Department of Health

health

Good practice in management of emergency surgery: a literature review

A Victorian Government initiative

Good practice in management of emergency surgery: a literature review

October 2010

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1 Introduction

Patients who present to hospitals with acute conditions that require surgical intervention are significant consumers of health resources in Australia. As the Australian population continues to increase and age, observers have identified a corresponding increase in demand for health services (ABS 2008, 2009). These demographic changes will have an inevitable impact on demand for emergency surgery (AIHW 2008a). Consequently, increasing pressure will be placed upon the public health system to continue to provide equitable and timely access to emergency surgical care.

There are a number of challenges associated with providing emergency surgical services. The tension between balancing demand for elective and emergency surgery is well recognised, as are the flow-on effects to optimising bed capacity, and delivery of quality patient care. These factors have contributed to ongoing debates about how to prioritise emergency surgical patients based on standards of clinical urgency. Delays in initial patient assessment and treatment have resulted in calls for increased clinical leadership and consultant involvement throughout the patient journey. However, an emerging workforce issue has been observed where junior surgeons pursue career paths that are not associated with emergency surgical care, and senior surgeons increasingly opt out of emergency surgery on-call rosters or retire altogether. Addressing these challenges is integral to ensuring the public health system has the capacity to respond to increasing demands for emergency surgery.

In light of this, the Victorian Department of Health commenced a program of work designed to advance the understanding of emergency surgery in Victoria to ultimately inform the development of improved practices, management and policy. Already in Victoria individual hospitals are implementing specific initiatives to better manage emergency surgery, such as separating emergency and elective surgery. The separation of these two caseloads can be a purely administrative separation, or it can involve the physical separation of emergency and elective operating theatres and resources. Other strategies being implemented in Victoria include: reserving capacity for emergency cases in elective booked sessions; instigating twilight and weekend daytime theatre sessions for semi-urgent cases; and appointing emergency surgery patient flow coordinators. Different approaches to improving the emergency surgical service are more appropriate at individual facilities depending on their specific caseload and available resources. These strategies sit alongside, and are complemented by, a range of infrastructure initiatives and new operational models of emergency care.

Similar steps are being taken by governments and organisations across Australia more broadly. The NSW Department of Health recently published a set of *Emergency surgery guidelines*, which form the first stage of an initiative to redesign and reform emergency surgical care in NSW. Some Australian hospitals are introducing acute surgical units and adopting new models of care that are intended to improve the emergency surgical service. Professional groups are encouraging further investigation of these issues by hosting workshops, such as the Austrauma conference and other initiatives led by the Royal Australasian College of Surgeons (RACS). The Sydney West Area Health Service in NSW also hosted the Inaugural Australian Emergency Surgery Conference in July 2010.

Internationally, a range of emergency surgery initiatives are being explored and introduced. In the United Kingdom (UK), recommendations from the National Enquiry into Patient Outcome and Death triggered widespread adoption of consultant-led models of care. Surgical assessment units are also being implemented in UK hospitals to address delays in emergency surgical patient assessment. The United States (US) has addressed workforce shortages by developing a new curriculum and approach to the emergency surgical career path. The Netherlands has undertaken a range of studies aiming to improve efficiency in emergency surgical services.

Therefore, although challenges are associated with the provision of emergency surgical care, there are effective strategies for overcoming them. This literature review explores these challenges and provides insights into current practices in emergency surgical care within Australia and abroad.

1.1 Objectives of the literature review

This literature review aims to:

- identify issues relating to the supply of and access to emergency surgical services
- investigate service delivery models for emergency surgery that have been implemented in Australia and internationally
- investigate frameworks used to measure the performance of emergency surgical services
- provide an overview of relevant literature and models of care identified in five international jurisdictions, namely the US, the UK, New Zealand, the Netherlands and Canada.

The purpose of the literature review is not to prescribe a single best model of care, but rather to present an independent discussion of the different approaches to emergency surgical services identified throughout the review. It is acknowledged that different hospitals have unique characteristics, caseloads and resourcing considerations, and that an optimal model of care for one institution may be less applicable or effective in another.

1.2 Methodology

The literature review involved searching peer-reviewed journals, government policy documents, grey literature, white papers and project reports from studies in Australia and internationally. The search included literature published before February 2010. The search methodology for the literature review is included in Table 1.

Table 1: Literature review search methodology

Search terms	Emergency surgery; emergency surgical procedure; urgent; unplanned; unbooked; life threatening; definition; delivery model; management; model of care; prioritisation; issues; challenges; supply; demand; access; streaming; performance; outcomes; category; schedule; operating theatre; patient flow; parallel processing; acute surgical unit; acute care surgery; surgical assessment unit; workforce; KPI
Databases	Medline Cochrane Database of Systematic Reviews ACP Journal Club Database of Abstracts of Reviews of Effects (DARE) NHS Economic Evaluation Database (CLEED) Cochrane Methodology Register (CLMCR) Apais-Health Cinahl Web of Science Scopus Cochrane Library Meditext PubMed Web of Knowledge (including Web of Science) ERM
Websites	Google (and similar web search engines) World Society of Emergency Surgery: www.wses.org.uk World Journal of Emergency Surgery: www.wjes.org United States Department of Health and Human Services: www.whs.gov American College of Surgeons: www.facs.org Ontario Ministry of Health and Long-Term Care: www.health.gov.on.ca/en/default.aspx British Columbia Surgical Patient Registry: www.phsa.ca/HealthProfessionals/Surgical-services BC-Surgical-Patient-Registry/Background.htm United Kingdom Department of Health: www.dh.gov.uk/en/index.htm United Kingdom National Health Service: www.nhs.uk/pages/HomePage.aspx National Confidential Inquiry into Patient Outcome and Death: www.ncepod.org.uk The Trauma Audit and Research Network: www.tam.ac.uk/Logon.aspx New Zealand Ministry of Health: www.moh.govt.nz/moh.nsf The Netherlands Ministry of Health: www.minvws.nl/en/

The quality of the evidence in the literature has been considered in order to provide an indication of the weight that can be assigned to it. A range of classification systems already exist that can be used to designate the level, quality, relevance and strength of evidence and clinical recommendations, including the National Health and Medical Research Council guidelines. However, these guidelines are designed for the purpose of analysing the quality of treatment regimes, clinical trials and the like. The investigation of access to emergency surgery, like other health service operational literature, should focus on subjects that include the management of health systems, operational models of care, the health workforce, population demographics and the performance of emergency surgical services. The nature of these issues does not readily lend itself to controlled, randomised trials. More often, relevant studies depend upon opportunistic evidence and deductive logic to form recommendations and conclusions.

Nevertheless, the quality of the evidence, within these caveats, can vary. With this in mind, a classification system was developed specifically for the purpose of this review. Two lenses have been adopted to understand the quality of the evidence. The first lens considers the level of evidence included in each piece of literature. This ranges from literature with a high level of empirical evidence to literature that does not refer to empirical evidence but is based on clinical opinion or expert position papers. The second lens considers the type of source, ranging from peer-reviewed scientific articles to unpublished documents. In so doing, it is possible to gain insights into the collective weight of the evidence base. Figure 1 uses this framework to depict the classification of evidence used in the literature review.

Figure 1: Classification of evidence used in literature review

Level of evidence

	Evidence obtained from real-world case series either post-test or pre-test and post-test	**Evidence obtained from comprehensive simulation studies**	**Reviews based on empirical evidence obtained from a range of sources**	**Clinical or expert distillation / position paper with little reference to empirical evidence**	**Total**
Peer reviewed scientific literature (For example, acedemic journals)	24 per cent	7 per cent	14 per cent	0 per cent	45 per cent
Grey literature (For example, policy, papers, reports, websites)	29 per cent	0 per cent	12 per cent	9 per cent	50 per cent
Unpublished documents (For example, slide packs)	3 per cent	0 per cent	2 per cent	0 per cent	5 per cent
Total	56 per cent	7 per cent	28 per cent	9 per cent	

Almost two-thirds of the literature used empirical evidence obtained from real-world case studies or simulation studies. The majority of the remaining third of the literature is based on reviews of empirical evidence obtained from a range of sources. Only 9 per cent of the literature had little reference to empirical evidence. Generally, the documents that fall within this category are either (a) policy documents that have not referred to the underlying evidence supporting their recommendations, or (b) position statements made by professional colleges or organisations as determined by clinical experts. These pieces of literature may not carry as much weight as peer-reviewed scientific literature containing evidence obtained from empirical studies; however, they remain a useful source of information because they contribute insights from practitioners with frontline operational experience and/or relevant expertise.

1.3 Definition of terms

1.3.1 Emergency surgery

As there is no one standard definition of emergency surgery it is useful to begin with a discussion of definitions. Definitions of emergency surgery are typically based either on a recommended timeframe for surgical care (such as surgery required in less than 24 hours), on a place criterion (such as patients that are admitted for surgery via an emergency department) or on a disease criterion (such as surgery for trauma) (Catena & Moore 2007).

The World Society of Emergency Surgery (WSES) suggests a possible definition of emergency surgery as 'polispecialistic surgery performed for trauma injuries or for non-traumatic acute diseases during the same admission in the hospital' (Catena & Moore 2007). Simplistic definitions tend to emphasise the urgent nature of emergency surgery, such as 'surgery which must be done quickly to save life, limb or functional capacity' (Wikipedia 2009).

Despite the lack of consensus, many definitions will include two main components: an unplanned nature of identification of the need for surgery; and a relative urgency for surgical intervention, without which the patient's health may deteriorate and risk poor clinical outcomes (including loss of life, limb, or function, or reduced quality of life) (Fitzgerald, Lum & Dadich 2006).

