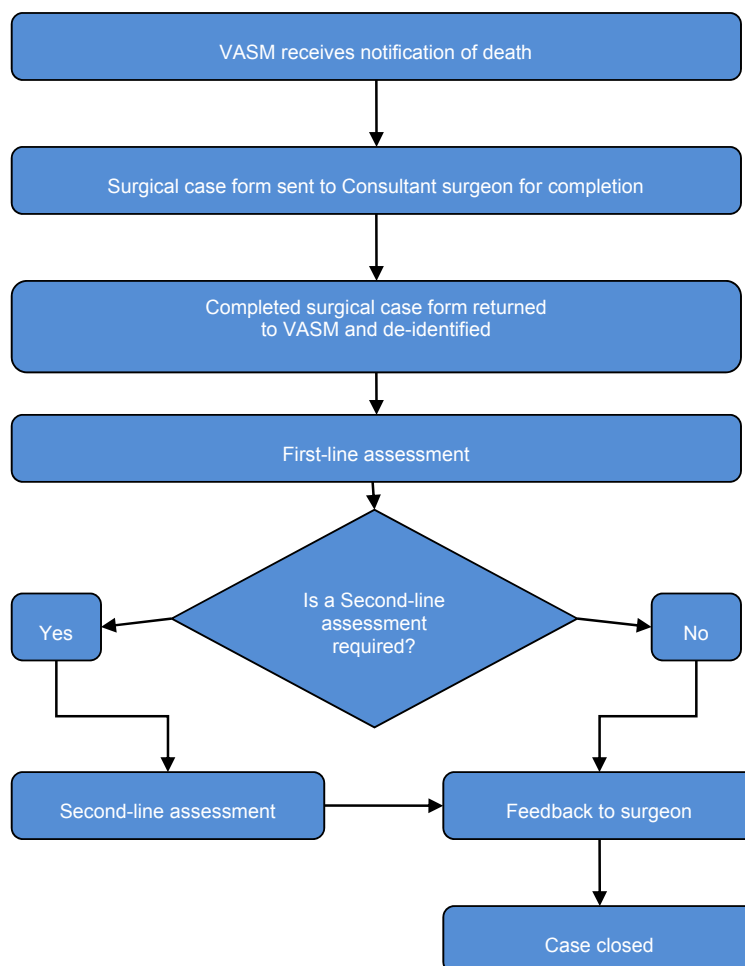
Clinical details pertaining to the management of each case are recorded on a standard, structured surgical case record form (SCF) completed by the consultant or treating surgeon associated with the case. The completed SCF is submitted to the audit office, and the information de-identified and sent for first-line assessment (FLA) by a surgeon from a different hospital with the same surgical specialty. The first-line assessor is unaware of the name of the deceased, the treating surgeon or the hospital where the death occurred.

There are two possible outcomes of the FLA:

- The information provided by the treating surgeon is adequate to reach a conclusion about the case and to identify issues of clinical management, if present.
- A further in-depth assessment (second-line assessment (SLA) or case note review) is necessary either:
 - for clarification of issues of patient management identified or suspected by the first-line assessor, or
 - because the information provided by the treating surgeon was inadequate to reach a conclusion.

Where a SLA is deemed necessary, assessors are selected using the same criteria as for first-line assessors.

Figure 2: The audit process





2. Audit participation and audit processes

2.1. Audit numbers

From its commencement on 1 July 2007 to the end of the current audit period (30 June 2013), VASM received 7,278 notifications of death that have been associated with surgical care.

It is beneficial to put these deaths into some perspective by reviewing the total number of surgical procedures performed in Victoria over this period. VASM interrogated the Victorian Admitted Episode Dataset (VAED) and during the audit period, a total of 3,306,147 patients underwent surgical procedures in Victoria.

It should be noted that a small percentage of reported deaths emanate from the private sector totalling 417 (10.6%) of the 3,948 total cases audited from July 2007 to June 2013. This is predictable from the known case-mix of the two sectors.

VAED indicated that in a single year (1 July 2012 to 30 June 2013) 634,626 patients underwent surgical procedures in both the public and private sector. The number of deaths attributed to surgery as recorded by VAED was 1,999 which equates to only 0.3% of the number of patients who actually underwent surgery over the same period. Of the 1,999 cases identified by VAED, 1,523 (76.2%) were reported to VASM.

Table 1: Audit numbers over sequential audit periods.

Case status	2007–2010	2010–2011	2011–2012	2012–2013	Audit period
Closed	1,629 (60.2%)	851 (56.3%)	842 (54.8%)	626 (41.1%)	3,948 (54.3%)
Lost to follow up	202 (7.5%)	181 (12%)	121 (7.9%)	40 (2.6%)	544 (7.5%)
Pending SCF/FLA or SLA	3 (0.1%)	14 (0.9%)	118 (7.7%)	533 (35%)	668 (9.2%)
Non-participant	514 (19%)	330 (21.8%)	250 (16.3%)	141 (9.3%)	1,235 (17%)
Terminal care	207 (7.7%)	105 (7%)	166 (10.8%)	150 (9.9%)	628 (8.6%)
Reported in error	151 (5.5%)	31 (2.1%)	40 (2.6%)	33 (2.2%)	255 (3.5%)
All cases	2,706 (100%)	1,512 (100%)	1,537 (100%)	1,523 (100%)	7,278 (100%)

Note: total n=7,278.

SCF: surgical case record form; FLA: first-line assessment; SLA: second-line assessment.

Comments (based on 3,948 audit cases 2007–2013)

- VASM's goal is to review all mortality cases within three months of notification. The specialties with the highest case mix were general surgery, orthopaedic and neurosurgery, vascular surgery and cardiothoracic surgery. Clinical information and completed assessment reviews were available on 3,948 (54.3%) of the 7,278 reported cases.
- A total of 628 (8.6%) of these cases were recorded as admissions for terminal care and therefore excluded from the review process.
- Additionally, 255 (3.5%) of these cases had been wrongly attributed to a surgical unit.
- A total of 544 (7.5%) of these cases were deemed lost to follow up due to the surgeon moving interstate, abroad, retiring or unavailability of medical records, and therefore excluded from the analysis.
- A total of 1,235 (17%) of these cases could not proceed in the audit process as the treating surgeon had elected not to participate. This rate of non-participant cases has declined since 2007–2011 from 19% to 9.3% in the current audit period of 2012–2013. VASM envisages that this rate will improve in the future as participation in VASM is now a mandatory component of

attaining Continuing Professional Development (CPD) recertification.

- By the census date, 3,948 deaths had been fully audited. The outcomes from the peer review process are restricted to these deaths and are the focus of this report. The outcomes of the remaining 668 (9.2%) cases still pending response from the treating surgeon or an assessor should be available in the next audit report. This process backlog is the reason the most recent reporting period (2012–2013) has the highest number of pending cases (35%).

2.2. Verification of audit numbers

The audit process is dependent on receiving notifications of death from participating hospitals. This requires each hospital to prepare and submit a list of deaths that have occurred while under the care of a surgeon. The discharging unit would be recorded as surgical. In some instances, patients who have received surgical care may not be under the care of a surgeon at the time of death. It can therefore be seen that the attribution of care to surgery or another clinical specialty is not exact.

In parallel with VASM's audit process, hospitals must also submit data to the VAED which is maintained by the DH. This is a robust database providing case-mix information required for hospital activity based



funding. The information allocates individual patient episodes to Diagnosis Related Groups (DRGs). These DRGs are specialty-specific and can therefore provide an alternative source of mortality data. The DH has provided VASM with a list of deaths that

occurred in patients with surgical DRGs over the period 1 July 2012 to 30 June 2013. The comparison of VAED data against VASM reported mortalities is performed to ascertain gaps in hospital mortality reporting.

Table 2: Comparison of mortalities reported to VAED with VASM.

Audit period	Total surgeries	VAED reported mortalities	VASM reported mortalities
2007–2010	1,434,824	5,397	2,706
2010–2011	608,069	2,182	1,512
2011–2012	628,628	2,026	1,537
2012–2013	634,626	1,999	1,523
Total	3,306,147	11,604	7,278

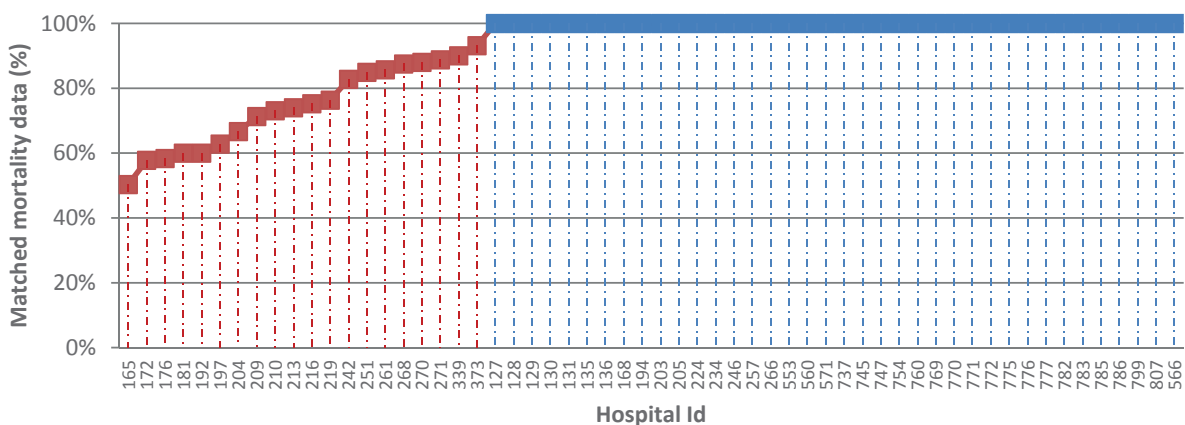
VAED: Victorian Admitted Episode Dataset; VASM: Victorian Audit of Surgical Mortality.

Comments:

- VAED indicates that during the audit period, 3,306,147 patients received surgical care in Victorian public and private hospitals, and of these 7,278 (0.2%) resulted in auditable mortalities reported to VASM.
- It should be noted that the VASM and VAED data are collected for different purposes and both databases should be considered as complementary rather than parallel.
- There has been a decrease in surgical mortality from 0.4% to 0.3% according to the VAED data over the last 5 years. This is highly statistically significant ($p < 0.0001$). It is postulated that one of the causal factors of this improved outcome is the establishment of VASM.

Figure 3: Matched mortality, VASM data against VAED data by hospital.

This graph shows a comparison of data collected between 1 July 2012 and 30 June 2013 on 1,523 deaths reported to VASM.



ID: identifier; VAED: Victorian Admitted Episodes Dataset.

Comments:

- VAED indicates that in a single year (2012–2013) 634,626 patients received surgical care in the Victorian public and private hospital sector. Of these 1,999 resulted in mortalities (0.3%).
- The match for the surgical mortality data reached 76.2% with 1,523 VASM-reported deaths against 1,999 VAED-surgical deaths.
- There were 417 VASM cases from private hospitals. Currently, VASM only captures 50% of the private sector as identified by VAED. The audit has been fully taken up by the private sector



only since the end of 2013, therefore VASM anticipates the private sector match with the VAED data will be higher by 2014.

- In 2013, there was a slight decrease in the match of VASM against VAED data, as some hospitals experienced difficulties in reporting mortalities in a timely manner to VASM due to upgrades in their electronic health information systems.

- Some gaps can be attributed to the further recruitment phase of private hospitals and the inclusion of gynaecological surgical Fellows into the VASM audit.
- Hospitals where no mortalities occurred or where deaths have not been reported have been excluded from further analysis.
- Hospitals with less than 90% compliance should revise their reporting approaches to VASM.

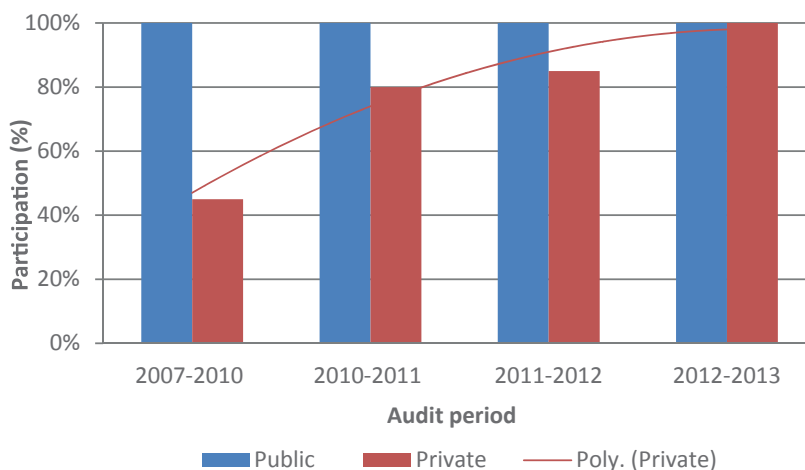
2.3. Audit participation rates

To comply with the audit process, surgeons must not only agree to participate but also return completed SCFs and assessment forms in a timely, accurate and

complete manner. The hospitals in which they work must provide notification of deaths on a regular basis, as this is the main trigger for the audit process to begin.

2.4. Hospital participation

Figure 4: Hospitals participating in the audit.



Note: The polynomial trend shows the rise and relationship of private hospital and public hospital enrolments. The graph also indicates the period of their participation in the audit.

Comments:

- All Victorian public and private hospitals providing relevant surgical services are now participating and providing notifications of death.
- At inception in 2007 public hospital participation stood at 31% and total participation by all public hospitals was achieved in 2010. Similarly, in 2010 when private hospital participation commenced this was 43% and all private hospitals joined the audit by 2012.
- Hospitals that joined the audit after 30 June 2013, had no mortalities or where deaths have not been reported have been excluded from analysis.

2.5. Participation by Fellows

Participation is now a mandatory component of attaining Continuing Professional Development (CPD) recertification. The Royal Australasian College of Surgeons College Council has delivered strong support to ANZASM by requiring surgeons to participate in their State mortality audit as a compulsory component of the CPD program since January 2010. The College CPD program conducts targeted 7% annual verification audits on compliance of surgeons for their CPD requirements. Verification of a surgeon's participation in the mortality audit is anticipated to increase to 100% in the near future.

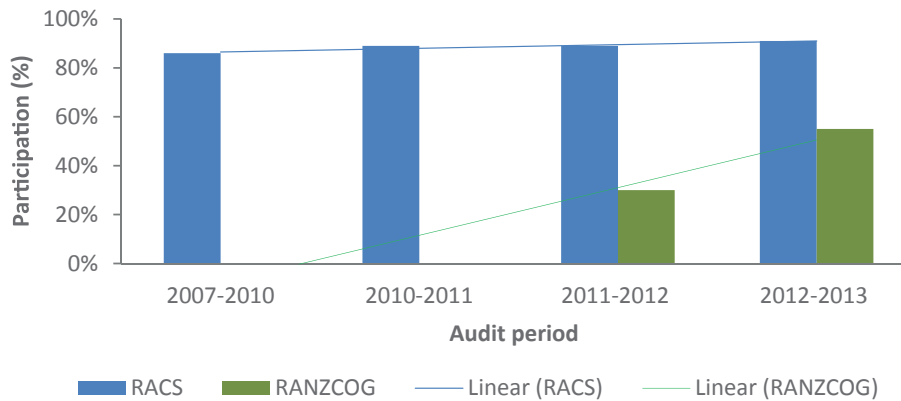
In August 2012 the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) Board approved a formal collaboration with the Australian and New Zealand Audit of Surgical Mortality (ANZASM), which is the reason for the lower participation rate under this specialty while registration of participants is increasing.



The VASM audit collects all deaths occurring after a gynaecological surgical procedure. The Consultative Council on Obstetric and Paediatric Mortality and Morbidity (CCOPMM) continues to separately review

all maternal, perinatal and paediatric deaths in Victoria to consider the clinical features of each case and identify preventable factors.

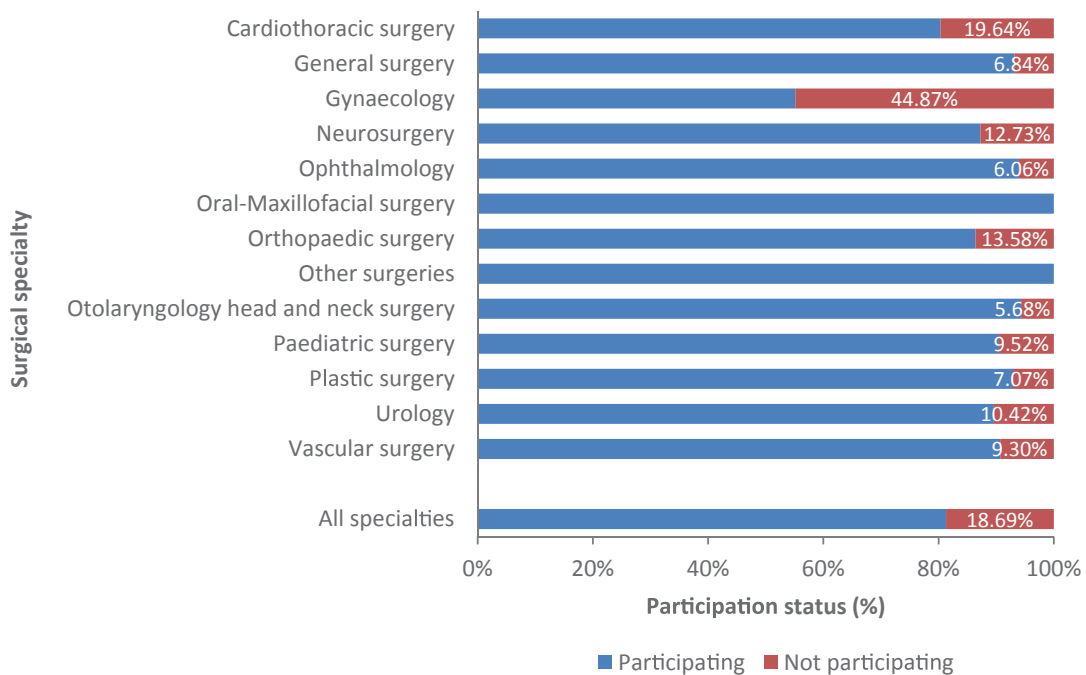
Figure 5: Surgeon agreement to participate.