For the purpose of the current review, the definition of emergency surgery includes unplanned surgical cases, both urgent and non-urgent, that arrive at a hospital through a variety of pathways. The timeframe for indication of urgency includes all unplanned cases requiring surgery within seven days. These cases include:

- major and minor trauma cases, as defined by the Victorian State Trauma System (Department of Human Services 2009)
- cases admitted via an emergency department requiring surgery of varying urgency, which is often described using the following language:
  - immediate life-threatening
  - life-threatening
  - organ/limb threatening
  - non-critical, emergent
  - non-critical, non-emergent, urgent
  - semi-urgent

- unplanned cases that are admitted via an elective surgery pathway that require surgical intervention within seven days and have a corresponding, related emergency department admission
- unplanned cases that are admitted via a non-elective surgery pathway (such as medical) and require unplanned surgery during their inpatient episode of care.

This broad definition of emergency surgery has been adopted in an effort to be inclusive of the variation in terms used to describe emergency surgical cases in different international jurisdictions. It also recognises the extent of cases accommodated under hospital processes developed to meet the challenges of emergency surgery.

It is acknowledged that the definition of emergency surgery used for the purpose of this review has some cross-over with the definition of elective surgery. Elective surgery in Australia is commonly defined in terms of surgery that, in the judgement of a specialist, is necessary and admission for which can be delayed for at least 24 hours. An example of the intersection between the emergency and elective surgical practice exists in instances where patients arrive at the hospital in an unplanned manner and require surgery within the following week. Often it may be safe for these patients to be sent home and return for admission via an elective surgery pathway within the seven-day timeframe. Another example can be found in cases where patients are admitted to hospital under a non-surgical specialty and are then found to require unplanned surgery. The definition of emergency surgery used in this review deliberately includes these groups of 'unplanned' patients because the challenges of surgical scheduling for these groups are similar to more urgent emergency patients. Moreover, these groups are often accommodated via the same processes and resources that are used for urgent emergency surgery patients.

Trauma surgery is a component of emergency surgery because trauma patients indeed contribute to the demand for emergency surgery in Victoria. However, trauma is not the primary focus of this review. Victoria conducted a Review of Trauma and Emergency Services (Ministerial Taskforce on Trauma and Emergency Services & Department Of Human Services Working Party on Emergency and Trauma Services 1999) in 1999 and established the Victoria State Trauma System in 2000. The review made more than 100 recommendations that have been progressively rolled out, with virtually all recommendations complete to date (Department of Human Services 2009). Significant improvements have been made in the field of trauma care across Victoria, including a reduction in mortality rates, positive trends in preventable deaths, and reduced lengths of stay in hospitals (Department of Human Services 2009). The trauma component of emergency surgery has therefore already been the subject of investigation, review and improvement in Victoria. Thus, although trauma is a subset of emergency surgery care, this review focuses on a wider scope of emergency cases including those that are not trauma related.

1.3.2 In-hours and out-of-hours

For purpose of this review, 'in-hours' refers to normal hospital daytime hours and is defined as the period between 8 am and 6 pm Monday to Friday. 'After-hours', or 'out-of-hours', refers to weekends and the period between 6 pm and 8 am on weekdays. In-hours and out-of-hours have been defined in this way because these hours are commonly used throughout the literature (National Confidential Enquiry into Patient Outcome and Death 2003).

However, it is acknowledged that the exact definitions do vary at different hospitals. The definition of 'in-hours' is often inclusive of evening or twilight lists that have been scheduled for the purpose of emergency surgery, which may continue until 10 pm. Some hospitals may continue to refer to this period as 'in-hours' surgery. This topic is discussed at greater length in section 3.2.3.

The definition of in-hours and out-of-hours that is used in this review is therefore only a guide. Where relevant to the content of this review, the in-hours definitions used by a particular hospital are clearly specified.

1.4 Roadmap to this report

This report has been structured to first provide an overview of current practice in emergency surgical care in the five international jurisdictions selected for review (section 2). These jurisdictions include Canada, the Netherlands, New Zealand, the UK and the US. The purpose of beginning with a brief summary of international practice is to set the broader context of the debate presented throughout the remainder of the review.

The next section of this review, section 3, examines the challenges relating to the operational management of emergency surgical care. Section 3 specifically aims to address the following questions:

- How can health services plan for emergency surgery?
- How can elective and emergency surgery demand be balanced?
- What role should surgeons play in the operational management of emergency surgery?
- How should patients be prioritised?
- How can efficiencies be gained in emergency surgical services?

In so doing, it is possible to gain an understanding of the key issues relating to emergency surgery and some of the specific strategies that have been introduced to address them. Included within this section are references to innovative models of care that have been discussed in the literature. This provides insights into ideas currently being investigated that have potential to shape the future of emergency surgical care.

Section 4 focuses on trends in the emergency surgical workforce to highlight some important considerations for the future of emergency surgery.

Finally, section 5 concludes the report with an analysis of the relevant performance monitoring and evaluation frameworks that exist in Australia and internationally. This section demonstrates the importance of using reliable performance data to inform future developments in emergency surgical care.

2 Overview of international practice

2.1 Summary

This section provides a summary overview (see Table 2) of key features of the emergency surgical service that exist in selected international jurisdictions, including Canada, New Zealand, the Netherlands, the UK and the US. The purpose of this section is to contextualise the discussion that is presented in the remainder of the report.

The information presented in Table 2 has been collected through the review of available literature and consultations with representatives from each jurisdiction who were willing to participate in a survey or telephone interview. A more detailed overview of practice in each jurisdiction has been included in Appendix 2.

Some key themes that have emerged internationally include:

- Standardised categories of clinical priority of emergency surgery are uncommon at the national level but may exist at a statewide or hospital level.
- Emergency surgical care is not necessarily viewed as being separate to elective surgery. Some jurisdictions take a more integrated approach to emergency and elective surgery, where all surgical patients are part of the same caseload even though there are variations of clinical urgency within that caseload.
- Although all countries have performance measurement frameworks in place that relate to the health care system or surgical services more broadly, it is not common practice to use a performance measurement framework that is specific to emergency surgery. This is not to say, however, that there is a lack of support for such an initiative.
- Funding is more clearly linked to elective surgery than it is to emergency surgery.

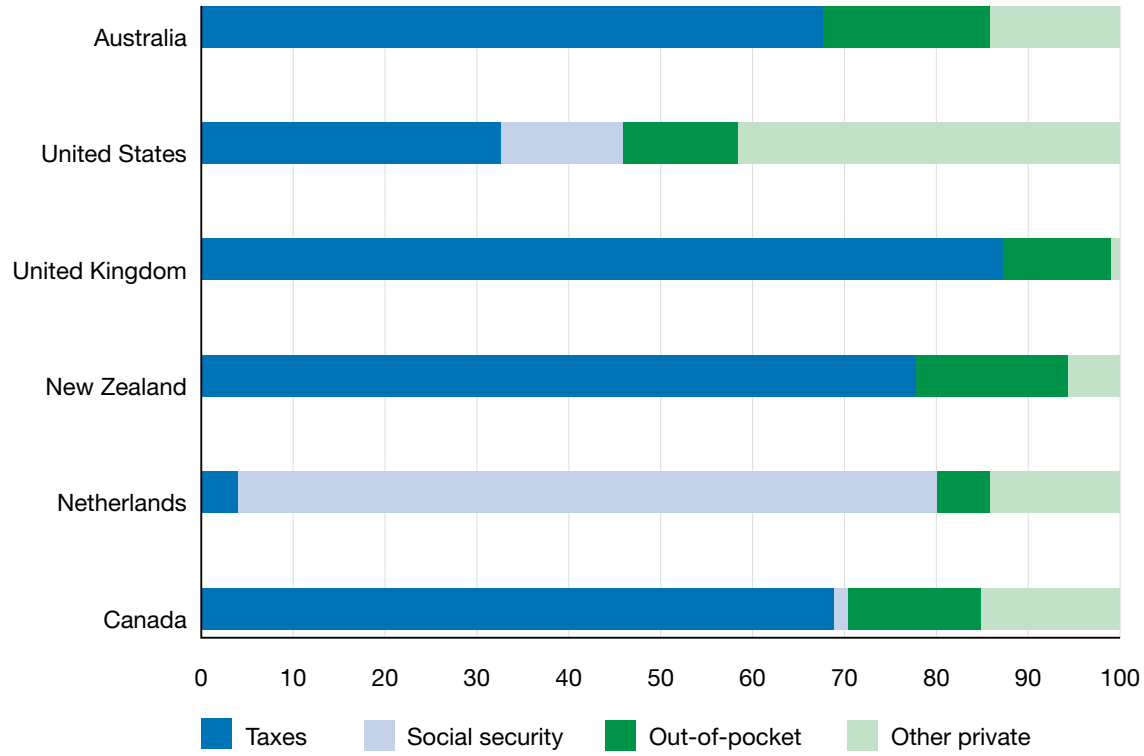
Table 2: Summary of key features of the emergency surgical service in five international jurisdictions

	Canada	Netherlands	New Zealand	United Kingdom	United States
Examples of innovative models of care	CritiCall. Call centre including emergency referral service. Resource Allocation Methodology. Calculates or allocation by surgeon, specialty and site.	*Information not available at time of writing.*	Short stay recovery unit. For pre- and post-theatre, moves patients out of the ED. CapPlan. Software program that matches demand for beds and staff.	Surgical assessment unit. Dedicated emergency surgeon model of care. Treatment centres dedicated to elective surgery.	Operating Room of the Future. Innovative technologies and processes. Acute care surgery model. New approach to trauma and general surgery.
Are there standardised categories of prioritisation?	Not standardised across jurisdiction. Exists in some provinces (For example, Ontario; priority 2 – urgent; priority 3 – semi-urgent)	*Information not available at time of writing.*	Not standardised across jurisdiction.	Yes. Intervention classification system developed by NCEPOD to include immediate, urgent, expedited and elective cases.	Not standardised across jurisdiction.
What kind of performance measurement framework is used across the jurisdiction?	A common system is not used across the jurisdiction. Measurement focuses on wait times for elective surgery.	Nationwide performance measurement framework includes indicators for emergency wards, operating theatres and ICUs.	No national performance framework relevant to emergency surgery. DHB Hospital Benchmark Information quarterly report collects data on hospitals more broadly.	NECPOD collect clinical and operational performance measures. TARN collect clinical indicators related to trauma. NHS collects generic performance data.	Performance data is often commercial-in-confidence. Examples of indicators include wait times, readmission, cancelled electives, morbidity/ mortality.
Does emergency surgery performance affect funding?	Funding is provided by provincial government and has varying conditions attached.	*Information not available at time of writing.*	Not specifically – funding is tied to elective surgery.	Performance in the UK is tied to funding, but KPIs do not specifically target emergency surgery.	*Information not available at time of writing.*

2.2 International funding models

In order to provide some context to the health care funding environment that exists in each jurisdiction, an analysis of sources of health care reimbursement is provided in Figure 2. This figure depicts the percentage of health care that is funded by public sources (taxes or social security/ insurance) and private sources (household out-of-pocket expenses or private insurance) (World Health Organization 2009).