Comments:

- A total of 1,058 (91%) of the eligible 1,162 Victorian RACS Fellows registered in the College database are currently participating. The increase in participation rate from 60% in 2007–2008 to the current level in 2012–2013 is encouraging and, as anticipated, due to the College’s professional development programs.
- Currently 215 (55%) of the 390 gynaecological specialists invited to participate in August 2012 have now enrolled in the VASM audit.
- Almost half of RANZCOG and RACS Fellows perform assessments as first or second-line assessors. Moreover 50% of enrolled RANZCOG and RACS Fellows are also submitting data electronically. The electronic interface offers a paperless process with timely reporting, complete data submission and the opportunity for ongoing reflection; therefore this will be the only method of data submission envisaged during the latter half of 2014.

Figure 6: Surgeon agreement to participate by surgical specialty.



Note: total n=1,552.

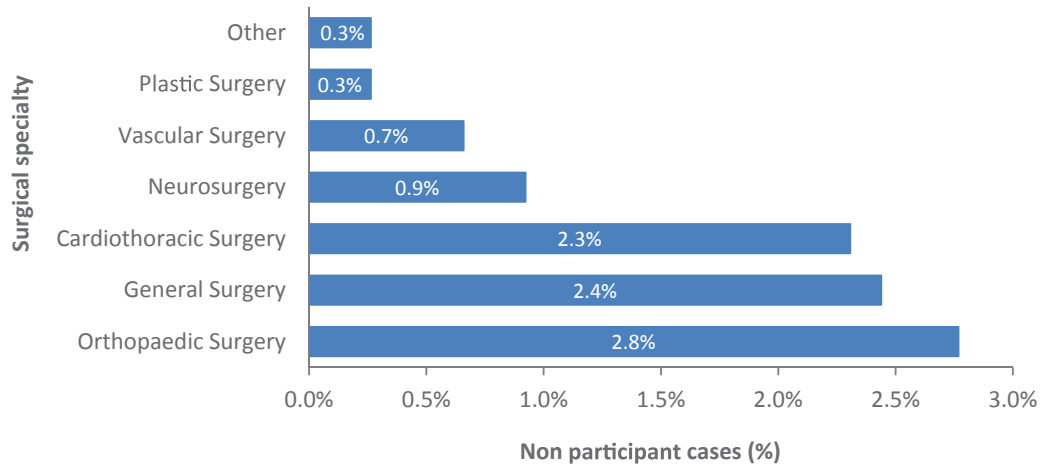
‘Other surgeries’ includes Trauma, Transplant and Oncology.



Comments:

- Combined participation in the surgical specialties ranges from 45% to 100%.
- The reason for the lower participation rate under the gynaecology craft group is due to the very recent introduction of the audit for this group. It is expected that registration of participants will increase further in 2014.

Figure 7: Cases by specialty that could not be reviewed due to non-participation.



Note: total n=142.

'Other Surgeries' includes Oral/maxillofacial, Ophthalmology, Trauma, Transplant and Oncology.

Comments:

- The specialties with the greatest degree of non-compliance in 2012–2013 are orthopaedic surgery, general surgery, cardiothoracic surgery, neurosurgery and vascular surgery (see Figure 7). These specialties have a larger volume of operative procedures to other specialties. These cases therefore contribute two-thirds of deaths that could not be audited due to surgeon non-participation.
 - The return rate by specialties across other states and territories varies between 70% and 99%.⁽¹⁾
- The audit process relies on active and ongoing participation of surgeons. The introduction of mandatory participation for CPD compliance since January 2010 is hoped to lead to the full participation of treating surgeons. It should also be noted that Fellows may however chose to do their CPD through another program such as Australian Orthopaedic Association (AOA) for which ANZASM audits are not mandatory. VASM would like to encourage those hospitals that have a high number of non-participating surgeons to review the approach to VASM adopted by their surgical staff.

Figure 8: Hospital origin of cases that could not be reviewed due to non-participation by treating surgeon.



Note: total n=142.

ID: identifier.

Comments:

- Surgeons electing not to participate in 2012–2013 seem to be focused in only a few hospitals.
- In each instance, the hospital has agreed to participate by notifying deaths to VASM. However, the treating surgeons responsible have not returned the SCFs and thus the audit process cannot be completed for those cases.



2.6. Demographics and characteristics of audited deaths

Table 3: Characteristics of audited deaths.

Number of audited deaths	3, 948
Mean age (range)	80 years (1 day to 102 years)
Gender (Male: Female)	53.5 %: 46.4%
Admission status (Emergency: Elective)	85.6%: 14.4%
ASA grades	ASA 1-2: 8.5%
	ASA 3: 29.3%
	ASA 4: 46.4%
	ASA 5-6: 15.8%
Risk of death prior to surgery	Expected: 12.3%
	Considerable: 51.2%
	Moderate: 25.1%
	Small: 8.6%
	Minimal: 2.9%
Most common comorbid factors	Cardiovascular: 23.2%
	Age: 20.1%
	Respiratory: 13.7%
	Renal: 9.7%
	Neurological/Psychiatric: 7.8%
	Diabetes: 6%
	Advanced Malignancy: 5.1%
	Obesity: 2.9%
Hepatic: 2.5%	
Most common surgical diagnoses	Fracture of neck of femur: 12.9%
	Intestinal obstruction: 10.1%
	Subdural haematoma: 4.4%
	Carcinoma: 3.3%
	Coronary anomaly: 3.3%
	Ruptured AAA: 2.5%
Operative procedures performed	≥3: 8.9%
	2: 16.2%
	1: 74.7%
	0: 0.1%

Note: total n=3,948 from audited period 1/7/2007 to 31/6/2013.

Comorbidities describe coexisting medical conditions or disease processes that are additional to the primary diagnosis.

AAA: abdominal aortic aneurysm.

The ASA physical status is an international measure of patient risk used by anaesthetists.⁽⁵⁾

ASA grade characteristics:

1. A normal healthy patient.
2. A patient with mild systemic disease.
3. A patient with severe systemic disease.
4. A patient with severe systemic disease that is a constant threat to life.
5. A moribund patient who is not expected to survive without the operation.
6. A declared brain-dead patient whose organs are being removed for donor purposes.

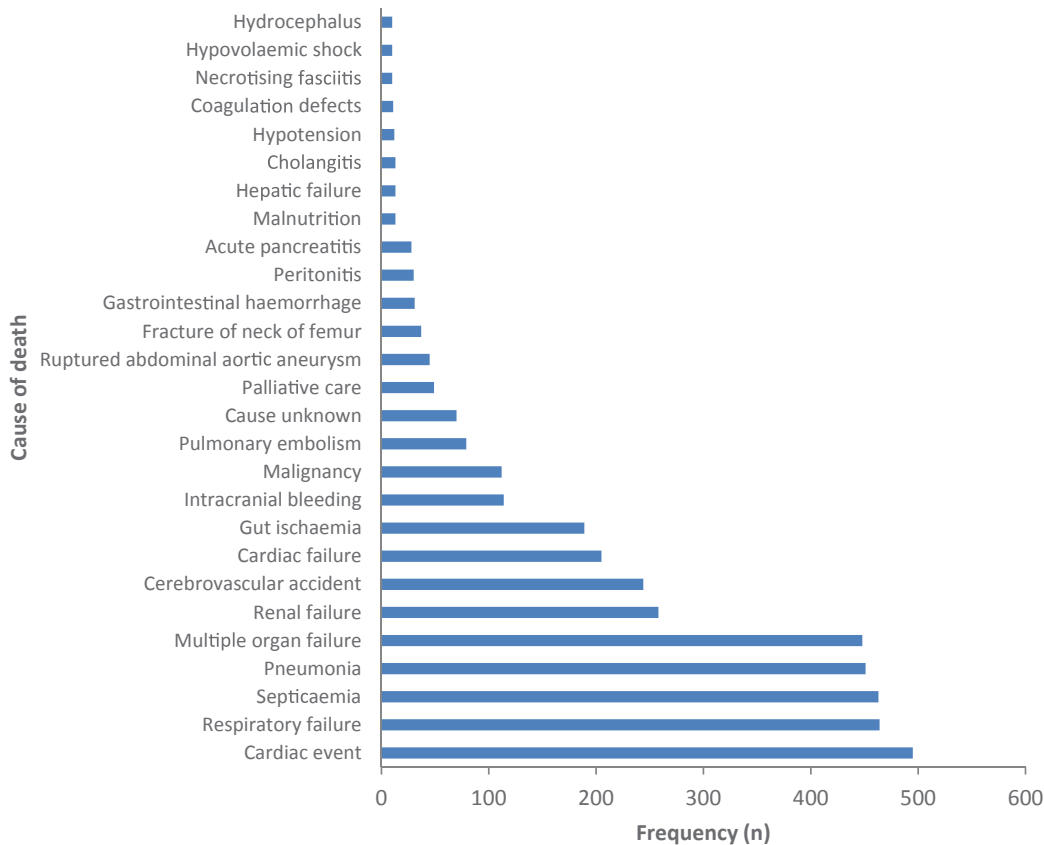


2.7. Establishing the cause of death

The cause of death recorded by the treating surgeon is based on the clinical course of the patient and any relevant supporting evidence from investigations.

Where doubt exists around the circumstances leading to death, the case will be referred to the Coroner. In other instances, where the cause of death is not clear, a postmortem examination may be requested. However, request for postmortems are decreasing.

Figure 9: Frequency of reported causes of death.



Note: total n=4,037 causes of death reported for 3,948 patients. Cause of death has been included in this graph if the total count was ≥10.

Comments:

- A total of 4,037 conditions were perceived to be responsible for death in 3,948 cases.
- The most frequently cited causes of death were cardiac factors including heart failure, cerebrovascular incident, ischaemic heart disease, cardiorespiratory failure and cardiac event (495, 12.3%), respiratory failure (464, 11.5%), septicaemia (463, 11.5%), pneumonia (451, 11.2%) and multiple organ failure (448, 11.1%). Death was attributed to these conditions in over half (2,321 58.8%) of the 3,948 cases.
- The number of post-mortems performed, including coronial requested postmortems, was 610 (15.7%) instances in 3,948 cases. This rate remained constant during the full audit period fluctuating from 14.6% to the current level. Reasons for the low postmortem referrals are unknown. Referral to the Coroner or request for

post-mortem was 113 (2.9%) in elective and 497 (12.6%) in emergency cases. Postmortems are deemed to provide educational information and valuable insights and these referral rates may be of concern.

2.8. Peer-review process

The VASM peer-review process is a retrospective examination of the clinical management of patients who died while under the care of a surgeon. All assessors (first and second-line) must decide if the death was a direct result of the disease process alone, or if aspects of the management of the patient may have contributed to the outcome. FLAs were completed in 3,948 cases. Each first-line assessor had to decide if the treating surgeon had provided adequate information to allow a conclusion to be reached. If the information is deemed inadequate

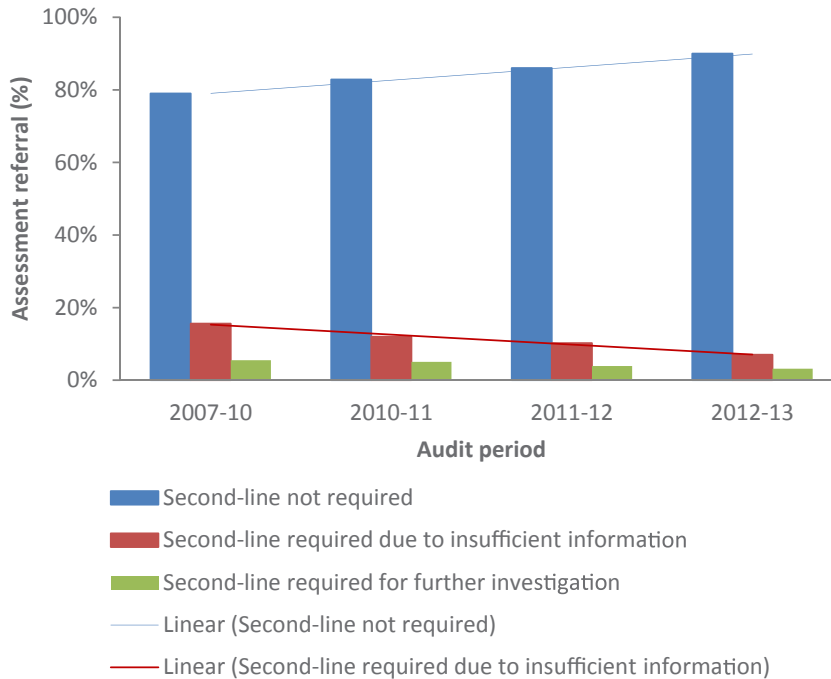


then a SLA or case note review is requested. Other triggers for requesting SLA are:

- A more detailed review of the case is required, which could better clarify events leading up to death and any lessons emanating from the case under review.
- Death is unexpected, for example in a young, fit patient with benign disease or a day surgery case.

The number of SLAs required due to a lack of information provided in the case record form is an indirect measure of surgeon compliance in the audit process. SLAs required for the other triggers are more likely to represent suspected issues of clinical management. This has decreased since the beginning of the audit, but still requires improvement. The reasons given for referral to second-line assessment are provided in Figure 10.

Figure 10: Reason for referral for second-line assessment.



Note: total n=3,948. Missing data: n=1 (<1%).

Comments:

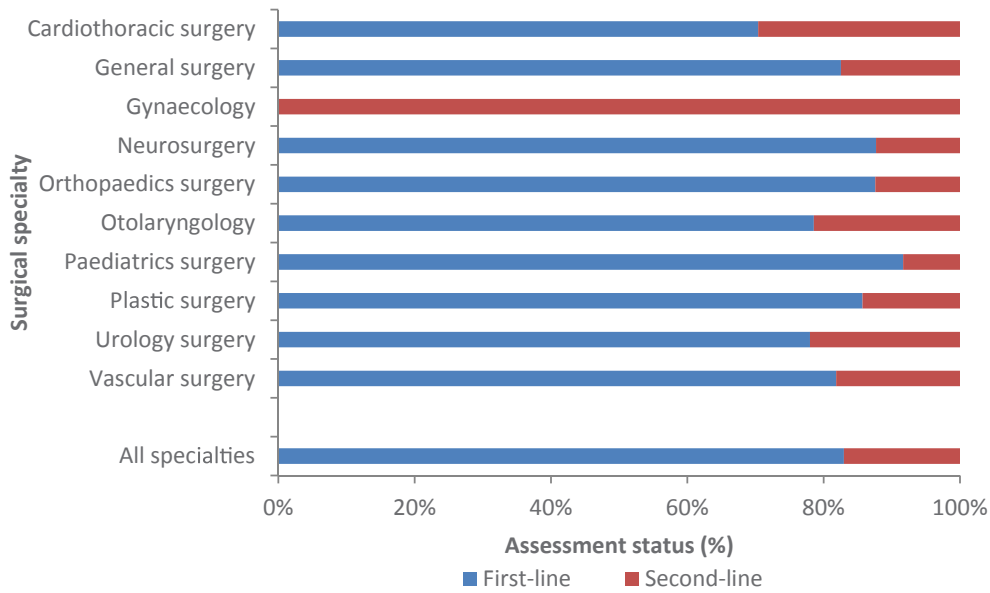
- The perception of need for SLA has decreased over time, in part because the quality of the information provided in SCFs returned by treating surgeons has improved. The percentage of cases referred for SLA has dropped significantly from 21.1% in the 2007–2010 period to 10.2% in 2012–2013. Cases with an ASA \geq 4 were significantly more likely to be referred for SLA ($p<0.001$) (data not shown in this graph).
- In 3,275 (83%) of the 3,948 audited cases no second-line referral was made by the first-line assessor.
- Despite some improvement, insufficient clinical information provided by the treating surgeon remains the most common trigger for SLA, occurring in 487 (72.5%) of the 672 cases that had a second-line assessment. There is a decreasing trend for this reason over time; however it has not yet reached statistical significance.
- The remaining 186 cases (27.7%) of the 672 second-line requests required more detailed review for perceived issues of management.
- There have been improvements in the quality of the data provided to VASM since 2007; however the issue with the quality of the data provided by some treating surgeons is unfortunately still ongoing. Greater attention to detail in completing the SCF would help reduce the workload of colleagues who have agreed to act as first and second-line assessors and for the quality assurance and medical records representatives at collaborating hospitals.
- In 166 (26.5%) of 627 SLAs, at least one aspect of the medical record was deemed unsatisfactory. Criticism included poor medical admission notes and follow-up records and unsatisfactory description of the surgical procedure.



- The hospital case notes are an important record of what occurred during a patient's treatment. The difficulty in managing patients in a complex environment where there is an increasing lack of continuity in the care provided during a patient's

stay in hospital is exacerbated by poor and inaccurate clinical notes. This is a similar finding to a review of care received by the elderly patients undergoing surgery in the UK.⁽¹⁵⁾

Figure 11: Frequency of need for second-line assessment by surgical specialties.



Note: total n= 3,948.
Missing data: n=1 (<1%).

Comments:

- The need for SLA referral varied between specialties (see Figure 11). No inferences have been made since gynaecology is a new specialty recruited only in 2013 and only two cases completed the second-line assessment.
- The need for referral for SLA was similar in metropolitan and rural regions (data not shown in this graph).





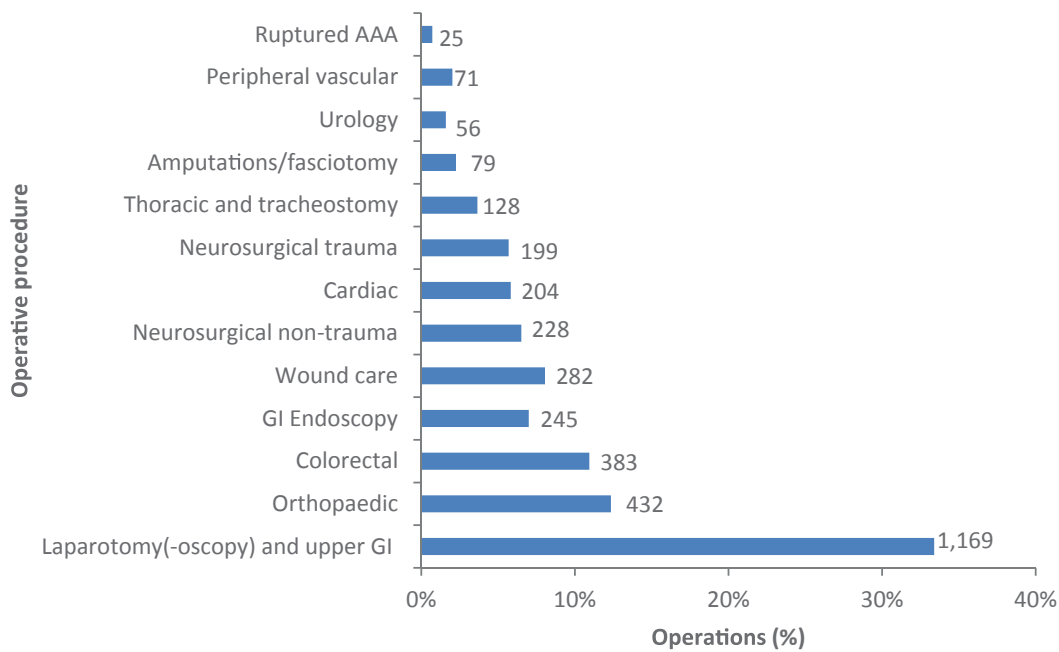
3. Clinical risk management

3.1. Profile of operative procedures

The following section examines the frequency and timing of surgical procedures, the seniority of the surgeon performing them and the need for reoperation.

The role of the treating surgeon is to take responsibility for the overall success of the operation; they need to ensure that the operation proceeds smoothly and without complications or unplanned return to theatre.

Figure 12: Frequency of individual surgical procedures reported.



Note: total n=3,195 patients having operative treatment (with 4,455 episodes).

Missing data: n=488 (11%).

Only procedures with a frequency >10 interventions have been recorded.

AAA: abdominal aortic aneurysm; GI: gastrointestinal.

The operative procedures were categorised in this year's report to group the operations for simpler classification. A breakdown of operative procedures is detailed in the Appendix section 10.5 of this report.

Comments:

- There were 3,195 patients undergoing operative treatment described in the 3,948 audit pool. As a patient can undergo multiple procedures during the same admission and at the same surgical session, 4,455 separate procedures were performed in total.
- The most frequent procedures reported have usually been associated with laparotomy, laparoscopy and upper GI (the most usual group of multiple procedures), and orthopaedic pathologies.



Table 4: Operative mortality frequency by specialty.

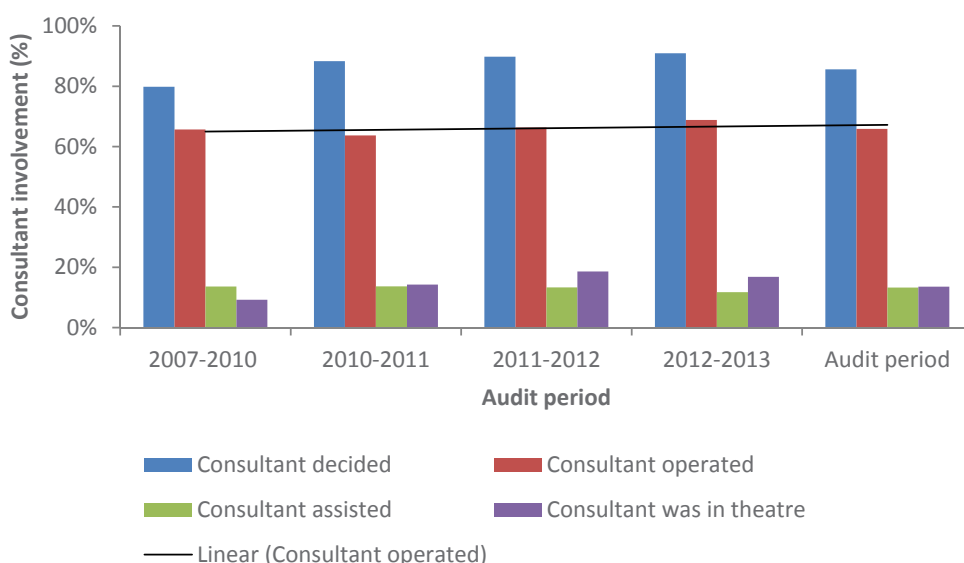
Specialty	Frequency (%)
Cardiothoracic surgery	295 (9.2%)
General surgery	1,354 (42.4%)
Gynaecology	2 (0.1%)
Neurosurgery	374 (11.7%)
Orthopaedic surgery	633 (19.8%)
Other	5 (0.1%)
Otolaryngology	38 (1.2%)
Paediatric surgery	32 (1%)
Plastic surgery	51 (1.6%)
Urology	128 (4%)
Vascular surgery	283 (8.9%)
Total	3,195 (100%)

Note: total n=4,455 episodes in 3,195 patients having operative treatment. Missing data: n=488 (11%).

Comments:

- There is great variation by specialty in the rate of operative intervention over the audit period, attributable to the case mix and risk group of patients in each specialty. Only two gynaecology patients are included in this year’s report.
- The 752 patients admitted electively who subsequently died had a higher rate of operative intervention (83.6%) than the 3,211 patients admitted as emergencies (81.1%) (p<0.001). This is not unexpected as most elective admissions to a surgical unit are for an operative procedure.
- Sometimes during surgery it is deemed inappropriate to continue with the procedure as there is no prospect of even short-term survival of the patient due to the extent of the disease process. This was necessary in a very low percentage of the audited cases (240, 6.1%).
- Death was more often associated with operative intervention in metropolitan areas compared to rural (p<0.001). This finding could be attributable to frail patients who require complex surgery being referred to and managed in metropolitan hospitals.

Figure 13: Seniority of surgeons deciding on and performing surgery.



Note: total n=4,455 episodes in 3,195 patients having operative treatment. The consultant operated exponential trend line is constant.

Comments:

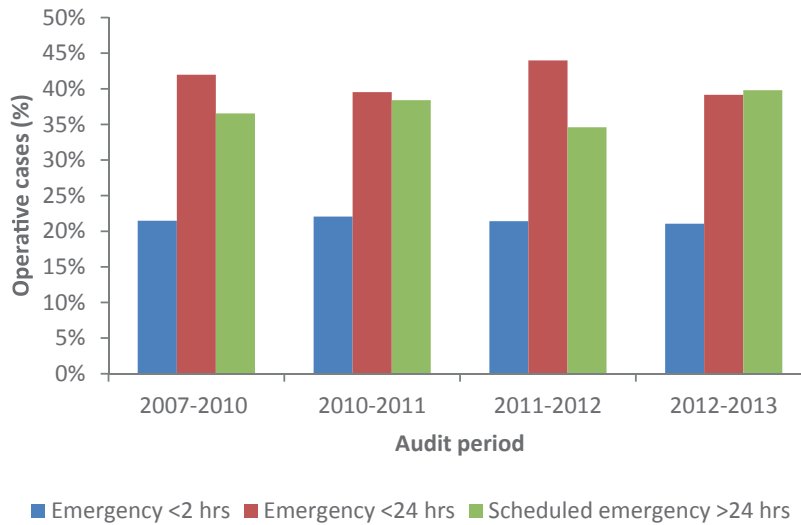
- A consultant surgeon performed the surgery in 65.9% of cases and took the decision to proceed to surgery in 85.6% of instances. VASM would like to see a further increase in these figures.
- This move towards senior consultants is appropriate when the risk profile of the audited cases is considered. The increase in active participation by consultants over time reached statistical significance (p<0.001).



- The role of the consultant is to take responsibility for the overall success of the operation, thus their presence in theatre is crucial.
- An anaesthetist was present in 3,069 (96.1%) of the 3,195 cases where an operative procedure

occurred from the 3,948 audited series. The frequency of delays related to anaesthesia was 28% (895 of the 3,195 operative cases audited). The reasons for these delays were not stated.

Figure 14: Timing of operative procedures in emergency admissions.



Note: total n=4,455 episodes in 3,195 patients having operative treatment.
 Missing data: n=588 (18%).
 Hrs: hours.

Comments:

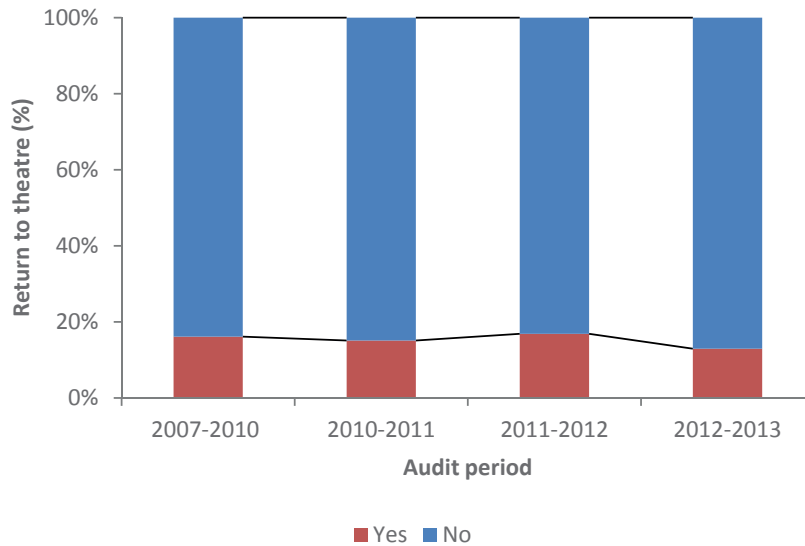
- The time criticality of a patient's condition predicts the timing of emergency surgery. Of 2,606 emergency admissions who underwent surgery, 562 (21.6%) had surgery within two hours of admission, 1,082 (41.5%) within 24 hours, and 962 (36.9%) after 24 hours. The skewed high emergency profile for this operative group of patients is highly appropriate as it is critical to support this most seriously ill subgroup of patients.
- Therefore 1,644 (63.1%) of 2,606 emergency admissions to a surgical unit required surgery within 24 hours of admission. Strategies to address the associated scheduling problems are being implemented by the government surgeons and hospitals.^(10,12,14) For example, The Society of Cardiothoracic Surgery initiated measurement and monitoring of safety and quality in cardiac interventional procedures by establishing the Australian Cardiac Procedures Registry.⁽¹³⁾

3.1.1 Unplanned return to the operating room

An unplanned return to the operating room (OR) is usually necessitated by the development of a complication requiring further operative intervention. Some complications following complex surgery are to be expected due to patients' pre-existing comorbidity profile, surgical risk status and the nature of the disease being treated. However, a high rate of return to the operating can indicate that the care being provided could be improved, and VASM's goal is to see the trend decreasing over future audit periods.



Figure 15: Unplanned return to the operating room.



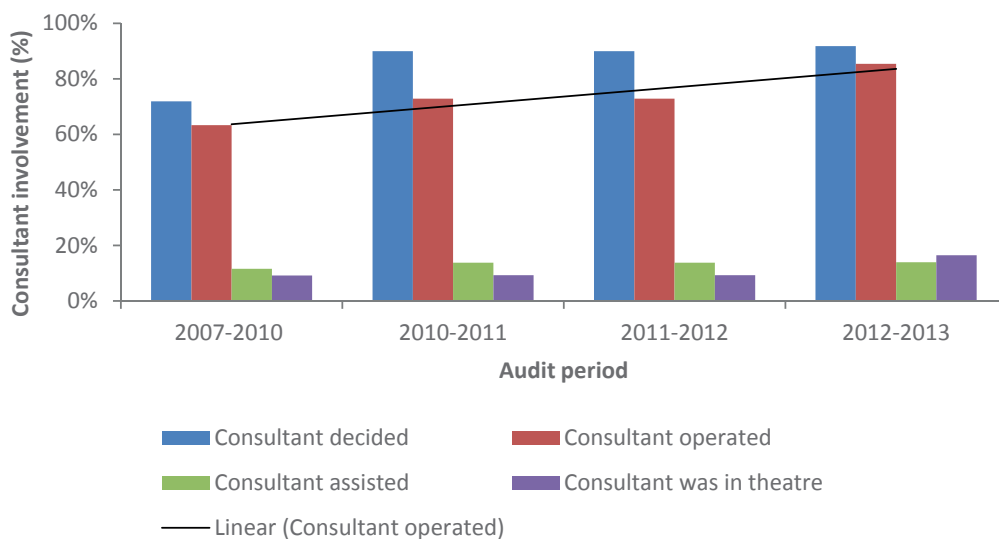
Note: total n=4,455 episodes in 3,195 patients having operative treatment.
Missing data: n=42 (1%).

Comments:

- An unplanned return to the OR was reported in 490 (15.3%) of 3,195 cases where a surgical procedure was performed and these figures are similar to the national mortality audit findings.
- There has been a slight variation of trend in frequency of unplanned returns during the audit period, which is not statistically significant, and an overall decrease in this over the audit period would be highly recommended.

The increased trend over time of senior consultants performing surgery at unplanned return to the operating room is highly recommended and appropriate when considering the patient’s surgical risk profile and operative complications (see Figure16).

Figure 16: Seniority of surgeons performing surgery at unplanned return to the operating room.



Note: total n=4,455 episodes in 3,195 patients having operative treatment.
Missing data: n=55 (2%).
The consultant operated exponential trend line is curved which highlights considerable rise in consultant involvement.

Comments:

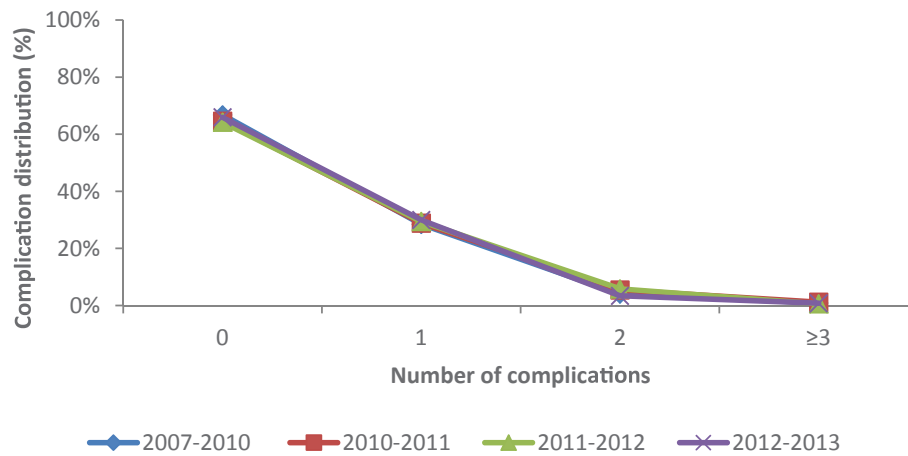
- Active consultant participation was exponentially higher in cases requiring unplanned return to the OR (p<0.001) and this result is appropriate as such cases are more challenging and the risks are greater.



- An unplanned return to the OR was reported in 490 (15.3%) of 3,195 cases where a surgical procedure was performed.
- The frequency of unplanned return to the OR by surgical specialty is a reflection of the risk profile inherent in their casemix or surgical inferences as some surgical specialties stand higher complication risks than others.
- There were no major differences in unplanned return to the OR between metropolitan and rural regions. The seniority of surgeons operating in rural and metropolitan regions was also similar.

3.1.2 Postoperative complications

Figure 17: Postoperative complications recorded by treating surgeon.

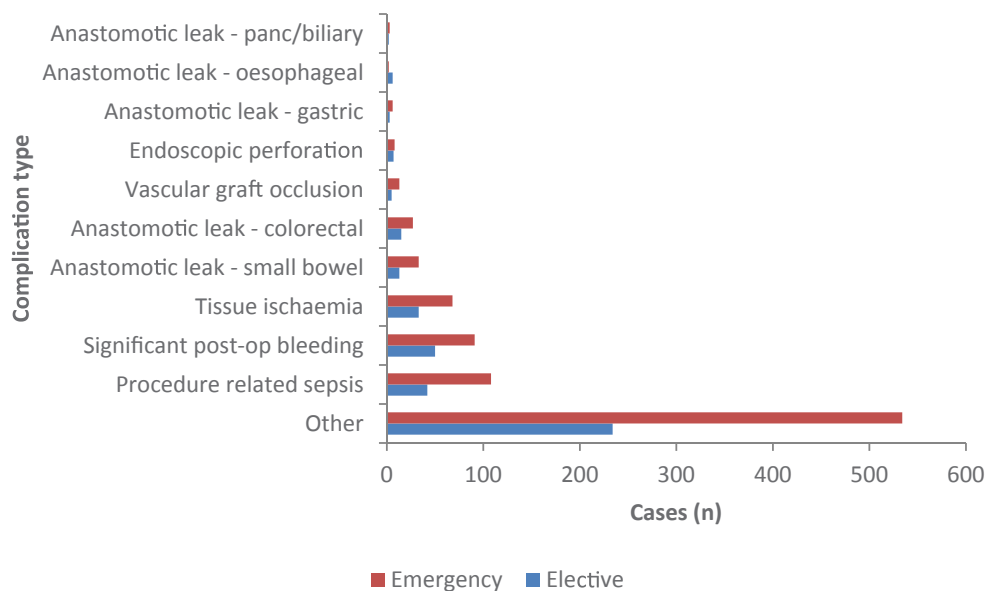


Note: total n=3,195.

Comments:

- The low rate of postoperative complications reported by treating surgeons has remained constant throughout the audit period. Of the 3,195 operative cases audited, 2,096 (65.6%) had no complications and only a single complication was recorded in 926 (29%) patients.

Figure 18: Frequency of specific postoperative complications by urgency status.



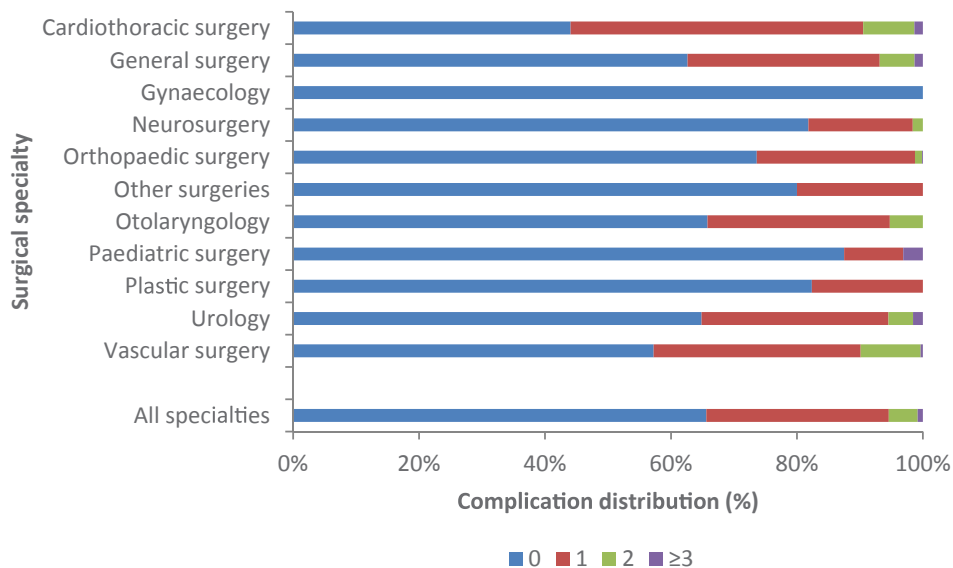
Note: total n=4,455 episodes in 3,195 patients having operative treatment.
 Missing data: n=2 (<1%).
 Panc: pancreatic; Post-op: postoperative.