Figure 2: Sources of health care reimbursement in Australia and five international jurisdictions (2006)



Adapted from WHO 2009

3 Operational management of emergency surgery

The review of relevant literature has highlighted five key challenges in relation to the operational management of emergency surgery. This section focuses upon these challenges in order to provide insights into how health systems in Australia and abroad have responded to them. The structure of this section has been developed around these five challenges:

1 **How can health services plan for emergency surgery?** Despite emergency surgery being essentially unplanned, it is recognised that it is possible to track and predict emergency surgery demand. A better understanding of emergency surgery demand facilitates resource allocation and allows for more accurate planning to ensure the future supply of emergency surgical services will be sufficient.

2 **How can elective and emergency surgery demand be balanced?** The literature presents a range of strategies for overcoming this challenge, however, these can be summarised into variations on the following four themes:

- using dedicated emergency surgery lists or theatres
- reserving capacity in elective surgery lists to allow flexibility in the schedule for expected emergency cases
- balancing in-hours and out-of-hours work by using twilight lists or out-of-hours operating theatre sessions for emergency surgery
- clearly separating elective and emergency surgery resources to reduce the impact that emergency cases have upon elective sessions (and vice versa).

Considerations of patient scheduling strategies and patient booking systems are also relevant to the management of emergency and elective surgery demand.

3 **What role should surgeons play in operational management of emergency surgery?** There is growing evidence highlighting the benefits of consultant-led emergency surgical care. This refers not only to consultant-surgeon involvement in the operating theatre, but also to the value of consultant-surgeon involvement in the diagnosis of patients, and the provision of clinical leadership across a specialty or facility in a broader sense.

4 **How should patients be prioritised?** There is little consensus with regard to patient priority – and while some advocate for standardised categories of clinical urgency, others dispute the practicality of such standards. Notwithstanding, there is recognition of the importance of robust patient priority decision making models that include an effective system for communicating decisions between relevant stakeholders.

5 **How can efficiencies be gained in the emergency surgery operating suite?** Given that a more efficient emergency surgery operating model can potentially allow more patients to be treated within a given timeframe, there is some research that focuses on how to achieve operational efficiencies and assesses the value of doing so. While the weight of the literature is focused on elective surgery there are similar studies revealing benefits to emergency surgery efficiency. This relates particularly to decreasing turnaround times, minimising patient length of stay, creating more efficient logistical arrangements, and re-designing hospital infrastructure.

3.1 How can health services plan for emergency surgery?

There is growing momentum in the global health care community to utilise an expanding range of sophisticated planning and management decision-support tools. These tools are often based on learnings from other industries and focus on the effective allocation of valuable resources to meet an increasing demand for health care.

A sound understanding of the dynamic between the demand for and supply of emergency surgical services can contribute to this objective. The following paragraphs explore several perspectives on how to track emergency surgery demand and allocate resources accordingly. The importance of ensuring that sufficient capacity is developed to meet future demands for emergency surgery is also highlighted.

3.1.1 Tracking emergency surgery demand

The recent Emergency Surgery Workshop hosted by the Royal Australasian College of Surgeons noted that one of the principles of emergency surgery that must be understood is 'that emergency surgery demand can be measured, predicted and planned for, and that resources should be allocated accordingly' (RACS 2009a).

Emergency surgery, as defined previously, is predominantly unplanned in nature. However, this natural (uncontrollable) variability is largely predictable. This does not mean that it is possible to accurately predict the precise volume or complexity of cases that will present at a hospital by hour of the day. Rather, it recognises the growing acceptance that the volume and variability in emergency surgery demand can be measured and predicted.

Once an understanding of the predicted volume and variability in demand is established, it becomes possible to allocate resources to the predicted volume and plan for the management of spikes in demand. This data can assist to further define emergency surgery into categories of planned and unplanned emergencies, which can facilitate theatre scheduling and allocation of resources. The concept of measuring the 'generally predictable workload' was one of the key principles identified in the 2009 NSW Health *Emergency surgery guidelines* (NSW Health 2009). These guidelines represent the position of a body of clinical experts in NSW. They state that an estimation of emergency surgery demand by specialty at area health service and facility levels is a necessary first step in operational reconfiguration.

Tracking emergency surgery demand by specialty can provide insight into the selection of optimal operating models for individual facilities. In addition, demand analysis can be used to identify trends that can further inform projections and planning for services. This information can assist in decisions relating to:

- which specialties require dedicated emergency surgery lists
- when lists should be scheduled to address peaks in emergency surgery demand
- whether staffing numbers and rostering patterns are sufficient for particular specialties.

The type of data required to identify meaningful trends in emergency surgery demand include:

- volume and duration of cases by specialty
- volume of emergency surgery that is planned or unplanned (such as emergency neck of femur operations that are scheduled onto theatre lists)
- procedure type

- episode of care data (such as date/time of admission, date/time of surgery)
- demographic characteristics of patients
- demographic characteristics of relevant geographic population.

This data will help identify correlations between demographic characteristics, rates of emergency surgery demand and types of procedures. Analysis of this type can help plan for future shifts in emergency surgery demand based on demographic trends.

Although measuring demand is valuable for the reasons outlined above, this literature review has identified a gap in published analyses of trends in emergency surgery demand. In Australia, elective surgery demand and emergency department demand is measured by the Australian Institute for Health and Welfare (AIHW) and the Australian Bureau of Statistics (ABS), yet emergency surgery demand is not specifically analysed (AIHW 2008b). The lack of available literature does not mean that emergency surgery demand is not measured at all. This data is captured by some hospitals for internal management purposes. However, inconsistent definitions of emergency surgery mean that data collected by different hospitals is not always comparable or meaningful in an aggregated form. In order to gain a true picture of emergency surgery demand in a given geographic area, it is important to apply the same definition of emergency surgery to capture consistent and comparable data. To date, this kind of data collection and analysis has not been used in Australia to measure changes in emergency surgery demand specifically.

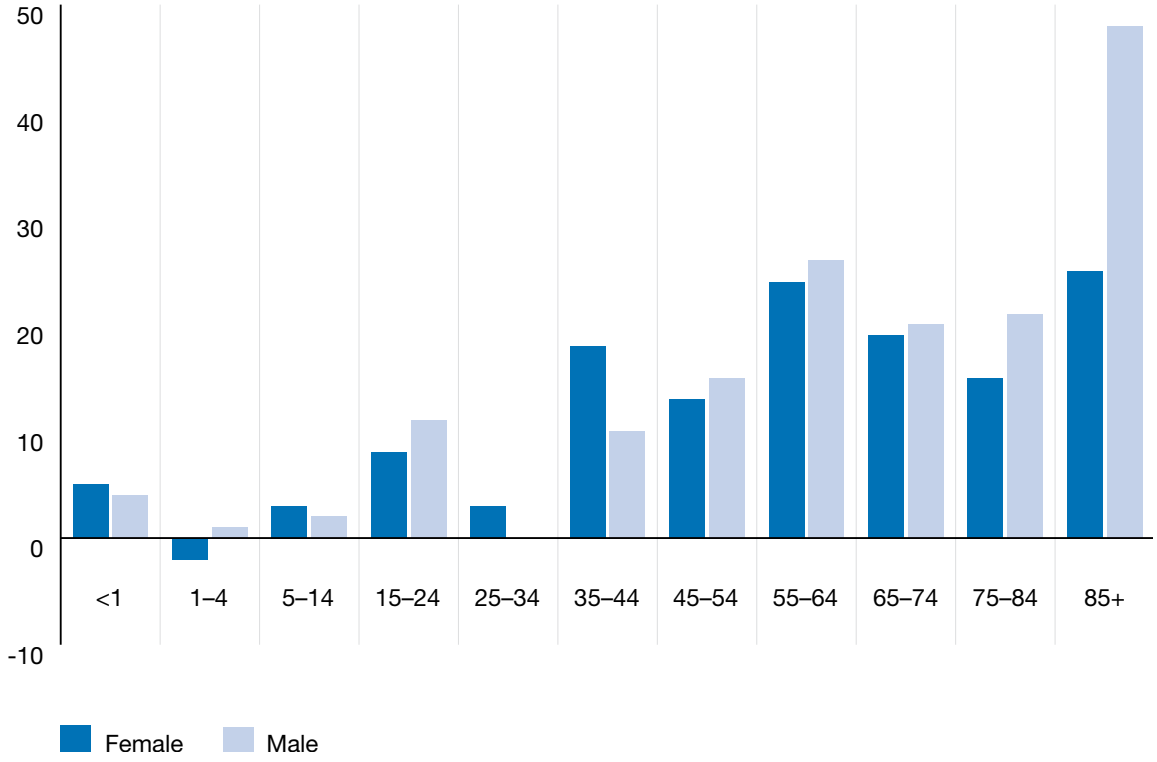
Regardless, some related evidence in the literature does lead to the conclusion that emergency surgery demand is indeed growing, and is likely to continue to do so in future. First, the trauma surgery caseload is steadily increasing. The Victorian State Trauma Registry measured a 35 per cent increase in the number of hospitalised major trauma patients in Victoria over a five-year period, with an annual rate of 30 incidents per 100,000 population in 2001–02, and 46 incidents per 100,000 population in 2006–07 (Department of Human Services 2009). These statistics were supported by data collected by The Royal Melbourne Hospital, a level 1 trauma centre. The Royal Melbourne reported a 36 per cent increase in trauma volume over a four-year period, with 2,201 patients recorded in 2005–06 and 2,985 patients recorded in 2008–09 (Melbourne Health 2009). Although trauma forms just one component of the emergency surgery caseload, this data may provide some insights into trends in the broader emergency surgery demand.