Comments:

- Emergency cases are likely to have more complications. The audit pool contains 86.5% cases admitted as emergencies and highlights the greater complication risk during surgical procedures (see Figure 19).
- A total of 768 ‘other’ complications were identified, including cardiac failure, intrapulmonary haemorrhage, intra-cerebral bleed, postoperative hypoxia, acute or chronic renal failure, paraplegia, liver failure, pneumonia, perforated viscus, pulmonary embolism, pyelonephritis, respiratory failure, seizures, sepsis, stroke and wound haematoma.

Figure 19: Postoperative complications by specialty.



Note: total n=4,455 episodes in 3,195 patients having operative treatment. ‘Other surgeries’ include Oral/maxillofacial, Ophthalmology, Trauma, Transplant and Oncology.

Comments:

- There were differences in the rate of postoperative complications among specialties.

3.2. Clinically significant infections

In 2012 VASM started collecting data points on clinically significant infections. VASM is keen to monitor trends from the available retrospective mortality data of infections at hospitals.

It is envisaged that future VASM trending will show a reduction of clinically significant infections in this group of high risk patients.

Table 5: Clinically significant infections type.

Infection type	Frequency (%)
Pneumonia	168 (47.9%)
Systemic infection	36 (10.3%)
Septicaemia	97 (27.6%)
Other	50 (14.3%)
Total	351 (100%)

Note: total n=351. Missing data: n=18(<1%).



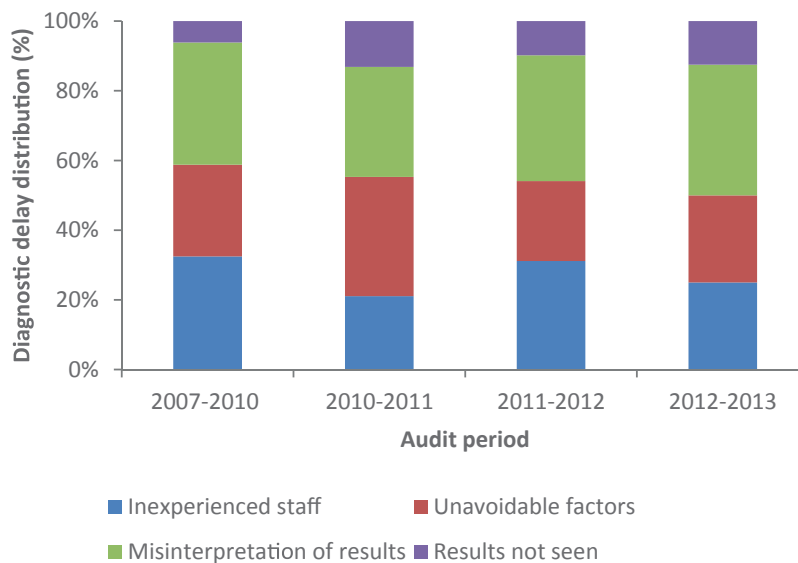
Comments:

- There was infection reported in 351 (31%) cases of the small data pool of 1,133 cases audited and recorded in 2012–2013. The infection rate between emergency (32.3%) and elective (34.3%) admission was similar.
- Pneumonia and septicaemia comprised 265 (75.5%) cases of the infection pool of 351 patients.
- Of the 351 cases, the infection was acquired during hospital in 202 (57.6%) cases and pre-admission in 136 (38.8%) cases; in 4 (1.1%) cases.
- It was unknown when the infection was acquired the emergency group (128, 36.5%) had a higher infection rate before admission than the elective group (8, 13.6%).
- The infection rate across specialties varies reflecting the case mix of individual specialties.
- The infective organisms identified were: Clostridium difficile, Candida albicans, Escherichia coli, Enterobacter aerogenes, Enterococcus, Klebsiella, Lactobacillus, Methicillin-resistant Staphylococcus aureus, Methicillin-sensitive Staphylococcus aureus, Staphylococcus haemolyticus, Staphylococcus pyogenes, Staphylococcus aureus, Varicella, yeast and mixed organisms.

3.3. Delay in diagnosis

Treating surgeons were asked to record and perceived delays in establishing a diagnosis and proceeding to definitive treatment.

Figure 20: Perceived delays in establishing a diagnosis.



Note: total n=237 issues identified in 3,948 audited cases.

Comments:

- The treating surgeons identified delays in establishing the diagnosis in 237 (6%) of the 3,948 audited cases. This rate has remained relatively constant over time.
- When cases were submitted to first or second-line assessment process, the incidence of perceived delay in patient care was higher at 20%.
- Delay in establishing a diagnosis is one facet of the concerning rate of delay in implementing definitive treatment shown in the clinical management issues section.
- It is important to note that such delays are not always attributable to the surgical team. For example, in a recent review in the United Kingdom on care received by elderly patients undergoing surgery, delay between admission and operation was related to risk assessment which “should include input from senior surgeons [or] anaesthetists” [and was also related to] “extremely poor documentation, nutritional assessment and evidence of appropriate management”⁽¹⁵⁾.



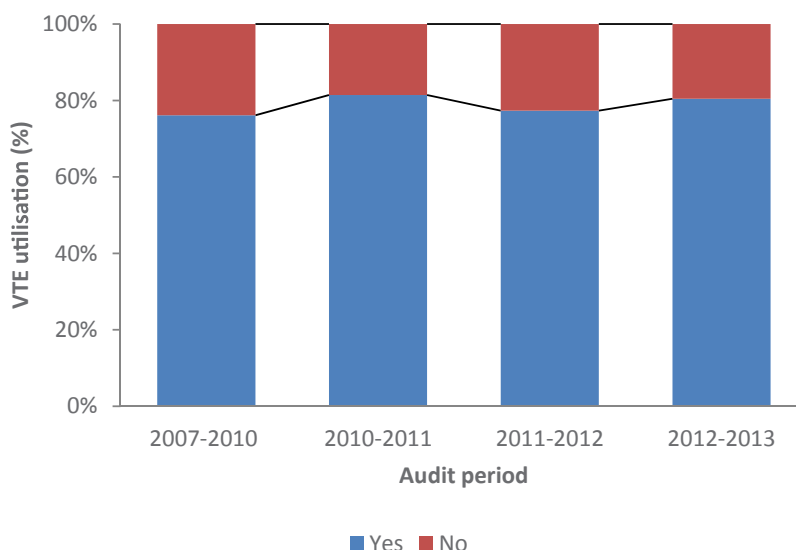
3.4. Prophylaxis is for venous thromboembolism

The goal to analyse this section is to identify if strategies are in place for treatment against the formation of deep vein thromboses and subsequent pulmonary embolisms in patients at risk. There are effective pharmacological and mechanical preventive options available; however venous thromboembolism (VTE) remains a major cause of mortality in hospitals patients across Australia. The “clinical practice guideline for the prevention of venous thromboembolism in patients admitted to Australian hospitals” are reviewed and updated periodically to facilitate the best care available to patients.

The recommendations in the guidelines and the VASM report are intended to encapsulate the available evidence on the prevention of VTE. However, the guidelines should only be followed subject to the judgement of clinicians caring for individual patients and the patients’ own preferences.

The treating surgeon has to record if venous thromboembolism (VTE) prophylaxis was given and what type of prophylaxis was actually used. The reasons given for not providing VTE prophylaxis are displayed in this section.

Figure 21: VTE prophylaxis use during the audit period.



Note: total n=3,195 operative cases.
 Missing data: n=63 (2%).
 VTE: venous thromboembolism.

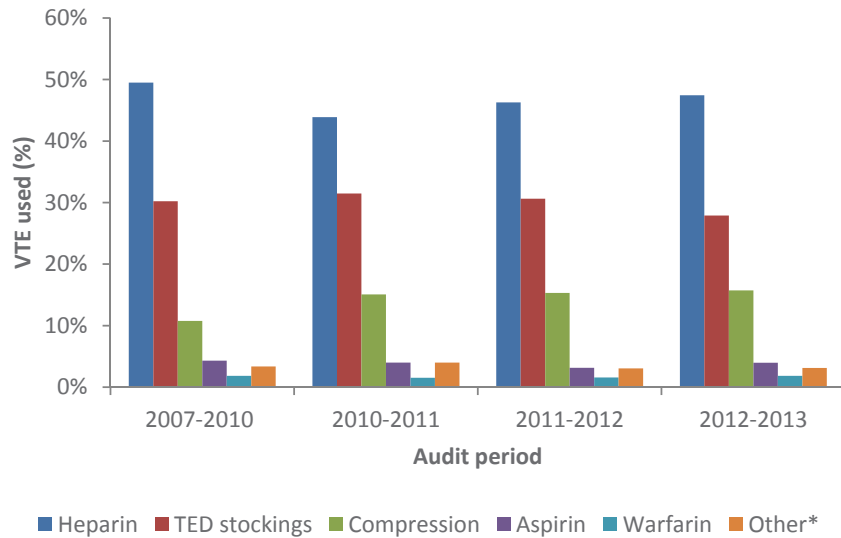
Comments:

- The use of VTE prophylaxis has risen slightly from 76.1% in the 2007–2010 period to 80.5% in 2012–2013 (p=0.52) and it could be improved further.
- The VASM data suggests that use of VTE prophylaxis is similar in both elective and emergency cases.





Figure 22: Type of VTE prophylaxis used.

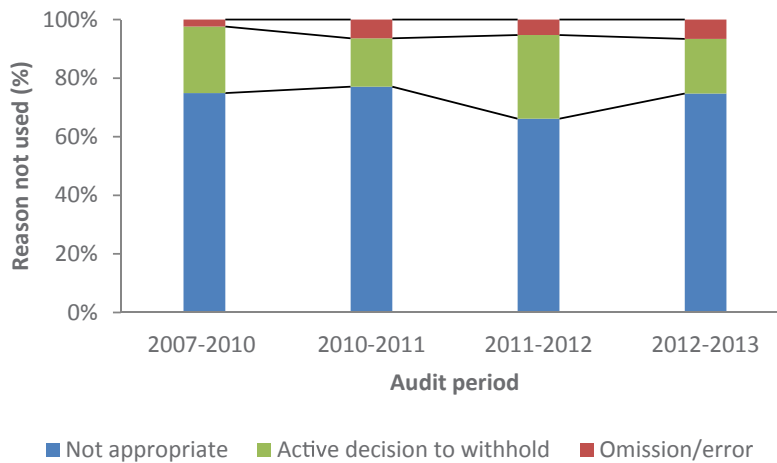


Note: total n=4,242.
 Missing data: n=95 (2%).
 'Other' prophylaxis included calf stimulators, Clexane, Fragmin, clopidogrel, enoxaparin, epidural, full anticoagulation for non-ST segment elevation myocardial infarction, and inferior vena cava filter and infusion.
 TED: thrombo-embolic deterrent stockings; VTE: venous thromboembolism.

Comments:

- The spectrum of VTE prophylaxis used has been consistent over time.
- The type of prophylaxis used is subject to the judgement of clinicians caring for individual patients.

Figure 23: Reasons given by treating surgeon for not providing VTE prophylaxis.



Note: total n=585 patients not receiving prophylaxis in 3,195 operative cases.
 Missing data: n=96 (14%).
 VTE: venous thromboembolism.

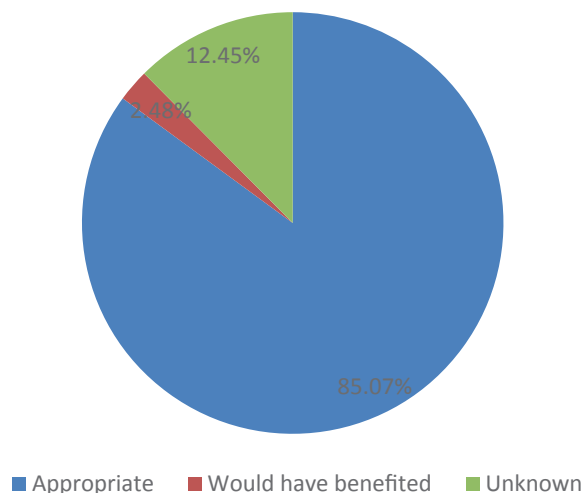
Comments:

- Overall, 585 (14.8%) of the 3,948 patients from the audit pool received no prophylaxis, and in the majority of these cases this was a conscious decision by the treating team.



Assessors were asked to comment on the appropriateness of withholding prophylaxis (see Figure 24).

Figure 24: Assessor perception of appropriateness of decision to withhold VTE prophylaxis.



Note: total n=585 patients not receiving prophylaxis in 3,195 operative cases.
 Missing data: n=96 (14%).
 VTE: venous thromboembolism.

Comments:

- Assessors felt the decision to withhold VTE on clinical grounds was appropriate in the majority (85.1%) of cases.
- Assessors felt that in only 2.5% of cases that did not receive VTE prophylaxis would have benefited from it. This percentage has decreased over time in successive audit years. These reductions in treatment gap are appropriate to prevent deep vein thrombosis and pulmonary embolisms in patients at risk.
- The assessors could not accurately assess the appropriateness of the decision to withhold VTE in 12.5% of cases due to insufficient evidence in the audit documentation to make an informed assessment.

3.5. Adequacy of provision of critical care support to patients

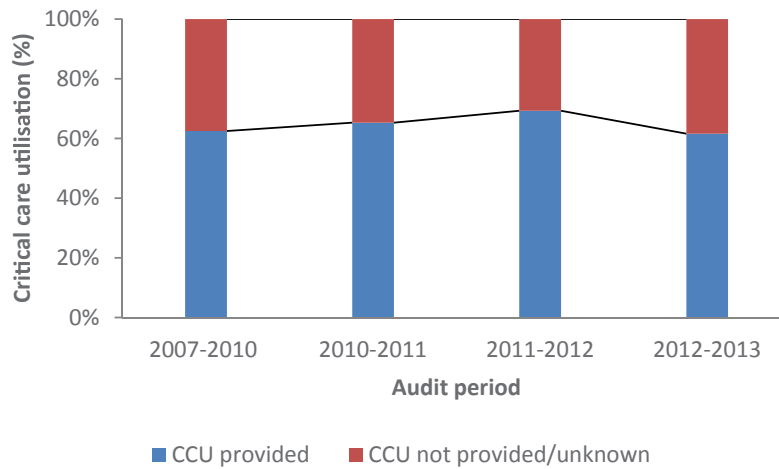
Critical care is essential to support acute medical admissions as they represent the most seriously ill group of patients.

Ideally critical care facilities should be co-located with the emergency department and surgical departments especially for larger acute hospitals. Close working relationships between the surgical team and critical care is essential; however, not all surgical patients require critical care support.

The treating surgeon was asked to record if their patient received critical care support before or after surgery. The first and second-line assessors also reviewed the appropriateness of the use of critical care facilities for patients.



Figure 25: Provision of critical care support during the audit period.

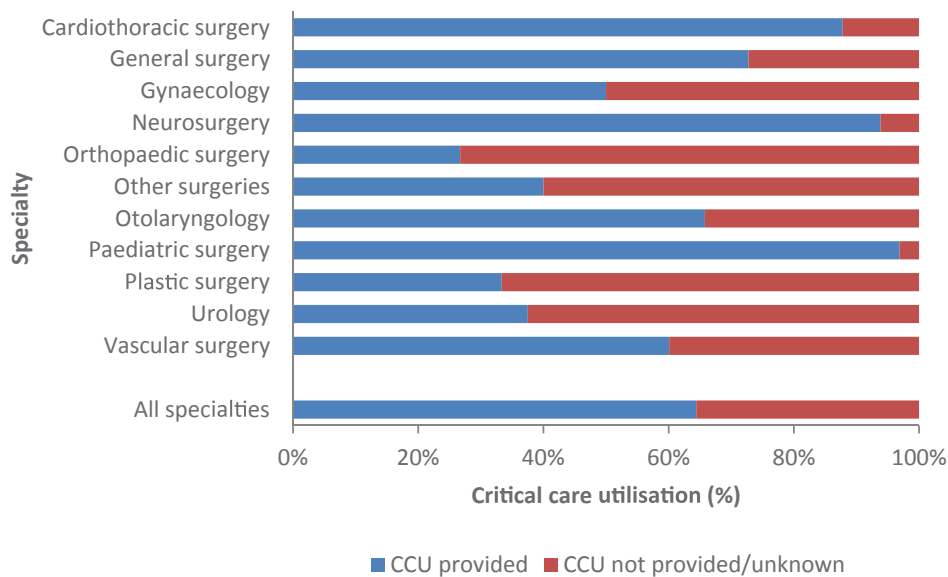


Note: total n=3,195 operative cases.
CCU: critical care unit.

Comments:

- This question was reframed in 2010 to make it more informative and reduce the amount of missing data. The data collected from 2007 to 2010 has been remapped to the current data format.
- A total of 64.4% of cases (2,058 of 3,195) received critical care support during their inpatient stay.
- The utilisation of critical care support increased steadily from 45.9% in 2008 to 69.3% in 2011–2012. However, the 2013 data results require further investigation due to a drop to 61.6% in the trend shown.
- The use and need for critical care is higher in emergency cases.
- It should be acknowledged that not all hospitals have critical care services and should therefore triage patients accordingly.

Figure 26: Provision of critical care support to patients by specialty.



Note: total n=3,195 operative cases.
'Other surgeries' include Oral/maxillofacial, Ophthalmology, Trauma, Transplant and Oncology.
CCU: critical care unit.

Comments:

- Similar to previous years, orthopaedic patients have low referral rates for critical care support. This is thought to be due to a high number of elderly patients with fractured neck of femur admitted from high-level care institutions.