Second, Australia's population is growing. The ABS recorded a 2.1 per cent population growth during the 12 months that ended 30 June 2009 (ABS 2009). In the decade preceding June 2009, Australia's population grew by 15 per cent (ABS 1999). The ABS expects that this growth will continue, and has predicted that the population will grow from 22.1 million in 2010 to between 30.9 and 42.5 million people by 2056 (ABS 2008). An increasing population will cause an increased demand for all health services, including emergency surgery.

Third, this growing population is also ageing. It is expected that, driven by long-term declines in fertility and increased longevity, one-quarter of Australians will be aged 65 years or more by 2045 (Productivity Commission 2005). The ageing population will have a significant impact upon demand for health care, which will have a corresponding impact upon demand for emergency surgery. This is demonstrated by an AIHW analysis of public hospital separations between 2003–04 and 2007–08, presented in Figure 3 (AIHW 2008a). The study shows an increase in public hospital separations of all age groups, with the most significant increases occurring in the population that is aged 55 and above. Most notably, separations increased by 24.2 per cent for females aged 55–64 years and by 47.6 per cent for males aged 85 years and above. Although the AIHW does not directly comment

on emergency surgical volumes, a portion of these hospital separations include emergency surgical patients. The ageing population is therefore likely to contribute to increased demand for emergency surgical care. This trend will have a particular impact on demand for procedures that are typically required by patients aged 65 and above, such as femoral neck fractures (Shaw & Anderson 1999).

Figure 3: Separations per 1,000 population, by age group and sex, Australia, 2007–08



Source: AIHW 2008a

Fourth, advances in medical technology are enabling surgical intervention in cases that may have previously been considered futile (Coddington, Moore & Stephens 2003). This has been noted by both the Australian Productivity Commission and the Australian National Health Workforce Taskforce (Productivity Commission 2005). Both groups conducted empirically based studies on the impact of increasing demand for health services on health workforce planning. Technological advances are expected to increase the scope of cases that are eligible for surgery, which would have a corresponding increase in volume of emergency surgical cases.

Thus, although emergency surgery demand has not been specifically analysed in the literature, there is sufficient evidence to conclude that emergency surgery demand in Australia will continue to grow. However, a more deliberate collection and analysis of emergency surgery data over time would indeed provide a more rigorous set of evidence in support of this conclusion.

3.1.2 Developing the capacity to meet increases in demand

At a facility level, operating models, rosters and theatre templates can be adjusted to accommodate changes in emergency surgery demand to an extent. However, this is constrained by infrastructure and resourcing limitations that arise once a hospital that functions efficiently has reached full resource utilisation rates (for example, in relation to bed, theatre and staff resources). Not all facilities will have access to the necessary resources and space to allow for hospital expansion. Furthermore, the decision to invest in increasing emergency surgical services will inevitably be influenced by competing priorities for capacity development, such as investment in IT, nursing and staff salaries, and medical technology (Productivity Commission 2005). There are therefore limitations on the extent to which individual facilities are able to increase the supply of emergency surgical service to match increasing demand.

At a jurisdictional level, emergency surgery reform and redesign can assist to increase the capacity of emergency surgical services. NSW Health presents one approach to emergency surgery redesign in their 2009 *Emergency surgery guidelines* (NSW Health 2009). These guidelines highlight the potential for more innovative thought around developing the capacity of emergency surgical services, such as the concept of acute hospitals dedicated solely to the provision of emergency services. In considering the NSW guidelines, however, it is important to note differences between the Victorian and NSW health systems that may affect applicability. For example, NSW Health advocates health service role delineation, specialisation and centralisation of emergency surgery, which may not be applicable in the Victorian jurisdiction.

It is clear that analysis of trends in emergency surgery demand can provide an important input into forward planning. Where planning and investment is required, such as in the expansion of theatre resources, decisions should be clearly informed by demand. These decisions should not only take consideration of current emergency surgery demand, but also ensure that sufficient flexibility for expansion is incorporated in new developments to accommodate the potential for future increases in demand (NSW Health 2009). In addition, facilities should be designed to accommodate the most efficient models of care

3.1.3 Is all emergency surgery justified?

The literature provides some discussion around the controversial concept of futile care in the management of severely injured patients. The term ‘futile’ is both a technical and ethical term (Brooks, Davies & Richardson 2004). Due to the ethical concerns that are inherent within this debate, the literature exploring this topic is inconclusive and there is a clear absence of consensus. However, these discussions do pose the question of whether guidelines around futile care can or should be developed.

The literature demonstrates that comparatively poor outcomes have been recorded in patients that present in extremis, which is defined as being ‘at the point of death’ (Brooks, Davies & Richardson 2004). Rhee, Acosta & Bridgeman (2000) reviewed 4,620 cases of emergency room thoracotomy (ERT) for trauma from the literature over the past 25 years. The overall survival for penetrating injuries without signs of life was 8.8 per cent, yet survival of blunt trauma was only 1.4 per cent. In the UK, Lockey, Davies and Coates (2001) found that the ability to intubate a trauma patient on scene without anaesthetic drugs can provide a pre-hospital indicator of futility. This was demonstrated in a study of 1480 patients that produced only one survivor (0.2 per cent) who had sustained a penetrating heart injury (Lockey, Davies & Coates 2001). Yet, despite he comparatively poor

outcomes described in much of the literature, surgeons and physicians frequently attempt to save lives in futile circumstances (Brooks, Davies & Richardson 2004) – and many would argue that they should do so, regardless of the statistical chances.

Although the literature does not resolve the debate around the concept of futile surgery, it does raise many questions. Namely, is all emergency surgery justified? If not, when is emergency surgery unjustified? Who should make the decision for surgical intervention in cases where there is a low chance of survival – clinical specialists or the family of the patient? Should guidelines be developed to support decision-makers? How much emergency surgery being undertaken in Victoria could be defined as 'futile'?

These are difficult and controversial questions to which there is no simple answer. However, further consideration of this concept may be relevant to Victoria as it responds to increases in emergency surgical demand.

3.2 How can elective and emergency surgery demand be balanced?

A recurring theme in the literature relating to emergency surgery scheduling is the question of how to manage competing demands for elective and emergency surgery. Although the definitions of emergency and elective surgery vary (as discussed in section 1.4), and there is some intersection between the two, each patient group can broadly be typified by the following characteristics: elective cases can be delayed and planned for the future; emergency cases require immediate or urgent surgical intervention; and the patient's initial presentation with a condition is generally unplanned (Lamiri et al. 2008). In most hospitals, both elective and emergency caseloads are serviced by the same operating theatres, surgeons and teams (Lamiri, Grimaud & Xie 2009). In these scenarios, emergency and elective surgery are often inherently linked in spite of the differences between the patient caseloads.

In order to deliver an effective emergency surgical service with minimal impact upon elective surgery, the following broad aims of surgical scheduling should be considered.

- The clinical urgency of each case should be reflected by the order of patients on the waiting list, with priority given to more urgent cases.
- Cancellation of elective cases should be minimised.
- Limited resources should be managed efficiently to minimise non-operative time, including the physical operating theatre space, associated infrastructure and equipment, and the emergency surgical workforce.
- Surgical rosters must take into account both elective and emergency commitments.
- Out-of-hours work should be limited to comply with safe working hours standards; at the same time, an after-hours service should still be available to respond to emergency cases that present during this period.
- Adequate standards of supervision should be provided for junior registrars both in- and out-of-hours.

This list is by no means exhaustive but provides some indication of the myriad challenges associated with scheduling emergency surgery without interrupting pre-booked surgical cases.

The literature has presented a range of different perspectives on how to best to respond to these challenges, which generally relate to four central themes:

- using dedicated emergency surgery lists or theatres
- reserving capacity in elective surgery lists to allow flexibility in the schedule to meet emergency surgery demand
- balancing in-hours and out-of-hours work by using twilight lists or out-of-hours operating theatre sessions for emergency surgery
- clearly separating elective and emergency surgery resources to reduce the impact that emergency cases have upon elective cases.

These options are explored in detail in the remainder of this section. In addition, other considerations for patient scheduling and the use of booking systems are discussed.

3.2.1 Dedicated emergency surgery operating theatres and lists

One strategy for managing the balance between elective and emergency surgery is to dedicate operating theatres or lists to emergency surgery cases. In the UK, dedicated emergency surgery theatre lists during normal work hours were introduced in the early 1990s as a recommendation emerging from the UK Confidential Enquiry into Perioperative Deaths (NCEPOD) (2009). It was recommended that dedicated emergency theatre lists should be available at all times of the day to ensure that each hospital had the capacity to respond to emergency surgery cases (NCEPOD 2009). Some hospitals with high emergency surgery caseloads require a regularly scheduled dedicated emergency surgery operating theatre or list in order to meet their emergency surgery demand. By specifically quarantining resources for emergency surgery, the impact of these cases upon elective surgery schedules is reduced.

However, it is also important to balance the availability of dedicated emergency surgery operating lists with the potential for wasted resources, particularly in smaller hospitals that may not have the volume of emergency surgery cases to justify the use of dedicated lists and theatres. If hospitals with a lower emergency surgery caseload were to adopt this strategy, resources may remain idle for unacceptable periods as the dedicated emergency lists would not always be filled (Wullink et al. 2007). This would represent unnecessary cost to the hospital and may also reduce the potential for elective throughput, considering that one or more operating theatres or lists would be excluded from use for elective cases (Trompetas et al. 2008). In such circumstances, half-day emergency surgery lists may be a more appropriate solution to address lower levels of emergency surgery demand (Trompetas et al. 2008). Morning half-day emergency lists are also a useful way of addressing emergency surgery case backlogs that accumulate, particularly for surgeons that had on-call duties the previous night.

The key benefit of adopting dedicated emergency surgery operating theatres (or half/full-day lists) is that they increase the accessibility of emergency surgery by ensuring that resources are not being used for elective cases when an emergency surgical intervention is required. At the same time, allocated emergency surgery resources should reduce the interruptions to elective lists caused by emergency cases, and thereby decrease the cancellation of elective patients. The Santa Clara Valley Medical Centre in the US provides one example of a model of care that includes lists dedicated to emergency surgery.

Dedicated emergency and elective theatre time: Santa Clara Valley Medical Centre, US

At Santa Clara Valley Medical Centre (SCVMC), a dedicated on-call surgical Attending of the week (AOW) is responsible for all emergency general surgical patients admitted in the seven-day call cycle. The AOW responds to all major trauma activations in daytime hours. Night time trauma services are provided by a call pool consisting of full-time trauma surgeons and community and military surgeons. The full-time trauma surgeons maintain an elective surgery practice of one to two half days of outpatient clinic and at least one designated block of time for elective cases. An elective block of time is maintained for the AOW for urgent cases that do not need to be done at night and an urgent operating room is used on a first come, first served basis. Of the 2,276 surgical cases completed between 1 January 2005 and 31 December 2005, 65 per cent were elective; 32 per cent were emergency/urgent general surgery; and 4 per cent were emergency trauma surgery.

A more detailed case study is presented in Appendix 1.

Adapted from Garland et al. 2007

Although dedicated emergency surgery theatres and lists are conceptually sound, in practice often emergency surgery cases still 'bump' elective cases on elective lists, and elective cases will often be scheduled on underutilised emergency surgery lists. Truskett's (2009) presentation to the RACS 2009 Emergency Surgery Workshop on the Prince of Wales Hospital theatre utilisation demonstrates this dynamic. Truskett reported that between January and December 2004, elective theatres were utilised for emergency cases and vice versa, despite having dedicated emergency lists. Wullink et al. (2000) argue that such flexibility in theatre schedules is necessary – without it, emergency surgery cases may be forced to wait for available operating theatre resources if dedicated emergency surgery theatres and lists are already occupied. This is particularly problematic for less urgent emergency surgery cases that are inevitably put on hold for more time critical emergency cases.

Furthermore, if dedicated emergency surgery theatres are underutilised it is common practice to reassign staff to elective operating theatres to deal with temporary staff shortages, rather than have them wait idle (Lamiri, Grimaud & Xie 2009). In so doing, the purpose of dedicating theatres to emergency surgery may be defeated because a full team will not be available when an emergency patient arrives (Wullink et al. 2007). The patient will therefore have to wait until the team is available, which may not be until an ongoing elective case is completed.

A key question that underpins this model of care is how to determine what level of demand is required before dedicated emergency theatre time or lists should be introduced. The literature does not identify any clear guidelines that are based on practical evidence. It is a question that will require further analysis and investigation of data, which should monitor performance both before and after facilities have established dedicated emergency surgery lists. The examination of this empirical data will provide some insights into what threshold of emergency surgery activity justifies the introduction of emergency surgery lists.

Another relevant topic is the concept of dedicating lists for surgical specialties that receive consistent demand for emergency surgery. In this way, it would be possible to plan for more predictable emergency surgery caseloads using dedicated lists that are specialty specific. For example, in facilities with a high volume of orthopaedic trauma cases it may be appropriate to introduce an orthopaedic trauma list; while in facilities with a high volume of neurosurgical cases, it may be appropriate to establish a neurosurgery list. The literature does not identify what level of demand is required before this model of care should be introduced, whether it is in a general

or specialty-specific capacity. Evidently, it is important to analyse the emergency surgery demand at each facility in order to inform this decision.

The literature on dedicated emergency surgery theatres or lists therefore presents a range of perspectives. The concept is upheld as a useful way of separating emergency and elective caseloads and ensuring each group of patients has access to the operating theatre and resources (NCEPOD 2009). However, critics note that it is not always practically possible to do this without a true physical separation of elective and emergency theatre facilities (Wullink et al. 2007).

3.2.2 Flexibility in elective surgery lists for emergency cases

An alternative to using dedicated emergency surgery theatres or lists has been put forward by Wullink et al. (2007) based on a discrete event simulation study conducted at a large teaching hospital in the Netherlands. Two protocols for reserving operating room capacity for emergency surgery patients were compared. The first protocol used dedicated emergency surgery theatres, while the second protocol reserved capacity on elective surgery theatre lists for emergency cases.

The study showed that the distribution of unallocated capacity for emergency surgery evenly over all elective operating theatre lists performs better than dedicated emergency surgery operating theatres or lists, based on measures of the quality of patient care, staff satisfaction, and cost-effectiveness (Wullink et al. 2007). The simulation model provided theoretical evidence that using a dedicated emergency operating theatre did not reduce patient wait times as much as having additional capacity in elective surgery lists.

Apart from improved performance, reserving capacity for emergency surgery in elective surgery lists may have advantages for professional dynamics. Those clinical specialties that tend to have less acute cases experience more barriers in access to theatre time. Reserving time on every elective surgery list for each specialty ensures better access for all specialties (Wullink et al. 2007).

The challenge for each hospital (and indeed each specialty and/or surgeon) is to determine how much time to allow for emergency cases on their elective lists. This should be informed by analysis of their specific urgency and volume of their casemix. Lamiri et al. (2008) have also undertaken two consecutive studies using stochastic models to assist with operating room planning for elective and emergency surgery demand. In these studies, several optimisation methods are proposed and evaluated. These models may be adapted to take into account both over-utilisation and under-utilisation costs, which are central considerations to operating theatre planning (Lamiri et al. 2008).

Simulation studies can assist hospitals to balance their resources more efficiently by providing an insight into potential outcomes of this approach. However, they do not take into account real world constraints such as limited overtime capacity, assignment of patient to operating rooms (Lamiri et al. 2008), and different types of operating rooms.

Although results from real-world examples of this type of approach are not common in the published literature these models may currently be functioning in some capacity. An example from Hunter New England Area Health Service (HNEAHS) in NSW showcases the approach, if not the complete evaluation of implementation and results. As part of a clinical redesign initiative in 2007 HNEAHS developed ‘advance booking profiles’ to assist management in working with surgeons to plan theatre lists up to three months in advance. This approach required analysis of each surgeon’s urgency casemix to determine required ‘white space’ to be quarantined for the last week of booking to accommodate emergency cases. The profile continued further in analysis of elective urgency

casemix and the amount of theatre time required to accommodate category 1 patients (one month in advance) and the remaining time available for bookings of lesser urgency greater than one month in advance. In this way, booking rules were established for time periods of one week prior to operating theatre date, 2–4 weeks prior to operating theatre date, and 5–12 weeks prior to operating theatre date. This ensured reserve time on elective lists for emergency cases that arose in the week prior to operating theatre date. Although this model has been used to some extent at HNEAHS, literature has not yet been published on it.

Regardless of the specifics of the approach, it is clear that robust data analysis of urgency casemix is of critical importance in gaining the support of clinical staff and improving the capacity to plan for emergency demand on elective lists.

3.2.3 In-hours and out-of-hours schedules

Most hospitals that provide an emergency surgery service are organised to perform after-hours surgery for 'true' emergency patients – that is, where delays are judged to put life, limb or organ at risk. In addition, many hospitals perform emergency surgery out-of-hours in an effort to reduce the impact of emergency cases on scheduled elective cases, particularly when in-hours resources are fully utilised. The literature generally defines 'out-of-hours' to be the period between 6 pm to 8 am weeknights and all day during the weekend. However, in practice this definition does vary depending on the management practices at individual hospitals. A survey of surgeons and anaesthetists in the UK by the NCEPOD found that most respondents considered the 6 pm to 8 am definition of out-of-hours to be too restrictive – the working day for emergency surgery staff regularly extends after 6 pm in order to meet caseload demands (National Confidential Enquiry into Perioperative Deaths 2003).

Conducting emergency surgery after 6 pm is widely regarded as providing an alternative to cancelling elective lists when emergency surgery demand is too great (Parasyn et al. 2009). Some hospitals have scheduled 'evening lists' or 'twilight lists' to increase surgical capacity within fixed resources and accommodate the demand for emergency surgery cases. For example, the Eastbourne District Hospital in the UK schedules an evening list between 6 and 11 pm (Rowe, Lawrence & Fellows 2003). Certainly evening emergency surgery lists can reduce elective surgery cancellations and offer an option for surgeons to manage their competing priorities for elective and emergency surgery.

However, out-of-hours emergency surgery is often associated with higher costs to the facility for a variety of operating costs, including the need to provide sufficient incentives to encourage staff to work during socially disruptive hours (Van Oostrum et al. 2008). To facilitate hospitals with planning their optimal after-hours workforce, Van Oostrum et al. (2008) developed a simulation model at the Erasmus University Medical Centre. This study examined the balance between hospital costs and patient safety to determine the optimal size of emergency surgery teams that are on-call after-hours, including medical and nursing staff. The study found that the use of defined procedure-based safety intervals to plan on-call rosters can reduce the number of staff rostered on-call without jeopardising patient safety (Van Oostrum et al. 2008). The key premise of this argument is that fewer nighttime staff will be sufficient if patients wait a little longer for surgery, but not so long as to exceed safety intervals.

The concept of developing a list of procedures that should be undertaken at night is appealing because it can provide hospitals with some control over out-of-hours operating costs by limiting the number of procedures undertaken during this time period. However, the approach has not been the

subject of extensive empirical investigation or discussion in the literature. Van Oostrum et al. do not stipulate which procedures should take place at night. Instead of an empirical basis for listing specific procedures for out-of-hours surgery, clinicians in Van Oostrum et al.'s study, clinical judgement was the basis of decisions about whether cases could fit into safety intervals of less than 30 minutes, less than 90 minutes, less than three hours and less than eight hours. More recently, a suggested list of nighttime procedures was published in the UK by Faiz et al. (2007). This study presented a list of nighttime procedures that was developed at the London Teaching Centre using the revised NCEPOD classification system, which is depicted in Table 3. These guidelines reflect clinical judgements and are based on informed opinion. The authors advocate the guidelines as a starting point, with a recommendation for further and more rigorous empirical underpinnings.