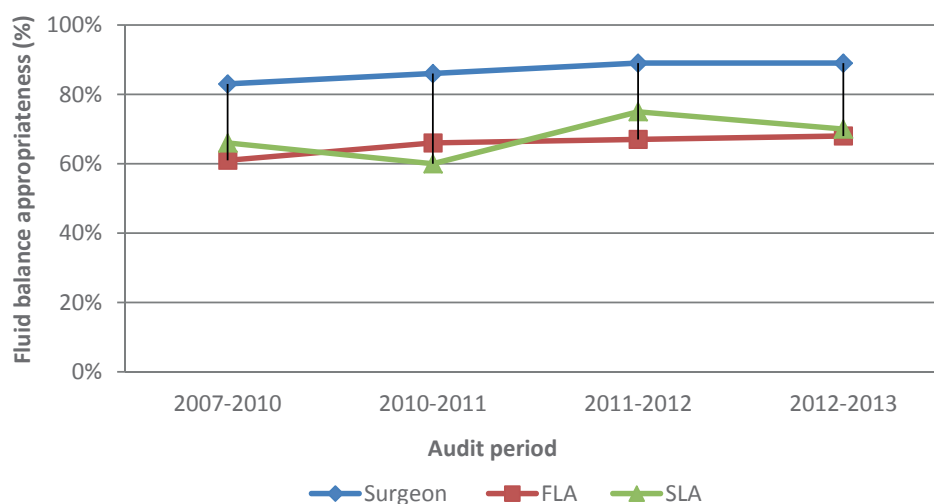
- The treating surgeon perceived that lack of provision of critical care support to their patients was potentially an issue in only a very small percentage (<1%) of their cases.
- The peer-review process (FLA and SLA) suggested that only 2.5% of patients who did not receive critical care support were likely to have benefited from it.

3.6. Issues with fluid balance

Deciding on the optimal amount of IV fluids to be administered to surgical patients and the best rate at which to give them can be complex. The treatment decisions must be based on careful assessments of the patient’s individual needs. The overall goal is to provide enough fluid and electrolytes to meet losses, maintain normal status of body fluid compartments and enable renal excretion of waste products.

Therefore, the surgical consultants and the clinical teams should be able to demonstrate continuing core fluid management competencies. The treating surgeon and all assessors are asked to comment on the appropriateness of fluid balance during the episode of care.

Figure 27: Perception of fluid balance appropriateness.



Note: total n=3,948.
Missing data: n=417 (10.6%).

Comments:

- Across the audit period 2007–2013, in 2,678 (83.8%) of the audited cases the treating surgeon felt that fluid balance had been managed appropriately by their clinical team.
- Overall, the first and second-line assessors made adverse comment on fluid balance management in 35.1% of the audited cases. This gap between appropriateness of perception of fluid balance between treating surgeon and assessors is noteworthy.
- Fluid balance was assessed as inappropriate in the combined groups of first and second-line assessors in 35 (5.2%) of the 672 cases that had a second-line assessment.
- From a recent study on the interaction between fluid balance and disease severity of the critically ill patients, it was found that “early adequate fluid resuscitation together with conservative late fluid management may provide better patient outcomes”.⁽⁹⁾



3.7. Trauma

In 2012 VASM started collecting data points on trauma cases where severe bodily injury or shock, for example from a fall, accident or violence, occurred in patients that required surgery (see table 6).

VASM is keen to monitor trends, especially in falls, to ensure strategies are implemented to prevent and minimize harm from falls in the future.

Table 6: Trauma causes.

Trauma causes	Frequency (%)
Fall at home	103 (37.7%)
Fall in a care facility	104 (38.1%)
Fall in hospital	15 (5.5%)
Fall type unknown	5 (1.8%)
Fall other*	13 (4.8%)
Road accident	26 (9.5%)
Violence	7 (2.6%)
Total	273 (100%)

Note: total n=273.
Other* category includes: roads and public venues.

Comments:

- Of the 1,523 cases reported since January 2012, only 273 (17.9%) were attributed to traumatic events.
- Of the 273 traumatic events, 240 (87.9%) were caused by falls, 26 (9.5%) were caused by traffic accidents, and 7 (2.6%) were victims of violence.
- Of the 240 falls, 119 (49.6%) occurred in hospitals or in a care facility, 103 (42.9%) at home and only 18 (7.5%) or elsewhere.
- The VASM surgical population is at an increased risk of falls due to the acuity of the life threatening pre-existing conditions, comorbidities and frailty due to advanced age; therefore, prevention of falls should be addressed at hospitals and care facilities should be improved where possible.
- Future analysis should provide greater insight into strategies for improvement in this aspect of patient care especially when falls occurred in a care facility and in hospital. VASM would like to see a reduction in trends in the years to come. A recent study found a reduction in postoperative falls in patients who participated in a preoperative education program.⁽²¹⁾ Therefore, similar educational strategies could be implemented at Victorian health care facilities.

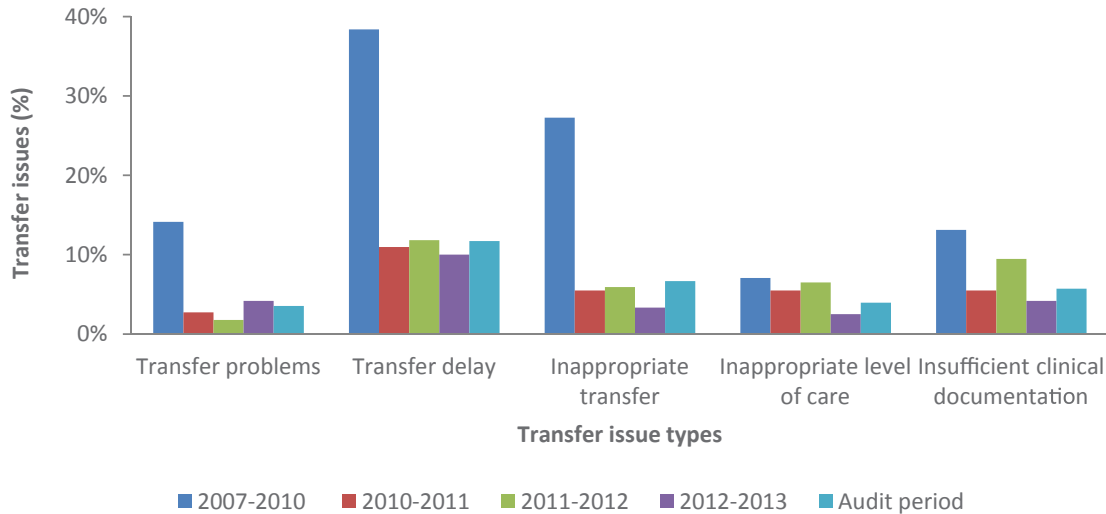


3.8. Patient transfer issues

The treating surgeon was asked to provide information on patients who required inter-hospital transfer as part of their care, and this included timeliness and appropriateness of transfer.

Treating surgeons were also asked to record any perceived clinical issues associated with individual patient transfers.

Figure 28: Inter-hospital transfer issues.



Note: total n=232 in 734 patients requiring transfer.
Missing data: n=0 (<1%).

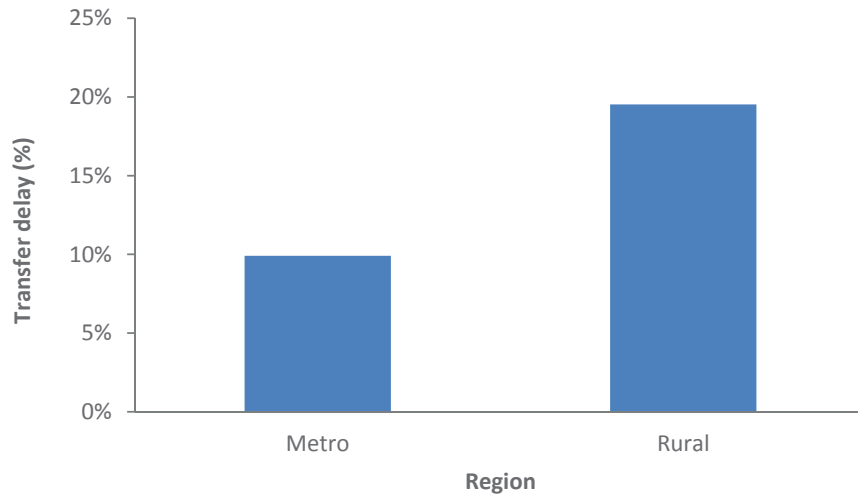
Comments:

- There were 734 (23%) instances in the audited series of 3,195 operative cases where patients underwent transfer to another hospital.
- The graph highlights 232 (31.6%) patients from the pool of 734 requiring transfer to another hospital, and the issues related to transfer.
- There were 131 (17.4%) patients that required transfer from the non-operative group of 753 patients.
- The frequency of patients requiring transfer for definitive care has remained similar throughout the audit period.
- Various issues of care related to patient transfers were identified in 232 (31.6%) of the 734 patients requiring transfer. This rate has been constant over time. Figure 28 demonstrates the spectrum of all issues identified by surgeons.
- Inappropriate level of care during transfer was identified in 49 (6.7%) cases of the 734 cases.
- During the audit period it was felt that inadequate clinical information and documentation had been provided to the receiving hospital in 42 (5.7%) of the 734 cases.
- In a further 86 (11.7%) it was felt that the transfer had occurred inappropriately late in the course of the illness.
- Delays and problems in transfer carry risks and challenges posed by shared care and there is a need to improve the safety of patients care in such settings and implement clear communication channels with relevant patient care teams.
- VASM has identified a need to better define the transfer issue types in the case record forms and these data collection points will be revised in 2014–2015.



3.8.1 Transfer delays by region

Figure 29: Perceived delays in transfer of patients to another hospital.



Note: total n=734 in 3,195 operative cases.
Missing data: n=30 (4%).
Metro: metropolitan.

Comments:

- A major reason for transfer is to attain a higher level of care such as access to critical care. It is expected that rural hospitals will have a greater number of transfer needs. However, the College supports the Rural Doctors Association of Victoria's recommendations to provide greater support and round the clock availability of well-trained rural doctors to ensure that appropriate patient care is provided to the patient prior transfer.⁽¹⁶⁾
- Transfer delays were more frequently seen in rural regions than metropolitan areas. This result was statistically significant ($p < 0.001$). The Rural Doctors Association of Victoria stated: 'ensuring that appropriate medical care is provided before transfer means a commitment on the part of the state to maintain the rural medical workforce and to ensure that rural hospitals take appropriate steps to guarantee round the clock availability of well trained and experienced rural doctors'.⁽¹⁶⁾

3.9. Outcomes of the peer review

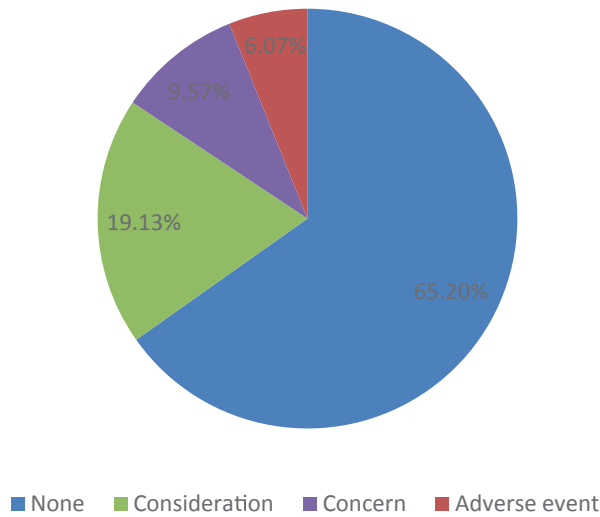
The audit process is outlined in the first section of the report and highlights the quality assurance loop in the audit review process, prior feedback and recommendations being provided to the treating Fellow, the surgical team, the clinical community and hospitals.

A primary objective of the VASM peer-review process is ascertaining if death was a direct result of the disease process alone, or if aspects of patient management might have contributed to that outcome. There are two possible outcomes: either death was a direct outcome of the disease process and the clinical management had no impact on the outcome, or there was a perception that aspects of patient management may have contributed to the death of the patient. In cases in which there is a perception that the clinical management may have contributed to death, VASM has specified a spectrum of criticism from which the assessor can choose:

- An area for **consideration** exists: the assessor believes an area of care **could** have been improved or different, but recognises that the issue is perhaps debatable. It represents very minor criticism.
- An area of **concern** exists: the assessor believes that an area of care **should** have been better.
- An **adverse event** occurred: this is defined as an unintended injury or event that was **caused** by the medical management of the patient rather than by the disease process, and which was sufficiently serious to lead to prolonged hospitalisation, or to temporary or permanent impairment or disability of the patient at the time of separation, or which contributed to or caused death.



Figure 30: Clinical management issues as identified by assessors.



Note: total n= 3,948.
Missing data: n=11 (<1%).

Comments:

- In 3,320 (84.1%) of the 3,948 cases that completed the audit process, no or only minor issues of patient management were perceived to have occurred (see Figure 30).
- In 378 (9.6%) of 3,948 patients, areas of concern were identified.
- In 239 (6.1%) of 3,948 patients, assessors felt the clinical issues were serious enough to be called adverse events.

3.9.1 Areas of clinical incidents

Table 7 shows the severity of criticism of perceived clinical management issues and table 8 shows the frequency of clinical management issues.

Table 7: Severity of criticism of perceived clinical management issues.

	Less severe ←————→ Most severe			
Areas of clinical incidents	None detected	Consideration	Concern	Adverse event
Outcome of incidents	N/A	Did not affect clinical outcome	May have contributed to death	Probably contributed to death
Preventable incidents	N/A	Probably not	Probably	Definitely
Association of incidents	N/A	Hospital	Clinical team	Surgical team



Table 8: Frequency of clinical management issues.

Degree of criticism of patient management	Total occurrences (n=5,411 in 3,948 cases)	Patients affected by clinical issues (n=3,948)
No issues identified	2,567	2,567 (65%)
Area of consideration	1,722	753 (19.1%)
Area of concern	779	378 (9.6%)
Area of adverse event	306	239 (6.1%)
Missing data	37	11 (<1%)
Total	5,411	3,948 (100%)
Perceived impact on patient outcome	Total occurrences (n=5,411 in 3,948 cases)	Patients affected by clinical issues (n=3,948)
No issues of management identified	2,567	2,567 (65%)
Did not affect clinical outcome	656	324 (8.2%)
May have contributed to death	1,820	813 (20.6%)
Probably contributed to death	239	197 (5%)
Missing data	129	47 (1.2%)
Total	5,411	3,948 (100%)
Perceived preventability of clinical issues	Total occurrences (n=5,411 in 3,948 cases)	Patients affected by clinical issues (n=3,948)
No issues identified	2,567	2,567 (65%)
Definitely preventable	339	243 (6.2%)
Probably preventable	1,144	522 (13.2%)
Probably not preventable	979	483 (12.2%)
Definitely not preventable	102	59 (1.5%)
Missing data	280	74 (1.9%)
Total	5,411	3,948 (100%)
Clinical team responsible for management issue	Total occurrences (n=5,411 in 3,948 cases)	Patients affected by clinical issues (n=3,948)
No issues identified	2,567	2,567 (65%)
Surgical team	1,626	878 (22.2%)
Other clinical team	801	246 (6.2%)
Hospital issue	211	53 (1.3%)
Other factors*	217	59 (1.5%)
Missing data	372	145 (3.7%)
Total	5,794	3,948 (100%)

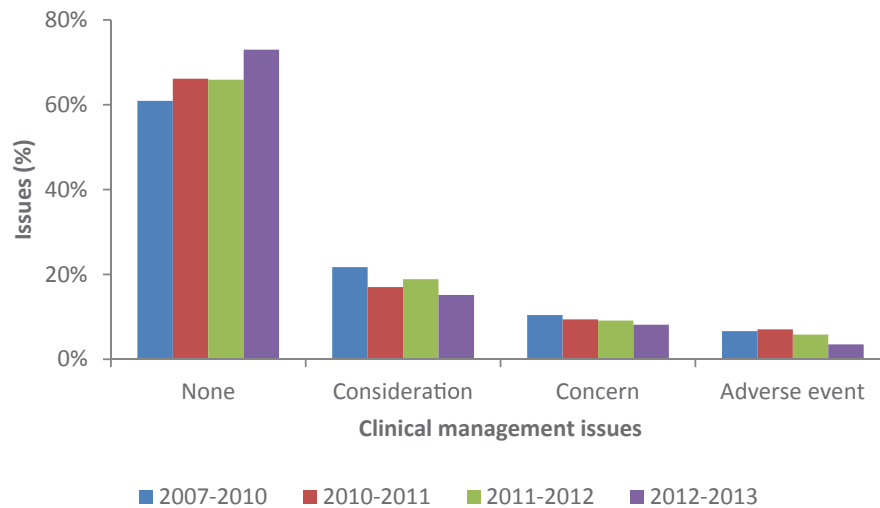
Note: other factors can include issues such as staffing levels, patient transfer, patient refusal, ambulance care, anaesthetic care and availability or quality of critical care support.

Comments:

- Audited cases can have more than one clinical management issue identified for each patient. The percentage of patients affected is the important measure.
- Patients often require input from other clinical teams during their course of treatment. Management issues raised may, therefore, be attributable to any of these teams.
- Assessors perceived that clinical management issues occurred in 1,381 (35%) of the 3,948 cases in this audited series.
- In 878 (22.2%) of the 3,948 cases, an issue was identified that was attributed to the surgical team.
- Another 6.2% of cases had an issue attributed to other clinical teams (for example; medical and emergency departments), 1.3% were attributed to hospital issues, and 1.5% to other factors. In 3.7% of cases, the responsible team was not identified by the assessors.
- Assessors felt that in 197 (5%) of the patients, clinical management issues probably contributed to death. In the remaining cases where management issues were perceived, the impact of these issues on the outcome was uncertain.
- These findings are similar to the national audit results.⁽¹⁾



Figure 31: Trends of clinical management issues.



Note: total n= 3,948.
Missing data: n=11 (<1%).

Comments:

- Overall, there has been a reduction in the rate of clinical issues over the six-year audit period (see Figure 31).
- In the 2007–2010 period, no clinical management issues were identified in 60.9% of patients. This figure rose to 73% in 2012–2013 (p<0.001).
- The assessors perceived more clinical issues over the six-year audit period than the treating surgeon. The ratio of issues identified by the treating surgeons versus the first-line assessor is 24.3%:33.3%. The gap widens between the treating surgeon and the second-line assessor to 44.7%:75.3%. These results highlight the importance and the value of an independent peer review assessment.
- The prevalence of areas of concern and adverse events identified by assessors was similar among the specialties. Some specialties have had few mortalities reported or just commenced the audit process, which may skew the data.

3.9.2 Frequency of clinical management issues

The frequency of specific clinical issues of management is shown in Table 9. The higher the frequency, the greater is the requirement to implement strategies to improve surgical care in that particular clinical arena.