Table 3: Guidelines for surgical procedures (excluding obstetrics) to be performed at night at the London Teaching Centre

Category	Specialty	Procedure
Immediate	Vascular	* Ruptured AAA
	Trauma	* Major trauma to thorax/abdomen with haemodynamic compromise
	Urology	* Suspected testicular torsion
Urgent	Abdomen	* Perforated viscus * Penetrating abdominal injuries * Peritonitis * Gastrointestinal haemorrhage with haemodynamic compromise * Intestinal obstruction with possible bowel infarction * Strangulated hernia * Acute appendicitis (especially in children and elderly)
	Vascular	* Critical limb ischaemia
	Orthopaedics	* Fracture with major neurovascular deficit * Compartment syndrome * Compound fracture

Source: Faiz et al. 2007

Balanced against the operational needs for capacity that might be provided by out of hours surgery, is the potential impact of working in unsafe hours. In fact, so-called 'out-of-hours' surgery often involved unsafe working hours, bringing with them the well documented risks to performance of the surgical team, and the quality of patient care provided (Fitzgerald, Lum & Dadich 2006; Lum & Fitzgerald 2007). The impacts of unsafe working hours are well documented in many work settings – laboratory and real world (Rosekind et al. 1996). First, undertaking work between midnight and dawn, when the human body's normal circadian rhythm is at its lowest ebb, and is physiologically and psychologically programmed for sleep, has clearly been demonstrated to uniformly result in decrements in performance across a wide range of tasks (Foster & Wulff 2005; Landrigan et al. 2007). Second, disruptions to circadian rhythms, that is wakefulness at times when the body is biologically programmed for sleep, and conversely obtaining sleep when the body is programmed for

alertness, have a significant impact on the quantity and quality of sleep. Third, a lack of sleep per se, is well documented in terms of impact on performance in many work settings (Dinges et al. 1997). More recently, the impact of restricted sleep opportunity on physician performance has been reported, with an increased rate of complications among post-nighttime surgical procedures performed by physicians with sleep opportunities of less than six hours reported (Rothschild et al. 2009). Finally, the cumulative increase in risk presented by prolonged work hours, work hours that occur at biologically inappropriate times, and the restricted sleep that is often associated with such work patterns has also been documented. There is a large body of replicated laboratory data showing, beyond a doubt, that fatigue impairs human performance. The effect of sleep deprivation on a range of cognitive and motor tasks has been shown to be equivalent to the effect of alcohol intoxication; performance after 24 hours of sustained wakefulness was equivalent to the performance with a blood alcohol concentration of 0.10 per cent, and equivalent to Australian legally proscribed levels well before 24 hours of wakefulness (Arnedt et al. 2001; Dawson & Reid 1997; Williamson & Feyer 2000). Operational research, specifically documenting the impact of working hours on surgical performance, is more limited.

In recognition of the potentially serious consequences due to fatigue, many standards and guidelines relating to safe working hours have been published in Australia and internationally. The RACS standards present key recommendations around safe working hours to inform emergency surgery schedules (Arnedt et al. 2001; Dawson & Reid 1997; Williamson & Feyer 2000).These standards incorporate some of the findings from the RACS Divisional Group of Rural Surgery, which identified that continuous working periods greater than 14 hours and a lack of sufficient breaks during and between periods will increase the risk of fatigue and fatigue-related errors (Divisional Group of Rural Surgeons of the Royal Australasian College of Surgeons 2005). RACS found that surgeons and registrars are at particularly high risk of fatigue, working an average of 85 hours per week – 97 per cent of surgical registrars in Australia fall into this group (RACS 2007). In order to assist hospitals and staff to measure the risks associated with their work hours, the Australian Medical Association published guidelines around safe working hours for doctors working in hospitals that incorporates a risk assessment checklist for surgeons (Australian Medical Association 2005).

The safe hours standards that exist in Australia reflect those that have emerged internationally. In the US, the Institute of Medicine published a report entitled *Resident duty hours: enhancing sleep, supervision, safety* (Ulmer, Miller & Johns 2008). This was followed by the 2003 Accreditation Council on Graduate Medical Education *Work hours duty policy*, which limited resident hours in the US to 80 hours per week (Basu et al. 2004). Similarly, the European Parliament and Council released a directive that limited the weekly hours of work for doctors in training (Directive 2000/34/Ec of the European Parliament and Council 2001.)

The concept of safe working hours is integral to the in-hours/out-of-hours debate. The evidence is clear: prolonged hours of work and night work carry a greater risk of undermining surgical performance. Fatigue increases the risk of serious errors that can lead to death or serious morbidity is substantial (RACS 2007). Quite apart from errors, the performance decrements due to fatigue are also likely to undermine the learning ability of junior staff, which is a particular concern for the ongoing education of the emergency workforce (RACS 2007). Increasingly historical perspectives are being recognised as untenable: a limitless work week is far from optimal for patient care, experienced attending physicians (and indeed the entire surgical team) are not better able to cope with the effects of sleep deprivation than other workforces, nor is the surgical environment sufficiently

different from other environments so as to make findings from them not directly applicable (Feyer 2000; Gaba & Howard 2002; Hyman 2009; Rothschild et al. 2009).

Taken together, the evidence indicates that, in principle, it is reasonably well accepted that necessary out-of-hours emergency surgery must be balanced by safe working hours. Operational strategies to manage this balance remain to be fully refined.

3.2.4 Separation of emergency and elective surgery

The fourth option for balancing elective and emergency surgery presented in the literature is through the physical separation of the two caseloads. This option is referred to by the Association of Surgeons of Great Britain and Ireland (ASGBI), who assert that there must be a clear and identifiable separation of delivery of emergency and elective care in order to manage this balance (ASGBI 2009). According to ASGBI, the benefits of adopting this strategy include more dedicated management of each case group and improvements in clinical care, training and education (ASGBI 2009).

This stance has been reiterated in the NSW Health *Emergency surgery guidelines*, where one of the key recommendations is the 'designation of hospitals for either elective or emergency surgery or for specific components of both' (NSW Health 2009). It was also included in the proceedings of the 2009 Royal Australasian College of Surgeons Emergency Surgery elective surgery (RACS 2009a). Furthermore, recommendation 1.173(a) in the Garling report (on the NSW public hospital system) is for 'the separation by facility, or operating list or otherwise, of planned or elective surgery from emergency or urgent unplanned surgery' (Garling 2008).

However, the literature advocating the separation of elective and emergency surgery mentioned above is based predominately on collective expert opinions. Empirical studies of the effectiveness of this strategy have yet to be undertaken. Further research would therefore be useful to determine whether this strategy is practically viable and effective. It is possible that empirical studies will be published in future based on the experiences of hospitals that have introduced a separation of emergency and elective surgery in recent years.

Some of the hospitals that have implemented this approach include The Alfred hospital and the Austin Hospital in Victoria. The Alfred hospital established the Alfred Centre in 2007, which is a separate theatre suite used to treat elective surgery patients that is connected to the main hospital campus via a walkway. A slightly different model has been used by the Austin, which has dedicated one of its two hospital campuses to elective surgery only.

In the US, the Vanderbilt University Medical Centre in Tennessee has a division of trauma and critical care that is dedicated to emergency surgery patients. This division includes a multidisciplinary surgical critical care (MDSCC) service and an emergency general surgery (EGS) service (Vanderbilt Medical Center and Vanderbilt University 2009). A 21-bed surgical intensive care unit is incorporated into the MDSCC, which serves a diverse group of patients including critically ill general, vascular, oncologic, transplant, thoracic, orthopaedic, plastic, urologic, and head and neck surgical patients. The EGS aims to provide timely surgical assessment and operative management of the patient with an acute general surgical problem all within the one unit.

The separation of elective and emergency surgery is a relatively new model that has not yet been subject to widespread implementation or evaluation. Further investigation of data captured by hospitals that have adopted this approach would provide a better understanding of the practical outcomes it is likely to generate.

3.2.5 Patient scheduling considerations

The four different strategies for balancing elective and emergency surgery outlined above all encounter similar issues when it comes to developing theatre schedules. The scheduling of emergency surgery patients has received minimal attention in the literature to date (Fitzgerald, Lum & Dadich 2006). The literature that does exist specifically highlights the fact that research into this topic remains underdeveloped. In the UK, Hadley and Forster (1993) identified that operating theatre lists are typically scheduled in an unplanned manner. In the US it has also been noted that emergency surgery patient schedules that have been established are seldom observed (Ferrera et al. 2001).

This gap in the literature can be attributed to the fact that most emergency surgery cases cannot be scheduled in advance in the same way that elective surgery cases can. However, there is often some capacity to schedule less urgent emergency cases. Furthermore, inefficient scheduling of elective cases can reduce the access to operating resources for emergency surgery cases. This is particularly the case if time is reserved in elective surgery lists for emergency surgery patients. Patient scheduling considerations are therefore relevant to emergency surgery.

A key limitation around scheduling for theatres is the need for estimates of case duration. Case duration estimates are generally not accurate reflections of the actual length of time each case requires (Olmstead et al. 2007; Jones & McCullough 2007; Lebowitz 2003a, b). The reason for this inaccuracy is three-fold. First, most hospitals do not have sufficient historical data that captures reliable indications of procedure durations by each surgeon (Lebowitz 2003a). Lebowtiz (2003a) points out that this is partly because data collection systems do not capture this information, but also because hospitals perform such a variety of surgical procedures that a particular surgeon/procedure combination is not frequently repeated. Second, there are inherent variations to the length of time taken to perform each surgical procedure, even by the same surgeon (Lebowitz 2003a, b). Third, where surgeon estimates are relied upon to determine the time required for specific procedures, according to Jones and McCullogh (2007), estimations will often be ‘compressed’ in order to book more cases into the schedule.

The tendency for over-scheduling lists beyond hospital capacity remains a concern, as it undermines the capacity of management staff to plan for emergency and elective surgery caseloads (Jones & McCullough 2007). If elective surgery times are not scheduled effectively and cases overrun their allocated time slot, this can have a negative impact upon emergency surgery lists and vice versa. One initiative to address this has emerged from a study in the Netherlands that suggests incorporating planned slack into theatre schedules to ensure ‘robust surgery loading’ (Hans et al. 2008). This approach involves determining the amount of time that theatre lists typically overrun and then reducing the available list capacity in order to accommodate this overrun. For example, a list would be booked at 90 per cent capacity instead of 100 per cent capacity. This strategy can also be combined with the option of reserving capacity in elective lists for emergency cases outlined in section 3.2.2. For example, an elective list that is booked at 60 per cent capacity, with 30 per cent of the time reserved for potential emergency surgery cases, and 10 per cent to accommodate case overruns.

Although these studies are in some ways more applicable to elective surgery caseloads, they also have implications for managing emergency surgery. This is particularly the case in hospitals that manage the elective and emergency surgery demand using shared resources.

3.2.6 Electronic theatre booking systems

Operating theatre booking systems have the potential to play an integral part of the dynamic between elective and emergency surgery, and form the basis for planning and communication relating to surgical scheduling. Nonetheless, minimal research investigated which booking systems are most effective. In practice, paper-based booking systems are gradually being replaced by electronic systems throughout the world. This indicates growing recognition that electronic systems deliver a range of benefits, such as real-time scheduling, increased transparency of patient bookings, better patient tracking systems to ensure timeliness of care, and a useful dataset (Gillies, unpublished; O'Leary 2008).

Two hospitals that have introduced emergency theatre booking systems (ETBS) in Victoria have reported positive outcomes but have not yet published literature presenting the empirical findings. These hospitals are The Royal Melbourne Hospital, which introduced an ETBS in February 2005, and the Austin Hospital (Gillies, unpublished; O'Leary 2008, Williams et al., unpublished). The Austin Hospital's ETBS was based on the technology developed by The Royal Melbourne Hospital and introduced in October 2007. Both hospitals found that the introduction of an ETBS improved communication by increasing visibility of the operating theatre schedule across different units. The ETBS also enabled better patient tracking and identification of patients that were in danger of not being treated within priority timeframes.

One of the key benefits provided by an electronic booking system is the extensive dataset that it collects, which facilitates performance monitoring and improvement. Using the ETBS, The Royal Melbourne Hospital collects data that show patterns in caseload demand, timeliness of care, and reasons for delay of surgery. ETBS data can be used to measure booking effectiveness, assisting hospitals to address operating scheduling inefficiencies. In addition, where booking systems are combined with operating theatre data it may be possible to analyse the interaction of scheduling and session variables (such as the effect of scheduling protocols on theatre utilisation). The data items that could be collected to show operating suite utilisation include in theatre time (such as anaesthetic start, surgical access, surgery finish, time into and out of the post-anaesthetic care unit) and reasons for delays in operating theatre time data (Williams et al., unpublished). Data from electronic booking systems can also be used to refine clinical pathways and monitor the quality of patient care (O'Leary 2008). Consistent with all time-related data entry it is essential that data collected by an ETBS is entered in a timely accurate manner so that it is reliable.

Hospitals that are considering introducing an ETBS have two options: to purchase 'off-the-shelf' solutions or to have software custom designed so that it can be integrated with the existing IT environment (Williams et al., unpublished). Off-the-shelf solutions tend to be less costly than custom-designed solutions. However, investment in a custom-designed ETBS has potential to deliver greater value if it is better able to communicate with existing IT platforms and software (such as existing operating theatre data systems). This can reduce staff frustrations and ensure that the system is more user friendly in practice.

The transition from a paper-based booking system to an ETBS can be challenging as staff adapt to the new technology. Despite this, reports from The Royal Melbourne Hospital show that staff are generally happy with the system, despite initial concerns (Gillies, unpublished). Some issues that do persist relate to IT systems issues or 'down times', communication issues with the anaesthetist that makes final decisions about patient priority, and the development of skills to use the new technology (Gillies, unpublished).

The Austin Hospital identified some key lessons from the process of introducing an ETBS that may be applicable to other hospitals in this position (O'Leary 2008). These include the need to: tailor the ETBS to each particular health service; engage key stakeholders and constantly revisit their needs to ensure that they are met; and have dedicated IT support, and executive/senior manager support.

The Royal Melbourne Hospital and the Austin Hospital are just two examples of ETBS being implemented in practice. Thus far there has not been much literature containing strong evidence published in relation to other examples, which is due to the fact that ETBS are a relatively new concept.

It is also worth noting that ETBS are for booking emergency surgery patients only. There has been little discussion in the literature of the potential for developing electronic booking systems that combine both elective and emergency surgery patients for hospitals that manage both caseloads using the same resources. This may provide an opportunity to better manage the balance between elective and emergency cases, and track the impact that each caseload has upon the other.

How can elective and emergency surgery demand be balanced?

One of the key challenges in managing emergency surgery is to minimise the impact that emergency surgery cases have on scheduled elective surgery cases. The literature highlights four principal strategies for balancing elective and emergency surgery demand.

First, the use of dedicated emergency surgery operating theatres and lists can ensure that both elective and emergency surgery cases have access to operating theatre resources. A flexible approach to scheduling is required to reflect this reality.

Second, capacity can be reserved on elective lists for the purpose of emergency surgery cases. Studies suggest that this strategy has potential to reduce patient wait times and improve staff satisfaction. It has also been shown to effectively distribute emergency surgery theatre time between clinical specialties.

Third, evening or twilight lists can be used to schedule emergency surgery cases instead of interrupting elective lists that have been planned in-hours. However, this option must be balanced with considerations of the additional costs associated with operating after hours, and the need to maintain safe working hours standards.

Fourth, emergency and elective surgery can be physically separated in order to more definitively quarantine resources for each caseload. Different models of implementation include: the dedication of different divisions or wings of the same hospital campus to each caseload; the use of separate hospital campuses for each caseload; or dedicating specific hospitals to the provision of services for either elective or emergency surgery.

Regardless of which strategy is adopted, effective patient scheduling processes and systems are crucial to balancing emergency and elective surgery demand. Over-scheduling should be avoided because it places an unrealistic burden on resources and contributes to the amount of cases that must be done out-of-hours. This is less cost-effective and can potentially have negative implications on patient outcomes. Paper-based booking systems are being replaced by electronic booking systems in recognition of the range of benefits that electronic systems can provide. Such benefits include real-time scheduling, increased transparency of patient bookings, better patient tracking systems to ensure timeliness of care, and the development of a dataset that can be used to monitor performance.

3.3 What role should surgeons play in operational management of emergency surgery?

The role that surgeons play in an emergency surgical service is important to the operational management of emergency surgery. There are three areas of clinical consultant involvement that have drawn particular attention in the literature. First, the consultant-led operational model of emergency surgery has gained mounting support for its perceived benefits relating to patient outcomes and the training of junior surgeons. Second, there is growing recognition that consultant-surgeon leadership is not only important during an emergency surgical intervention, but also at the front-end of the patient journey. Consultant involvement in emergency surgery patient assessment and diagnosis can ensure more accurate and timely decision making. The third focus of the literature relates to the broader value of clinical leadership across clinical units and hospitals. This level of consultant involvement is advocated as a means for improving the morale, commitment, quality of care and cost-effectiveness of emergency surgical services.

3.3.1 Consultant-led models of care

Consistent support for the use of consultant-led models of emergency surgery management has emerged from the literature review. A consultant-led model of care aims to ensure that consultant-surgeons are available to provide leadership, technical expertise and teaching opportunities in emergency surgery. Although there are many different operational models that adopt consultant-led approaches, most will typically involve assigning consultant-surgeons a particular realm of responsibility – for example, an emergency surgery list(s), a surgical assessment unit or an acute surgical unit. The appointed consultant-surgeon then has responsibility for all emergency surgery cases within this domain during his/her rostered period, which means that he/she is responsible for case decisions, leading and/or supervising surgical interventions, and patient handovers. Depending on the operational model being used, this surgeon may also be responsible for on-call duties and other aspects of the patient journey. Some facilities that manage elective and emergency cases separately also refer to this model as the dedicated emergency surgeon model (Sorelli et al. 2008).

The potential benefits of consultant-led models of care include (Sorelli et al. 2008):

- early senior clinical assessment of patients, decision making and diagnosis
- early patient discharge
- better access to prompt day-time emergency surgery, which is more cost-efficient and improves staff work–life balance
- increased supervision of specialist registrars
- improved quality of care resulting from more consultant involvement
- continuity of patient care, which avoids repetitive history taking, examination and investigations
- potential financial savings as a result of more prompt/accurate decision making, reduced numbers of unnecessary investigations, decreased out-of-hours operating time, and reduced lengths of stay.

The UK Government recommended that hospitals across the UK adopt consultant-led models of care after the NCEPOD exposed poor operative outcomes in emergency surgery patients undergoing operative intervention by junior surgical staff without consultant supervision in 1991 (Buck, Devlin & Lunn 1987). Changes that UK hospitals have introduced have demonstrated the positive impact that consultant-led models of care have upon emergency surgical services. The Charing Cross Hospital in the UK appointed a dedicated consultant-surgeon to provide a weekday emergency surgical service

between 8 am and 5 pm to ensure a fast track for referrals, diagnosis, early discharge or prompt day-time emergency surgery (Sorelli et al. 2008). The study concluded that the appointment of a dedicated emergency surgical consultant resulted in an increase in day-time consultant-supervised operations, shorter hospital stays for emergency admissions, improved training for surgical trainees, and potential financial savings for the organisation (Sorelli et al. 2008).