Table 9: Frequency of clinical management issues.

Clinical management issues	Frequency (%)
Operation inappropriate	652 (22.1%)
Delay in definitive treatment	592 (20%)
Preoperative care issues	389 (13.5%)
Management or protocol issues	370 (12.5%)
Postoperative care issues	316 (10.7%)
General complications after surgery	182 (6.2%)
Communication or poor documentation	171 (5.8%)
Adverse events	93 (3.2%)
Critical care issues	47 (1.6%)
Intraoperative complication	47 (1.6%)
Septicaemia and wound	42 (1.4%)
Anaesthesia related	36 (1.2%)
Transfer problems	19 (<1%)
Total	2,956 (100%)

Note: total n=1,381 cases with 2,956 clinical management issues identified of the 3,948 audited pool. More than one clinical management issue can be attributed to one audited case. The clinical issues were re-categorised and detailed in the Appendix section 10.6 of this report.

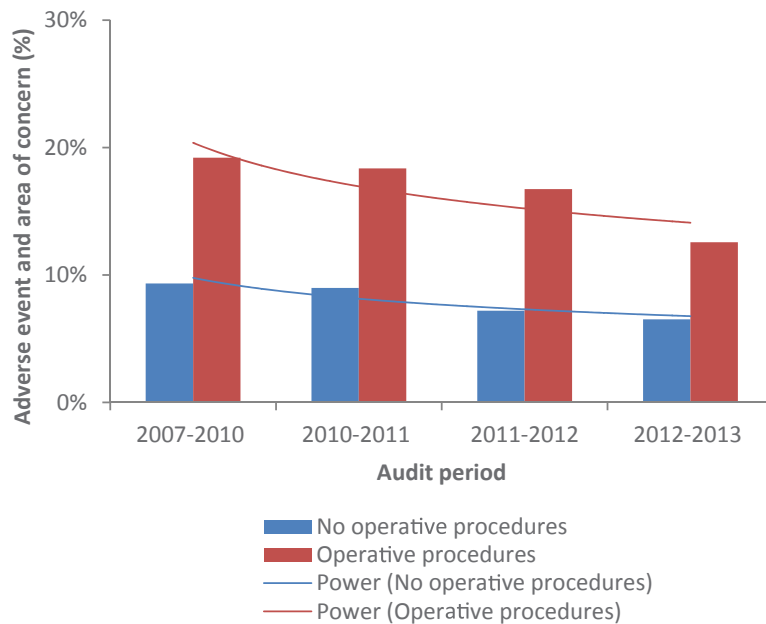


Comments:

- Inappropriate operation (22.1%) and delay in implementing definitive treatment (20%) were the most common clinical issues found in 1,244 instances. These are significant findings and highlight the issue that clinical deterioration must be acted upon not just recorded.
- The delay category includes delays in transfer, establishing diagnosis and starting treatment. A number of studies on hip fracture patients found that delay to surgery was attributable to patient factors such as age⁽⁸⁾ and comorbidities⁽⁶⁾, in addition to waiting times.^(10, 17, 18)
- The attribution of delays were delay in patient care, delay in diagnosis, delay in fully investigating the patient, delay in patient presenting, delay in recognising complications, delay in transfer to surgical unit, delay in transfer to delay in starting medical treatment, delay to tertiary operation caused by missed diagnosis and delay hospital to surgery where earlier operation was desirable.
- There was also criticism of the choice of operative procedure and decision to consider another operative approach. For example, “patients with significant comorbidities may be better suited to less complex and invasive procedures”.⁽⁶⁾
- Another example was related to the type of operation where “open surgery had greater risk of anastomotic leak than laparoscopic operations. Anastomotic leaks had higher rates of surgical site infection and greater need for intraoperative blood transfusions”.⁽¹⁹⁾

This graph shows the frequency of adverse events and areas of concern by operative status.

Figure 32: Frequency of adverse events and areas of concern by operative status.



Note: total n=617.
 Missing data: n=11 (<1%).
 The operative and non-operative power trend line indicates the decreased adverse event and areas of concern rates in both groups.

Comments:

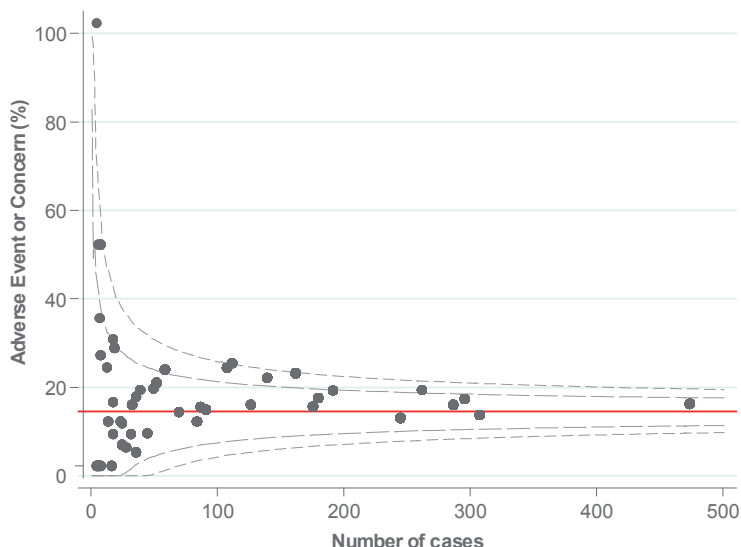
- Overall, audited cases where no operative procedure occurred had a significantly lower rate of areas of concern and adverse events identified (64, 1.6%) than cases where an operative procedure occurred (553, 13.5%).
- There was a reduction in the frequency of areas of concern and adverse events from 15% (p<0.001) during the 2007–2010 period to 11.4% in 2012–2013 (data not shown).
- Cases where the consultant surgeon had no involvement in the surgery (for example, not operating, deciding, assisting or being present in theatre) had slightly higher rates of areas of concern and adverse events (19%) as those where a consultant was involved in the operative procedure (17%).



This suggests that in these cases the physical absence of the consultant had minor impact on the outcome which may reflect the more complex cases consultant surgeons manage.

If an assessor flags an area of concern or adverse event, this implies significant criticism. In the funnel plots detailed in Figure 33 and 34, we have combined these to look at the prevalence of this degree of criticism among hospitals and surgical specialties. Where cases have undergone both FLA and SLA, only the SLA was included in the analyses provided.

Figure 33: Adverse events and areas of concern by hospital during the audit period.

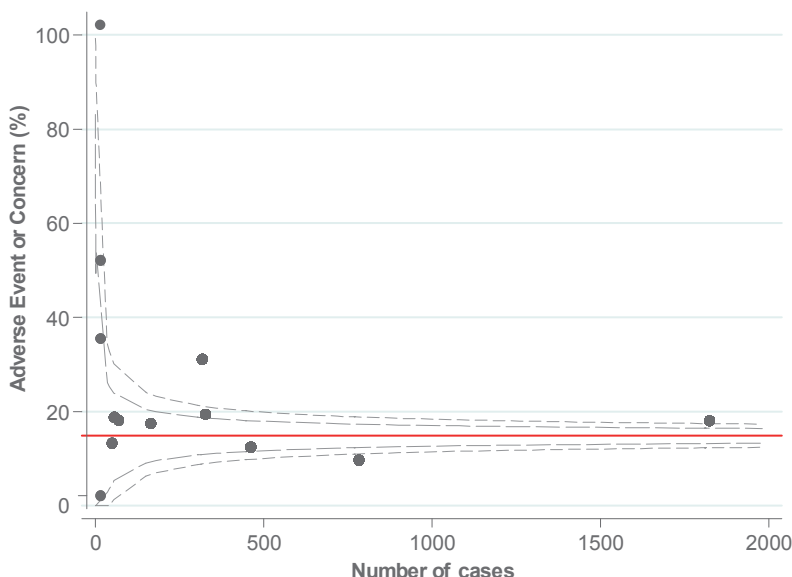


Note: total n=3,948.
Missing data: n=0 (<1%).
Grey lines represent percentage grids.

Comments:

- No hospital was outside the upper 3 SD limit during the audit period.

Figure 34: Adverse events and areas of concern by surgical specialty.



Note: total n=3,948.
Missing data: n=0 (<1%).
Grey lines represent percentage grids.



Comments:

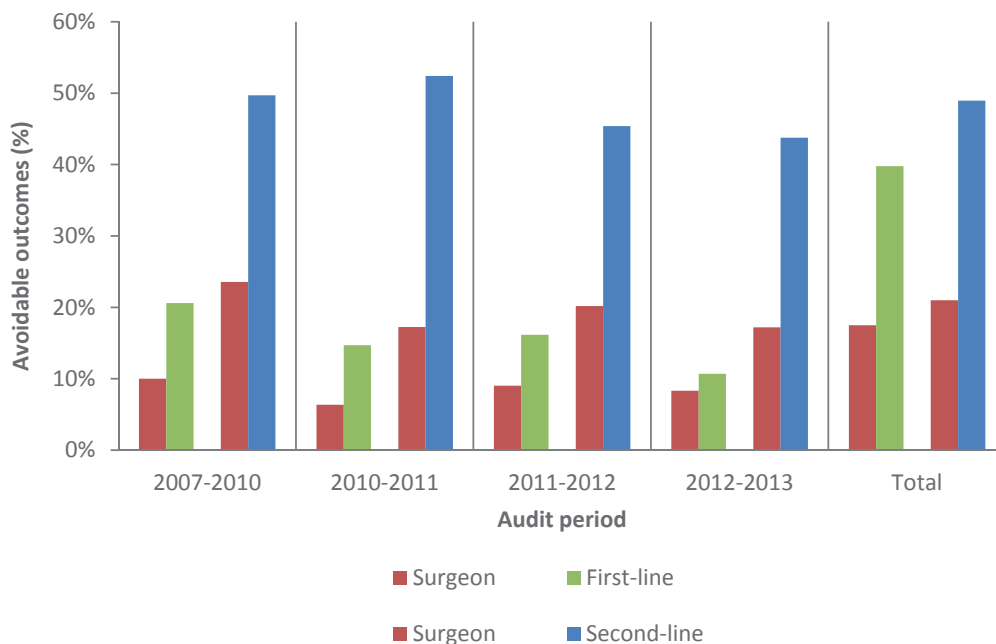
- One specialty was outside the upper 3 SD limit; however, as it is not possible to stratify risk among the specialties, some of which encompass a very high-risk group of patients, no inference can be made.
- In addition to simply identifying if a management issue occurred, assessors have to indicate and categorise the actual clinical issue.

3.9.3 VSCC classification of preventable outcomes

Audited cases in Victoria are assessed further by the Victorian Surgical Consultative Council (VSCC) to classify where cases with a focus on potentially preventable outcomes. Based on the VSCC classification the VASM mortality outcomes are classified as avoidable or unavoidable.

Performing a full case note review on all reported deaths is not feasible for logistical reasons. However, verifying the clinical issues identified in the case record forms provided against the VSCC classification adds an additional layer of validation to the peer review process.

Figure 35: Potentially preventable outcomes as perceived by treating surgeons versus assessors.



Note: total n=3,948.
 First-line assessment pool n=3,948.
 Second-line assessment pool n=672.
 Missing data: n=1,626 (41.18%).

Comments:

- The treating surgeon identified 690 (17.5%) cases where based on the VSCC classification the outcome was avoidable versus 1,303 (33%) cases where the outcome was avoidable were identified by first-line assessor. A further gap of 142 (21%) versus 329 (49%) cases where the outcome was avoidable was established by the second-line assessments of 672 cases.

3.9.4 Conclusions

VASM would like to encourage participating stakeholders to improve their leadership approaches in patient care, to focus on better documentation of clinical events and to take action on evidence of

clinical deterioration, focus on communication and improve awareness for shared care requirements, focus on improved pre-, intra- and postoperative management as outlined in the 'Emerging issues and recommendations to VASM clinical stakeholders' section of this report.



4. Selected sub-analysis: Necrotizing fasciitis

4.1 Necrotizing fasciitis; high mortality risk, delays are crucial

Necrotizing soft tissue infections are important because they progress rapidly and are associated with **high mortality**. They represent a wide spectrum of soft tissue infections affecting skin, subcutaneous tissue and muscle. Necrotizing fasciitis can affect any part of the body, but most commonly affects the trunk, extremities and perineum. It typically begins with the inoculation of the bacteria into the subcutaneous space via a disruption of the epithelial barrier from local trauma, an insect bite, a burn or surgical incision.⁽²¹⁾ Spontaneous cases in the absence of any obvious source have also been reported. The disease is classified into type 1, a polymicrobial infection often associated with diabetes mellitus or obesity, and type 2, which is monomicrobial and caused by group A haemolytic streptococci.⁽²²⁾ Diabetes predisposes patients to this disease and is associated with a higher mortality. Obesity, immunosuppression, increased age and peripheral vascular disease are also associated with higher predisposition.

4.2 Demographics and characteristics of the sub-analysis group

The current annual report includes 43 patients (1.1% of the 3,948 mortalities) that had a diagnosis of gas gangrene, Fournier's gangrene or necrotizing fasciitis. These conditions are life-threatening with high mortality rates. The analysis focuses on this subgroup due to the time-critical aspect of treatment.

The major principles of necrotizing fasciitis treatment are fluid resuscitation, early broadspectrum antimicrobials and immediate debridement of necrotic tissues and support of failing organs. The single most important factor in determining outcome is early operative debridement, with delay in the diagnosis and instigation of treatment associated with an increased mortality rate.

The surgical wound should be evaluated as often as necessary to ensure adequate debridement of necrotic tissue. A median of four operations per patient was required in the Middlemore study.⁽²¹⁾ Mortality rates as high as 76% have been reported with a usual range of 16–40%.

Fournier's gangrene has been used to describe necrotizing fasciitis of the perirectal, perineal or genital area. The principles of treatment are the same but this condition carries a lower mortality than non-perineal infection.⁽²³⁾

Demographics, length of stay in hospital and ICU, infection site, risk factors and operation profiles, initial bacterial identification and antibiotic regime, medical and surgical units involvement, complications and clinical management deficiencies were reviewed to find the factors associated with this group and its increased mortality risks.



Table 10: Characteristics of the necrotizing fasciitis analysis subgroup of the audited deaths.

Number of audited deaths	43	
Mean age (range)	63 years (38 to 98 years)	
Gender (Male: Female)	53.5 %:	46.5%
Admission status (Emergency: Elective)	86.1%:	14%
ASA grades	ASA 1-2:	10%
	ASA 3:	17.5%
	ASA 4:	35%
	ASA 5-6:	37.5%
Risk of death prior surgery	Expected:	11.6%
	Considerable:	7%
	Moderate:	39.5%
	Small:	23.3%
	Minimal:	18.6%
Most common comorbid factors	Cardiovascular:	21%
	Other*:	18.1%
	Age:	16.2%
	Respiratory:	13.3%
	Diabetes:	9.6%
	Obesity:	6.7%
	Renal:	6.7%
	Advanced malignancy:	4.8%
	Neurological/Psychiatric:	3.8%

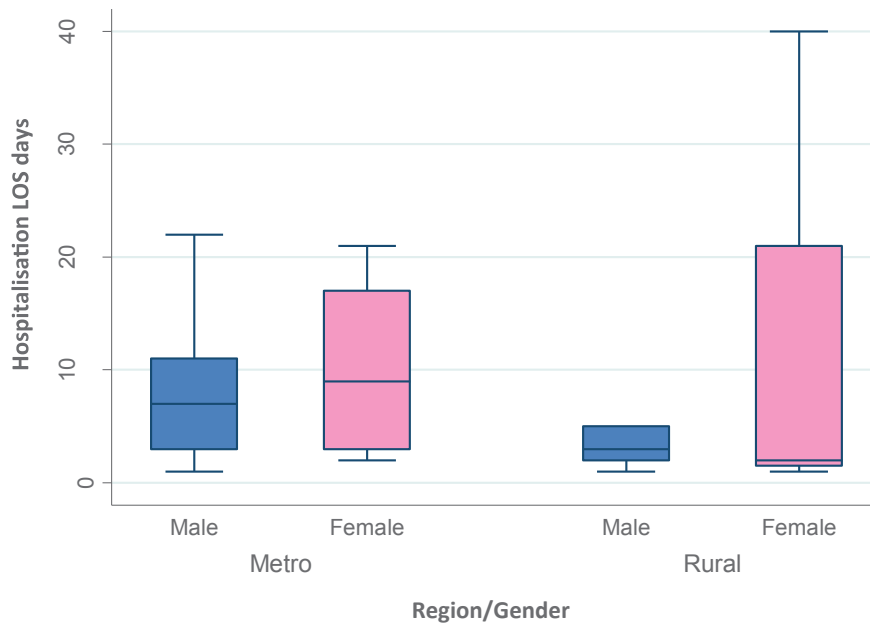
Note: Other comorbidities refers to vascular, infection, patient-related factors).

Comments:

- There were 43 deaths in the gangrene group identified in the 2007–2013 analysis data pool of the 3,948 patients. There were 23 (53.5%) male and 20 (46.5%) female patients in this subgroup. The mean age for non-survivors was 63.
- Of the 43 patients in this group 68.75% had the cause of death identified as septicemia, gangrene or multiple organ failure.
- The ASA status of this group of patients contained a higher proportion (37.5%) in ASA 5 and 6 versus the audited data pool (15%).
- In total 19% of cases were identified as having minimal or small risk of death, 81% of cases were identified as moderate (40%), considerable (23%) or expected (19%).
- There were 39 (90.7%) patients identified with comorbidities in this group, of which 32 (74.4%) had at least two comorbidities.
- Diabetes, obesity and other factors such as vascular disease, infections and patient-related factors were common this subgroup in comparison with the 3,983 audited cases.



Figure 36: Length of stay of the gangrene subgroup.

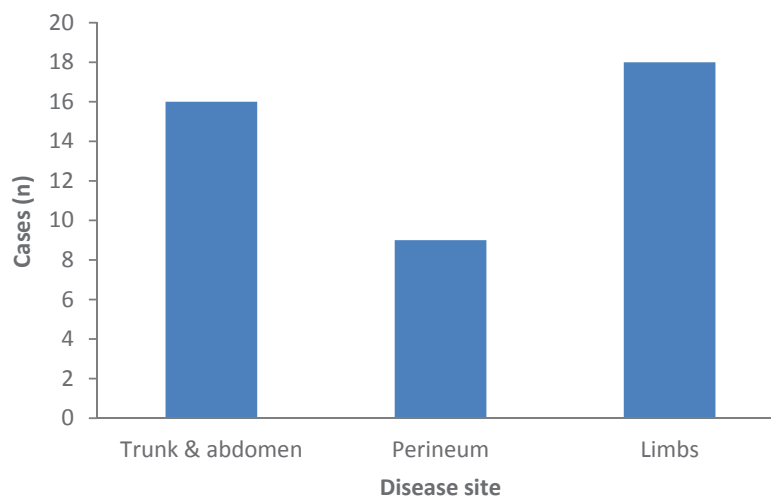


Note: total n=43.
Missing data: n=0 (<1%).
Outliers excluded.

Comments:

- The length of hospitalisation in this patient pool is short-term reflecting the rapid progression of the disease.

Figure 37: Site of disease of the gangrene subgroup.



Note: total n=43.
Missing data: n=0 (<1%).

Comments:

- The site of infection was most common on limbs, truck and abdomen.





4.3 Operative profile

Table 11: Operative profile of the gangrene subgroup.

Operative profile	Elective	Emergency	Total
Surgical procedure	5 (8.3%)	55 (91.7%)	60 (100%)
Procedure abandoned	1 (14.3%)	6 (85.7%)	7 (100%)
No procedure	0 (0%)	22 (100%)	22 (100%)
Return to theatre	3 (27.3%)	8 (72.7%)	11 (100%)
Complications	2 (13.3%)	13 (86.7%)	15 (100%)

Note: total n=60 operative cases reported for 35 patients.
Missing data: n=0 (<1%).

Comments:

- There were 35 (81.4%) patients who had a surgical procedure with a total of 60 surgical sessions and a further 121 surgical episodes. The most common surgical episodes quoted were debridement 42 (34.7%).
- 35 (81.4 %) patients had been transferred to another hospital.
- 11 (31.4 %) patients of the 35 that had surgery have had a return to theatre with a median return rate of 3 operative sessions.
- 29 (82.9%) patients had been treated in a critical care unit and in 23 (65.7%) this care was deemed satisfactory by the clinical and surgical team.
- In total 15 (42.9%) patients of the 35 had a postoperative complication. The most common complication identified was procedure-related sepsis in 7 (46.7%) instances of the 15 cases with complications.
- The most common infective organisms noted were; Clostridium septicum, Klebsiella oxytoca, mixed anaerobic organisms, Pseudomonas, Streptococcus agalactiae and Streptococcus pyogenes.

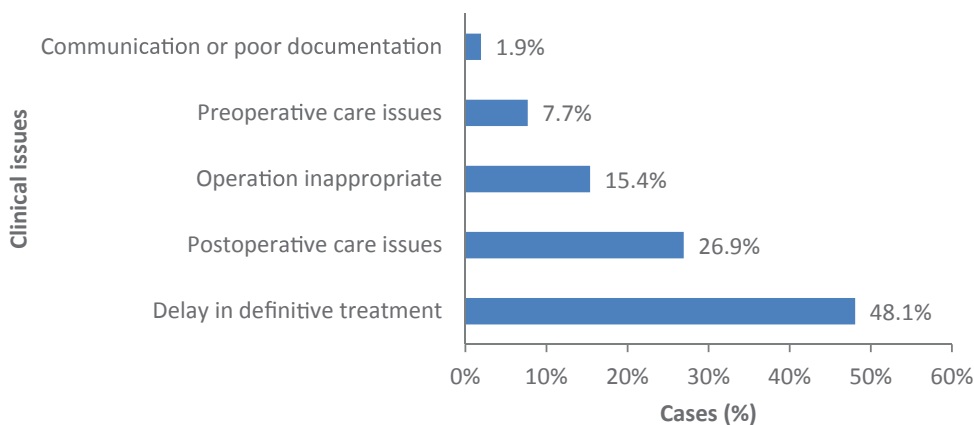
4.4 Deficiency of care

Identifying deficiencies of care in this subgroup of patients remains crucial in order to ensure better care in this high risk group of patients. During the peer-review process 8 (18.6%) of the 43 cases were referred to a second-line assessment.

In five cases (11.6%) the treating surgeons deemed the outcome avoidable, versus 11 (25.6%) of the first-line assessors. From the second-line assessment pool, 6 (75%) out of the assessments, the assessors deemed the outcome avoidable.

In total 18 (41.9%) cases of the 43 patients in this group were identified with a clinical management issue, the rate being 6% higher than the referral in the full audited pool. The most concerns raised were about delay in definitive treatment, particularly delay in diagnosis and delay in commencing treatment.

Figure 38: Frequencies of clinical issues of management.



Note: total n=52 clinical issues reported for 43 patients.
Missing data: n=0 (<1%).



Comments:

- There were 25 (48.1%) incidences identified with delay in definitive treatment in this high-risk group of patients.
- Patients with necrotizing fasciitis must be started on intravenous antibiotics and should be referred immediately for surgical debridement. VASM found that the care of this group of patients could be better and the treatment of this group of patients should always be arranged urgently.
- A delay in treatment in this high risk group of patients will result in infection that will spread at a rapid rate. Repeated surgery is often required. Lack of appropriate diagnostic of organism or delay in treatment will increase the risk of death.

4.5 Conclusion and recommendations

The diagnosis of Fournier's disease, gas gangrene or necrotizing fasciitis should result in prioritising resources to prevent delay in treatment. This will prevent complications and reduce mortality in this high-risk group of patients.





5. VASM performance review

Table 12: Project schedule and delivery status.

Schedule of key deliverables	Status
Key performance reviews 2007–2012	✓ Completed
VASM contract renewal 2013–2019	✓ Completed 12 August 2012
Enhancement of the Fellows electronic interface	✓ Completed 1 November 2013
Establishment of mortality audit at all Victorian public and private hospitals	✓ Completed 1 August 2013
Establishment of internal validation of the VASM audit processes 2013–2019 <ul style="list-style-type: none"> ● First-line validation ● Second-line validation 	✓ Completed 12 August 2013
Provision of educational seminars to Fellows and hospital administrators, and other healthcare professionals on: <ul style="list-style-type: none"> ● 'Managing the Deteriorating Patient' in collaboration with VSCC and VMIA ● 'Profiling the accreditation advantages of the Victorian Audit of Surgical Mortality' ● 'Patient Transfers - Between hospitals and within hospitals' ● 'Aviation error reduction strategies applied to surgery - How to conduct second-line VASM peer review assessments' ● 'Surgical Emergencies and Shared Care' ● 'Understanding the literature and preparing for journal submission' 	✓ Completed 23 February 2012 ✓ Completed 30 October 2012 ✓ Completed 23 February 2013 ✓ Completed 18 October 2013 ✓ Completed 19 February 2014 ✓ Completed 1 May 2014
Provision of educational publications; <ul style="list-style-type: none"> ● Case note review booklet ● Scientific papers ● Annual report 	✓ Completed 15 November 2013 ✓ Completed 15 October 2013 ✓ Completed 15 March 2014
Follow up on the of external evaluation of the VASM audit processes	In development
Enhancement of Hospital reports for accreditation processes	In development

6. Audit limitations and data management

As an audit, the data is collected to provide feedback to surgeons, rather than for academic research. However, in audit terms, the data is of a high quality because every case had external peer review.

The data is self-reported and a certain level of bias may be present, but independent assessors make their own assessments on the facts presented.

Data quality is an essential component of all audits. Inaccurate and incomplete clinical information will impair the audit process and prevent identification of trends.^(11,12)

The volume of missing data continues to be most prevalent in the 'fluid balance management'

(417, 10.6%), 'operative section' (488, 10.7%), 'anaesthetic associated' sections (789, 20%) and 'critical care utilisation' (725, 18.4%). These questions are important if we are to identify and address adverse trends. Where data integrity issues are identified, it is important to review the format of the questions that will generate the data. ANZASM felt it appropriate to revise the surgical case record form.

VASM will implement 100% uptake of the electronic Fellows interface during 2014 for data submission and this should lead to improved data integrity in the future.



7. VASM evaluation survey

With the release of each VASM Annual Report, an evaluation survey was sent to surgeons and hospitals. The survey sought feedback on the perceived value of the annual reports, case note review booklets previously published, the value of the personal feedback sent to treating surgeons as part of the peer review process and the value of the new electronic interface. In addition there were also free text sections

soliciting suggestions for improvement and requesting topics that might be addressed with future educational seminars. Surgeons were also asked if the outcomes from any part of the audit process had led to any change in their practice.

From all the surveys received, the majority of respondents agreed with the appropriateness of the VASM program.

Table 13: VASM Evaluation Hospital Survey Results 2007–2012.

The Victorian Audit of Surgical Mortality (VASM) surveyed a total of 83 (20%) out of 419 hospital contacts from the 129 health services with surgical services. This survey evaluated the value and impact of the VASM activities on their clinical settings. The 2012 data was compared to the evaluation findings in 2011 from VASM's inception. The data were analysed using quantitative and qualitative methodologies. The results are as indicated below. The averages represent the Likert scale where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree. The response on the survey on the value of the VASM process represent a scale where 1=Yes and 2=No.

VASM publication and electronic platform	2007–2011 (n=54)			2012 (n=29)			
	n	(%)	Ave	n	(%)	Ave	Trend
The VASM Annual Report is informative.	54	(100%)	4.20	28	(96.6%)	4.07	↓
The Case Note Review Booklet is a valid education tool.	54	(100%)	4.24	28	(96.6%)	4.29	↑
The VASM webpage is a useful resource about VASM.	36	(66.7%)	3.64	28	(96.6%)	3.72	↑
VASM electronic publications would be valuable.	24	(44.5%)	3.63	29	(100%)	3.93	↑

Educational value	2007–2011 (n=54)			2012 (n=29)			
	n	(%)	Ave	n	(%)	Ave	Trend
The seminar held was educational.	7	(13%)	3.71	11	(37.9%)	3.91	↑
The VASM process helped improve surgical care at my institution/health service.*	0	(0%)	N/A	27	(93.1%)	1.37	N/A

Topics	2007–2011 (n=54)		2012 (n=29)	
	n	(%)	n	(%)
Delay in diagnosis.	8	(14.8%)	11	(37.9%)
Delay in transfer.	11	(20.4%)	14	(48.3%)
Fluid balance/resuscitation.	10	(18.5%)	7	(24.1%)
Communication issues.	12	(22.2%)	15	(51.7%)
Hospital accreditation tool.	0	(0%)	16	(55.2%)
Pre-operative management.	9	(16.7%)	16	(55.2%)
Other topics suggested.	0	(0%)	3	(10.3%)



Themes about the impact of the VASM activities on their institution/ health service	Examples from respondents:
Improvement in quality of care and risk reductions.	<p><i>"It definitely makes us sit back and look at what we are doing, and ways to improve."</i></p> <p><i>"Has provided a focus, in particular regarding appropriate types of surgery to be done at this hospital."</i></p> <p><i>"Has contributed to better quality surgical audits in our health service."</i></p> <p><i>"Has good ideas for improved care and outcomes."</i></p>
Review of policies and procedures.	<p><i>"Tabled and discussed at medical advisory committee."</i></p> <p><i>"Cases are reviewed by a committee which makes appropriate adjustments to current policies and procedures to minimise mortality risks."</i></p> <p><i>"Providing an opportunity for review of cases that assist in education of all healthcare workers."</i></p>
Raised awareness on clinical issues and lessons learned.	<p><i>"Increased awareness and lessons learned have influenced our processes for managing the deteriorating patient."</i></p> <p><i>"Awareness, knowledge, review of current process, learning from other facilities experiences."</i></p> <p><i>"Nursing awareness, notifying consultants earlier."</i></p> <p><i>"We cater for education purposes - to raise awareness."</i></p>
Educational value.	<p><i>"The note review booklet is a great tool to challenge staff to look at better ways to practice and prevent complications."</i></p> <p><i>"I feel this is a very good comprehensive booklet as it is."</i></p> <p><i>"Great initiative seminars relevant and practical."</i></p> <p><i>"Learning from other specialty experiences."</i></p> <p><i>"Education for surgeons and theatre staff."</i></p> <p><i>"Surgeons and anaesthetists have found the case reports especially useful."</i></p>
Limitations of the audit.	<p><i>"There is insufficient information to make a judgement on this topic, though I believe this will occur over time."</i></p> <p><i>"We are small rural health service with limited surgical activity so the report is interesting and informative but has limited impact on our work."</i></p> <p><i>"As a small organisation not everything in the audit is relevant to us but it is still a good educational tool to review."</i></p> <p><i>"Hospitals need to be provided with details of cases particularly when a "hospital" issue has been identified."</i></p> <p><i>"There is no feedback to hospitals for reported cases."</i></p>
Recommendations for future events and publications.	<p><i>"To try and improve the bigger hospitals with ICU/HDU being receptive to transfers from smaller hospitals without such facilities."</i></p> <p><i>"It would be useful if hospitals/ units cooperate more when patients need transfer for higher level of care. This I feel is a major issue in Victoria and possibly nationally."</i></p> <p><i>"Surgical decision making especially high-risk cases."</i></p> <p><i>"Grouping hospitals by size/rurality/etc."</i></p> <p><i>"Larger graphs."</i></p>
Value of electronic communication.	<p><i>"Electronic activities are better..."</i></p> <p><i>"Send it out as electronic version so it is easy to distribute."</i></p> <p><i>"Make it readily available in electronic format to increase distribution opportunities."</i></p>


Table 14: VASM Evaluation Surgeon Survey Results 2007–2012.

The Victorian Audit of Surgical Mortality (VASM) surveyed a total of 651 (70%) out of 1,051 Fellows. This survey evaluated the value and impact of the VASM activities on their clinical settings. The 2012 data was compared to the evaluation findings since VASM's inception. The data were analysed using quantitative and qualitative methodologies. The results are as indicated below. In Table 1, 2 and 3 the averages represent the Likert scale where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree. The response on the survey item on the value of the VASM process represent a scale where 1=Yes and 2=No.

VASM publication and electronic platform	2007–2011 (n=455)			2012 (n=196)			Trend
	n	(%)	Ave	n	(%)	Ave	
The VASM Annual Report is informative.	453	(100%)	3.79	194	(99%)	3.99	↑
The Case Note Review Booklet is a valid education tool.	450	(99%)	3.92	194	(99%)	4.04	↑
The VASM Newsletter is informative.	162	(35.6%)	3.72	194	(99%)	3.82	↑
The VASM webpage is a useful resource about VASM.	152	(33.4%)	3.37	191	(97.5%)	3.38	↑
The electronic platform, Fellows Interface is valuable	355	(78%)	3.42	138	(70.4%)	3.44	↑
The assessor's comment from the feedback letter is valuable.	384	(84.4%)	4.23	144	(73.5%)	3.84	↓
VASM electronic publications would be valuable.	156	(34.3%)	3.51	191	(97.5%)	3.40	↓

Educational value	2007–2011 (n=455)			2012 (n=196)			Trend
	n	(%)	Ave	n	(%)	Ave	
The seminar held was educational.	40	(8.8%)	3.38	81	(41.3%)	3.59	↑
The VASM process helped improve surgical care at my institution/health service.	0	(0%)	N/A	173	(88.3%)	1.55	N/A



Workshop topics	2007–2011 (n=455)		2012 (n=196)	
	n	(%)	n	(%)
Delay in diagnosis.	67	14.7%	58	29.6%
Delay in transfer.	46	10%	30	15.3%
Pre-operative management.	56	12.3%	43	21.9%
Fluid balance/resuscitation.	40	8.8%	37	18.9%
Deteriorating patient.	79	17.4%	68	34.7%
Guideline for assessment.	53	11.7%	33	16.8%
Communication issues.	39	8.6%	52	26.5%
Other topics suggested.	8	1.8%	11	5.6%

Themes about the impact of the VASM activities on their institution/health service	Examples from respondents:
Educational value.	<p><i>"I am happy with the current audit activities."</i></p> <p><i>"Improved documentation."</i></p> <p><i>"More awareness of events leading to poor outcome."</i></p> <p><i>"Enabled surgeons to have a common platform on which to discuss difficult cases."</i></p> <p><i>"My Fellow colleagues and I learn from the adverse events in these critical situations and make every effort to avoid the complications encountered by others."</i></p> <p><i>"Lead us to question why we are doing operations."</i></p> <p><i>"Has promoted discussion between surgical staff and anaesthetic staff as to how to reduce unnecessary delays in surgery."</i></p> <p><i>"Delays are what caused a lot of these problems. This is at all levels. The solution is not to audit but to act."</i></p> <p><i>"This process is duplicating hospital processes - why? Some specialties vastly more affected than others in this process and you will find increasing resistance."</i></p>
Publications - option for brief or detailed information.	<p><i>"Personally, I found the current review booklet very comprehensive."</i></p> <p><i>"Its current format is worth maintaining."</i></p> <p><i>"More clinically orientated executive summary."</i></p> <p><i>"More obvious summary of important findings i.e. clinical errors."</i></p> <p><i>"The summary report is concise and therefore more likely to be read."</i></p> <p><i>"The summary is an excellent idea."</i></p> <p><i>"Lacks detail i.e. more specialty specific data/issues."</i></p>
Publications - provision of specialty specific clinical examples.	<p><i>"More cases from each subspecialty."</i></p> <p><i>"Expanded with an attempt to include each specialty each edition."</i></p> <p><i>"Break into specialty sections and general section with lessons for all."</i></p> <p><i>"More specialty specific groupings."</i></p> <p><i>"Educational case studies of 'what went wrong'; with targeted audience i.e. general surgeons get general surgical case studies only."</i></p> <p><i>"Change to a specialty board review rather than lumping all specialities together. I want to know what are the messages for my own craft group."</i></p>



<p>Data collection of morbidity and encourage post-mortem investigations.</p>	<p><i>"I would like to see information about numbers of patients having autopsies."</i></p> <p><i>"VASM focuses on mortality only, not adverse outcome e.g. stroke after carotid endarterectomy, amputation after lower limb bypass."</i></p> <p><i>"Collect data on systemic problems in hospitals which contribute to mortality e.g. access to the OR Improve surgical care at my institution - unable to comment."</i></p>
<p>Value of electronic communication.</p>	<p><i>"Encourage as much electronic activity as possible."</i></p> <p><i>"Until audit forms are emailed or web based compliance will be low."</i></p> <p><i>"Electronic presence would be useful way of increasing surgeons' awareness of VASM."</i></p> <p><i>"Deliver as an online education package, attracting CPD points for completion."</i></p> <p><i>"It is more difficult to review materials on a computer than in written form. In regards to reports, we delegate this to our registrars. This would be difficult online."</i></p>
<p>Meaningful feedback and recommendations.</p>	<p><i>"Recommendations based on data after each section."</i></p> <p><i>"Translate in meaningful ways of improving surgical care or shedding light on difficult scenarios or ways in which improvements at the bedside or in the operating circumstances. Should like to see more cases relevant to my specialty."</i></p> <p><i>"Increase the clinical interpretation/implications of the data, as well as trends."</i></p> <p><i>"Provision of several 'expert consultant' opinions and legal opinions."</i></p> <p><i>"It provides valuable second opinions and peer review to uphold the best surgical practice."</i></p> <p><i>"There is no form mechanism for right of reply if for example the surgeon involved feels that an erroneous decision has been made."</i></p> <p><i>"Assessors comments on my cases - ill-informed for my subspecialty and at times incorrect management in my view."</i></p> <p><i>"The next step is going to recommending/implementing changes & remeasuring this is a huge challenge, but what makes the audit cycle incomplete."</i></p> <p><i>"No organised process of communicating comments/ experience/ learning from deaths to surgeons in the institution."</i></p>
<p>Recommendations for future events and publications.</p>	<p><i>"Getting the correct diagnosis, ordering tests appropriately, interpreting results."</i></p> <p><i>"Feedback and how to provide it."</i></p> <p><i>"What cases are not suitable for commuting or peripheral hospital."</i></p> <p><i>"Surgical decision making especially high-risk cases."</i></p> <p><i>"How to facilitate 'in hours' treatment of semi urgent/urgent cases."</i></p> <p><i>"Topics of interest for education: a) interventional radiology, b) definitive management of surgical complications."</i></p> <p><i>"VASM findings should be presented at conference/AGSFM."</i></p>
<p>Participation in the audit - CPD compliance and legal implications.</p>	<p><i>"Encouraging other surgeons to participate."</i></p> <p><i>"Report of my participation very helpful for my CPD records."</i></p> <p><i>"The fact that CPD points can be attained reading the practice statements is appropriate and encouraging to read them."</i></p> <p><i>"Is it legal, appropriate, possible, helpful to link participation to fellowship, i.e. make it compulsory? Without full participation data may be irrelevant."</i></p> <p><i>"Make it mandatory and make all deaths within 30/7."</i></p> <p><i>"Compulsory participation."</i></p> <p><i>"It should be optional."</i></p>



8. VASM educational activities

VASM educational seminars commenced in 2012 and continued into early 2014 as a collaborative effort between VASM, the DH, VSCC and VMIA. The programs on the seminars can be downloaded from www.surgeons.org/VASM. The following educational programs have been offered to date;

- **Surgical Emergencies and Shared Care,**

The seminar was held on 19 February 2014 and presented jointly by VASM, VSCC, VMIA and the DH.

The seminar focused on: current problem areas in the care of surgical emergencies, as revealed in clinical audit, and; risks and challenges posed by shared care, and how surgeons and trainees may improve the safety of patient care in such settings. The seminar was positively received with more than 140 attendees.

- **How to conduct second-line VASM peer-review assessments,**

The workshop on 'How to conduct second-line VASM peer review assessments' was held on 18 October 2013 and aimed to increase proficiency of the peer assessment process.

Assessors had VASM case examples and had to consider whether the management of the case presented to them adhere to a reasonable care pathway. The seminar was positively received with more than 30 attendees.

- **Patient Transfers - between hospitals and within hospitals,**

The seminar was held on 21 February 2013 aims to increase medical and nursing staff awareness of safety factors for inter-hospital transfers, especially of emergency surgical patients; to promote better accompanying information when patients move within hospitals; to improve techniques for surgical patient handover between shifts or between wards.

The seminar was intended for: interns and HMOs, surgeons rural and urban, nurse managers and educators, intensivists, administrators, CEOs, and quality and safety officers. The seminar was positively received with more than 140 attendees.

- **Profiling the national accreditation advantages of the Victorian Audit of Surgical Mortality.**

The seminar was held on 30 October 2012 and was focused on promoting VASM as a quality assurance tool to help meet some of the accreditation standards based on the National Safety and Quality Health Service Standards (NSQHSS). NSQHSS address critical areas that require improvements.

The seminar highlighted that the VASM audit process is designed to attain information on factors involved in the death of patients undergoing surgical treatment allowing the possibility to detect emerging trends in the outcomes from surgical care and develop strategies to redress any system or process errors identified, VASM is a good tool that can help with some of the accreditation standards:

- Governance, review and reporting.
- Preventing and controlling healthcare associated infections.
- Clinical handover.
- Recognizing and responding to clinical deterioration in acute health care.
- Preventing falls and harm from falls.

The seminar was positively received with 100 attendees. From the attendees. From the attendees, 60% responded to the seminar survey where the target audience agreed that the seminar influenced them to consider changes in their quality assurance processes.

Comments:

The feedback on the educational value of the audit revealed that the VASM seminars and publications were relevant, practical and a great tool to challenge clinical staff to look at better ways to practice and prevent negative surgical outcomes.

The VASM educational events were identified as good tools to help "rationalise the thought process, increase awareness [on] patient management [and] vigilance when dealing with the very sick patients".

Areas to focus on in the future as recommended through the feedback process were identified as inclusion of each specialty in the editions of the VASM publications and educational events, strong presence at surgical conferences, development of hospital clinical governance reports and helping stakeholders implement changes based on the audit findings and recommendations.



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10. Appendix

10.1 Data management and statistical analysis

All deaths occurring in Victorian hospitals while the patient is under the care of a surgeon that are notified to VASM are audited. Cases admitted for terminal care and deaths incorrectly attributed to surgery are excluded from the full audit process. This 2011–2012 Annual Report includes deaths reported to VASM since data collection commenced on 1 January 2007 up to 30 June 2012. As the multiple rate-limiting steps in the audit process result in a mean time to completion of three months, information on some deaths that occurred during the reporting period are still under review and are not included.

Data is encrypted in the web database. This data is sent to, and stored in, a central Structured Query Language server database that includes a reporting engine. All transactions are time-stamped. All changes to audit data are written to an archive table, enabling a complete audit trail to be created for each case.

An integrated workflow rules engine supports the creation of letters, reminders and management reports. This system is designed and supported by Alcidion Corporation. All communications are encrypted with Secure Sockets Layer certificates.

Data is downloaded from the secure database and then analysed using the statistical package Stata version 10.1, and Microsoft Office Excel (2007). Demographic data and summary statistics have been presented. Continuous variables have been compared using Student's t-test or the non-parametric Rank-sum test as appropriate. Categorical variables have been compared using Pearson's Chi-square test. Variables have also been tested for yearly trend. Concordance and kappa scores have been used as measures of agreement. Funnel plots have been used to explore heterogeneity and have been presented with upper and lower two and three standard deviation (SD) limits.

Numbers in the parentheses in the text (n) represent the number of cases analysed. As not all data fields have been completed by surgeons, these numbers vary.

10.2 Interpretation of kappa scores and p values

The kappa score is used to understand the difference between agreement levels beyond chance where:

<0 = no agreement.

0.0–0.19 = poor agreement.

0.20–0.39 = fair agreement.

0.40–0.59 = moderate agreement.

0.60–0.79 = substantial agreement.

0.80–1.00 = almost perfect agreement.

A p-value <0.05 is considered statistically significant.

10.3 Interpretation of funnel plots

Funnel plots are a visual tool to investigate bias in meta-analysis. These have been modified for an easily visualised graph of health outcome data. They are scatter plots of the adverse outcome estimated from individual studies expressed as a percentage (y-axis), against a measure of study size (x-axis). On the scatter plot, 95% and 99% confidence limits are superimposed. The funnel plot is based on the precision in the estimation of the underlying treatment effect increasing as the sample size of component studies increases. This is why the smaller sized samples have wider confidence intervals.

10.4 Exclusion of identifiable data

Labels and data that might identify surgical groups, patients, hospitals and extreme values have been excluded from this report.

10.5 Classification of operative procedures

- Cardiac: includes angiograms, bypass of coronary artery, exploratory median sternotomy, median sternotomy approach, replacement of aortic and mitral valve.
- Colorectal: includes anterior resection of rectum and anastomosis, colostomy, partial colectomy, hemicolectomy, ileostomy and reversal of Hartmann's procedure.
- GI Endoscopy: includes colonoscopy, gastroscopy, endoscopic retrograde cholangiopancreatography and sigmoidoscopy.
- Laparotomy, laparostomy and upper GI includes cholecystectomy, endoscopic division of adhesions of peritoneum, gastrectomy, ileostomy, jejunostomy, oversewing of small bowel and repair of inguinal hernia.
- Neurosurgical trauma: includes burrhole(s) for ventricular external drainage, craniectomy, craniotomy, evacuation of haematoma, insertion of cranial monitor, insertion of drainage system into bone and intracranial pressure monitoring evacuation.
- Orthopaedic: includes hip joint operations, hemiarthroplasty, fracture and internal fixation.
- Peripheral vascular: includes embolectomy of femoral artery and vein graft thrombectomy.
- Thoracic and tracheostomy: includes bronchoscopy, insertion of tube drain into pleural cavity, thoracotomy and tracheostomy.
- Urology: includes diagnostic cystoscopy and transurethral resection of male bladder.
- Wound care: includes debridement of bone, muscle and skin, drainage of septal abscess, dressing of wound and lavage of peritoneum.



10.6 Classification of clinical management issues

- Adverse events: includes anastomotic leak after open surgery, injury caused by fall in hospital, pulmonary embolus, secondary haemorrhage and transfer should not have occurred.
- Communication or poor documentation: includes communication failures due to poor case notes and poor communication between physician and surgeon.
- General complications after operation: includes aspiration pneumonia, general complications of treatment, postoperative bleeding after open surgery and septicemia.
- Management or protocol issues: includes adverse events related to treatment guidelines or protocols, diagnosis-related complication, failure to use DVT prophylaxis, HDU not used postoperatively, patient-related factors and patient refusing treatment, surgeon too junior, treatment did not conform to guidelines and unsatisfactory medical management.
- Operation inappropriate: includes decision to operate and consider different operation or operation should not have been done.
- Preoperative care issues: includes CT scan should have been done, cardiac monitoring inadequate, failure to investigate or assess patient, failure to recognise severity of illness and inappropriate treatment prior to surgical referral.
- Postoperative care issues: includes drug-related complication, failure to use HDU postoperatively, fluid balance unsatisfactory, fluid overload and inadequate postoperative assessment.

10.7 Concordant validity considerations

Completion of all fields in the SCF by the treating surgeon requires some self-reflection. An example is where the treating surgeon is asked to nominate any areas of consideration, concern or adverse event emanating from their care of the patient. Such responses by the treating surgeon were compared to assessors' responses to the same question and the degree of concordance was estimated. These results are shown in Tables 15, 16 and 17.

Full concordance between the treating surgeon and assessor is not anticipated. There are various factors behind this. Among these, the information available to the first-line assessor relies heavily on the treating surgeon's account of the clinical events. However, the second-line assessor has a de-identified copy of the patient's medical records and thus a relatively unbiased chronology of care as it happened. The highest level of concordance expected would

therefore be between the treating surgeon and first-line assessor, as the first-line assessor only has access to the clinical information recorded by the treating surgeon. The lowest expected concordance is between the treating surgeon and second-line assessor, who have access to an independent description of the episode of care. For this reason, agreement between first and second-line assessors is also predicted to be weak.

Analysis of concordance is a method of studying inter-rater reliability in reporting all clinical management issues. Performing a full case note review on all reported deaths is not feasible for logistic reasons.

The outcomes of concordance analysis shown below are reassuring, as they mirror the predicted outcomes.



Table 15: Concordant validity between the treating surgeon and the first-line assessor.

Concord areas	Surgeon and first-line assessor				p value
	n (%)	% Concord	Kappa score	(95% CI)	
Risk of death	3,110 (78.77%)	89.58%	0.61	(0.60-0.62)	<0.0001
ICU care benefit if not received	777 (19.68%)	96.65%	0.22	(0.04-0.41)	<0.0001
HDU care benefit if not received	743 (18.82%)	93.00%	0.29	(0.15-0.42)	<0.0001
Fluid balance	3,675 (93.09%)	68.22%	0.22	(0.20-0.24)	<0.0001
Preoperative management/preparation	2,972 (75.28%)	87.55%	0.39	(0.34-0.44)	<0.0001
Intraoperative/technical management	2,928 (74.16%)	92.69%	0.31	(0.25-0.38)	<0.0001
Decision to operate at all	2,977 (75.41%)	89.02%	0.30	(0.24-0.35)	<0.0001
Choice of operation	2,967 (75.15%)	93.29%	0.25	(0.18-0.32)	<0.0001
Grade/experience of surgeon deciding	2,932 (74.27%)	98.36%	0.22	(0.08-0.36)	<0.0001
Grade/experience of surgeon operating	2,933 (74.29%)	97.44%	0.25	(0.14-0.36)	<0.0001
Timing of operation	2,965 (75.10%)	91.77%	0.45	(0.39-0.51)	<0.0001
Postoperative care	2,877 (72.87%)	90.86%	0.35	(0.29-0.40)	<0.0001
Clinical management issues	3,940 (99.00%)	77.69%	0.46	(0.43-0.49)	<0.0001

Note: a total of 3,948 surgical case record forms and first-line assessments were available for analysis.

There were 3,198 surgical procedures with 4,459 operative episodes.

'Critical care not received' data was available in 1,137 audited cases (15%).

Kappa score interpretation outlined in the Appendix section 10.2.

CI: confidence interval; HDU: high dependency unit; ICU: intensive care unit.

Comments:

- High concordance levels were achieved between the treating surgeon and first-line assessor.
- As expected and indicated by the kappa scores, there was fair to moderate agreement between the treating surgeon and the first-line assessor on all concordance areas.
- The areas with the lowest concordance between the surgeon and first-line assessor were fluid balance and clinical management issues. As outlined in the risk management section of this report fluid balance management requires further improvement.

Table 16: Concordant validity between the treating surgeon and the second-line assessor.

Concord areas	Surgeon and second-line assessor				p value
	n (%)	% Concord	Kappa score	(95% CI)	
Risk of death	581 (86.46%)	85.71%	0.52	(0.49-0.57)	<0.0001
ICU care benefit if not received	84 (12.50%)	86.90%	0.13	-	0.02
HDU care benefit if not received	80 (11.90%)	80.00%	0.15	-	0.04
Fluid balance	628 (93.45%)	69.90%	0.24	(0.18-0.27)	<0.0001
Preoperative management/preparation	560 (83.33%)	71.07%	0.03	(0.17-0.33)	<0.0001
Intraoperative/technical management	547 (81.40%)	81.90%	0.29	(0.19-0.38)	0.07
Decision to operate at all	560 (83.33%)	81.96%	0.17	(0.07-0.28)	<0.0001
Choice of operation	559 (83.18%)	81.57%	0.15	(0.06-0.25)	<0.0001
Grade/experience of surgeon deciding	545 (81.10%)	94.50%	0.04	-	0.14
Grade/experience of surgeon operating	544 (80.95%)	94.12%	0.25	(0.08-0.42)	<0.0001
Timing of operation	557 (82.89%)	77.02%	0.23	(0.14-0.32)	<0.0001
Postoperative care	541 (80.51%)	74.49%	0.13	(0.04-0.22)	0.04
Clinical management issues	672 (100.00%)	57.89%	0.20	(0.14-0.26)	<0.0001

Note: a total of 672 surgical case record forms and second-line assessments were available for analysis.

Kappa score interpretation outlined in the Appendix section 10.2.

CI: confidence interval; HDU: high dependency unit; ICU: intensive care unit.



Comments:

- Disagreement between the treating surgeon and second-line assessor was most marked in clinical management issues.
- Perhaps the treating surgeons is less objective in their assessment of the clinical management of patients. This is not unexpected finding and supports the value of independent peer review.

Table 17: Concordant validity between the first-line assessor and the second-line assessor.

Concord areas	First-line assessor and second-line assessor				
	n (%)	% Concord	Kappa score	(95% CI)	p value
Risk of death	609 (90.63%)	84.76%	0.49	(0.44-0.51)	<0.0001
ICU care benefit if not received	129 (19.20%)	54.26%	0.24	(0.20-0.38)	<0.0001
HDU care benefit if not received	191 (28.42%)	56.02%	0.32	(0.27-0.44)	<0.0001
Fluid balance	606 (90.18%)	43.73%	0.12	(0.09-0.15)	<0.0001
Preoperative management/preparation	517 (76.93%)	60.35%	0.31	(0.29-0.35)	<0.0001
Intraoperative/technical management	507 (75.45%)	70.81%	0.40	(0.38-0.40)	<0.0001
Decision to operate at all	536 (79.76%)	69.40%	0.30	(0.25-0.37)	<0.0001
Choice of operation	526 (78.27%)	68.82%	0.31	-	<0.0001
Grade/experience of surgeon deciding	508 (75.60%)	80.51%	0.27	(0.20-0.29)	<0.0001
Grade/experience of surgeon operating	512 (76.19%)	81.05%	0.37	-	<0.0001
Timing of operation	514 (76.49%)	67.12%	0.35	(0.29-0.36)	<0.0001
Postoperative care	503 (74.85%)	55.67%	0.23	(0.21-0.25)	<0.0001
Clinical management issues	672 (100.00%)	70.39%	0.08	(0.01-0.16)	0.01

Note: a total of 672 first and second-line assessments were available for analysis.
 Kappa score interpretation outlined in the Appendix section 10.2.
 CI: confidence interval; HDU: high dependency unit; ICU: intensive care unit.

Comments:

- As indicated by the kappa scores, agreement was poor to moderate between first and second-line assessors.
- Disagreement between first and second-line assessors was most marked in the fluid balance, timing of the operation, decision to operate, postoperative care and the clinical management section, with second-line assessors perceiving more issues than the first-line assessors.
- The tendency of second-line assessors to be more critical of clinical management events is foreseeable after the event than for the treating surgeon prior to the event. However, evaluating the quality of the decisions made by the treating surgeons allows preventative measures to be implemented during the peer review process and recommendations for improved surgical care to be delivered to the treating clinical teams.

Key messages: Concordant validity considerations

- In general, high levels of concordance percentages were observed with moderate kappa scores.
- As expected and potentially due to objectivity (surgeons' assessment) and availability of extra information (such as SLA), kappa scores generally tend to be low.

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