Consultant-led model of care: Charing Cross Hospital, UK

A dedicated emergency surgery consultant provided a weekday emergency surgery service between 8 am and 5 pm with other surgical consultants rostered to provide cover outside those hours. Daytime registrar cover was from a registrar solely committed to emergency surgery work or a registrar of the admitting team, free from other fixed commitments. Accident and Emergency (A&E) referrals were first made to the surgical registrar carrying the general surgery on-call bleep and, if they did not respond within 30 minutes, then the dedicated consultant was called. The registrar/consultant would decide whether to admit the patient to the surgical assessment unit or to discharge back to GP care.
A dedicated emergency surgery theatre was available and all major operations were performed within 12 hours, allowing for same-day discharge. The implementation of this model resulted in more daytime consultant-supervised operations, improved training, shorter hospital stays and financial savings.

A more detailed case study is presented in Appendix 1.

Adapted from: Sorelli et al. 2008

Similarly, the Frimley Park Hospital in the UK introduced a consultant-led emergency surgical team and published a study indicating that this model not only provided optimal continuity of patient care, but also increased the availability of learning opportunities for junior surgeons (Tincknell et al. 2009).

In Australia, the Prince of Wales Hospital acute care surgical service adopted a consultant-led model of care that is referred to as an acute surgery unit (ASU). The outcomes presented by Parasyn et al. (2009) mirror those reported by UK hospitals, and show that consultant-led models of care are not only safe but efficient, and have positive training implications for future surgeons. The ASU consultant-led model has emerged in Australia in order to provide acute surgery in a more timely and efficient manner. This model is currently being implemented at the Nepean Hospital, the Westmead Hospital, the John Hunter Hospital and Lismore Hospital, among others (Parasyn et al. 2009). Each ASU includes a surgical assessment unit (described in more detail in section 3.3.2), an acute surgical ward and an acute surgery operating theatre. An on-site surgical consultant is responsible for planning the first case of the day, triaging emergency cases, resolving conflicts that arise and managing the emergency theatre (Parasyn et al. 2009). Other key features of the ASU include a robust handover of patients and a separation of the elective and acute surgical streams (Truskett 2009).

Consultant-led model of care: Prince of Wales Hospital, Australia

An acute-care ward of four beds and an operating theatre were replaced under the control of a rostered acute-care surgeon (ACS), with the roster shared by eight general surgeons. An ACS was rostered to provide on-site service from 8 am to 6 pm weekdays and was on-call outside these times. The ACS was supported by an acute-care registrar and resident. The sole commitment was to treat and manage patients and the acute-care theatre during the duty period and resolve conflicts between specialities. All patients with acute general surgical illnesses from a range of specialities (excluding obstetrics) who did not require high dependency or intensive care were planned for admission to an acute surgical ward. The model resulted in a more efficient use of the entire theatre block, including higher utilisation rates and a decrease in after-hours cases.

A more detailed case study is presented in Appendix 1.

Adapted from Parasyn et al. 2009

Based on an extensive consultation approach, the Garling report recommended that most large hospitals in Australia should adopt an ASU with the objective of undertaking all acute surgery within 12 hours of arrival at the hospital (Garling 2008). This model is most appropriate in hospitals where there is a high enough volume of cases to justify an acute surgery operating theatre. If a hospital does not have a sufficient caseload to justify this, an alteration of this model could involve the use of an acute care theatre list each morning (Truskett 2009).

The Prince of Wales example highlights an approach to consultant-led care in which a general consultant surgeon receives patients from a range of surgical subspecialties, excluding obstetrics. The ACS surgeon coordinates patients requiring emergency surgery from each subspecialty and is responsible for identifying the need for specialist care as required. This is a similar approach to that adopted by most surgical assessment units, including Eastbourne District Hospital in the UK, where a consultant general surgeon assesses patients and determines which patients should be transferred to wards for specialist care (Sorelli et al. 2008). Other consultant-led models may focus on the provision of consultant leadership within specific surgical subspecialties. However, there is little discussion in the literature in relation to this. The literature also does not investigate whether the general or sub-specialised approach to consultant-led models is most effective.

One feature of consultant-led models of care that has generated increasing consensus in the literature is the importance of ensuring that consultants leading emergency surgery should have no elective commitments during the time they are on-call. This is one attribute of the model used in both the Prince of Wales Hospital and the Frimley Park Hospital – the dedicated emergency surgical consultant has no elective commitments during the period that he/she is rostered on for emergency surgery responsibilities (Parasyn et al. 2009; Tincknell et al. 2009). Parasyn suggests that this removes the external pressures and inefficiencies that result from surgeons having to juggle both elective and emergency commitments (Parasyn et al. 2009). The quarantining of surgeons' emergency commitments has potential to reduce surgeons' perceptions of emergency surgery as a burden that detracts from their elective work.

Sorelli et al. investigated the cost of dedicated emergency surgical consultants' salaries and argue that the quantifiable savings generated by this model of care more than offsets the salary costs (Sorelli et al. 2008). However, this should be explored in greater detail in the Australian context to understand what incentives are required in the context of existing funding models. The current literature relating to consultant-led models has largely originated from the UK, which is most likely a result of the NCEPOD recommendations published in 1991. As such, further research will be required to understand which consultant-led models are most appropriate in the Australian health system and in Victoria more specifically.

3.3.2 Consultant role in patient admission and assessment

Some consultant-led models of care specifically emphasise the importance of consultant-surgeon involvement during the initial patient admission, assessment and diagnosis. This is seen as particularly crucial to ensuring that accurate, timely and consistent decisions are made for each patient at the beginning of their patient journey, which is valuable both in terms of patient safety and optimising hospital resources.

A lack of experienced senior decision making for surgical patients up-front can contribute to increased wait times, increased lengths of stay, and bed block in the emergency department (O'Connell et al. 2008). Examination of the hospital admission process at Eastbourne District

General Hospital in the UK showed that a lack of senior surgical leadership in the admission process had flow-on effects throughout the hospital (Rowe, Lawrence & Fellows 2003). Junior registrars automatically admitted patients from general practitioners (GPs) because: they lacked experience to give advice to the GP; the registrar on-call needing to see the patient would be invariably busy with other commitments, such as clinics and operating lists; diagnosis would be delayed, often until the evening. This would contribute to further delays associated with poor out-of-hours access to investigative support services (Rowe, Lawrence & Fellows 2003). In this study, it was found that inadequately triaged emergency admissions could generate up to 20 per cent more emergency surgical admissions (Rowe, Lawrence & Fellows 2003). This places an unnecessary burden on emergency departments and has flow-on effects on elective waiting lists.

Simulation studies confirm the observation that patient assessments made by inexperienced registrars can increase hospital costs (Walker & Haslett 2003). Registrars with minimal experience have a tendency to: admit more patients due to conservative judgements; request more medical investigations to support decisions; and create increased lengths of stay as a result of prolonged decision making periods and additional investigations (Walker & Haslett 2003). These findings suggest that the costs associated with investing in clinical leadership may be offset by the potential savings that such a leadership model can bring.

The importance of consultant leadership in the admission and assessment process in order to minimise the flow-on effects of inadequately triaged patients throughout the hospital is well demonstrated. This evidence has informed the development of the surgical assessment unit (SAU). SAUs receive emergency surgery patient referrals and provide rapid diagnosis and investigation of emergency surgery patients. SAUs may use slightly different models of care, but are usually led by a dedicated on-call consultant surgeon who has no elective commitments during the period that he/she is rostered for SAU duties. Typically this consultant will aim to see each patient within one hour of arrival to the SAU, at which point any required investigations will be initiated. Most SAUs have good access to investigative support services, which enable the surgeon to make a more timely patient assessment. Where possible, patients will be discharged within 12 hours of arriving at the SAU.

The potential benefits of the SAU model of care include:

- rapid assessment and diagnosis of patients
- diversion of patients away from the ED to alleviate ED pressures
- reductions in waiting time for emergency and elective surgery
- reduced patient lengths of stay and more timely discharges
- better supervision of junior surgeons
- cost savings resulting from more accurate patient assessment and timely treatment.

Surgical Assessment Unit: Medway Maritime Hospital, UK

A SAU was established in a bay next to the general surgery ward to provide fast-track assessments of acute surgical and urological referrals. The unit is staffed all day by at least one registered nurse. A consultant surgeon is rostered on-call to the SAU with no elective commitments during this period. An operating theatre was available during work hours exclusively for SAU patients. The SAU had the potential to divert more than 2,000 patients away from the A&E annually. Nearly 65 per cent of patients arriving at the SAU came from sources other than the A&E. Without the SAU, these patients would have had to be seen in the A&E department, which was already struggling to need demands. The SAU streamlined the emergency surgery patient journey and provided patients with rapid assessment and management by senior surgical staff.

A more detailed case study is presented in Appendix 1.

Adapted from: Mohamed & Mufti 2005

One of the challenges associated with SAUs identified in the UK relates to the staffing model required. Mohamed and Mufti (2005) observed that the SAU model operates most effectively through the adoption of an 'emergency surgical team', which requires the reorganisation of staff timetables so that staff have no elective commitments when on-call. This obviously requires extra funding in order to compensate surgeons for their loss of private earnings. Another limitation of the SAU is that most only receive general surgical or urological cases. Patients that require specialised care are typically transferred to the specialist wards for treatment after initial assessment in the SAU (Rowe, Lawrence & Fellows 2003). SAU staffing therefore requires general surgical skills, which is a skill set that is becoming more scarce as the trend of sub-specialisation continues to grow. At this stage, only a limited amount of literature has been published on SAUs and it has predominately originated from the UK. This literature does include scientific studies that provide empirical evidence that demonstrates the value of the SAU (Mohamed & Mufti 2005). SAUs are one model of care that ensures greater consultant-surgeon involvement in patient admission and assessment.

3.3.3 Clinical leadership

The overarching theme of clinical leadership is a thread that runs throughout discussions of consultant-led models of care. The literature has highlighted the potential value to be gained from consultants providing clinical leadership of the emergency surgical service more broadly. This would facilitate a more integrated approach to emergency surgery care across different clinical specialties.

The concept of clinical leadership has been espoused by the ASGBI, who assert that morale, commitment, quality of care and cost-effectiveness all improve in hospitals where a strong sense of identity and purpose is engendered through effective medical leadership and an effectively functioning team (ASGBI 2009). This sentiment was reiterated at the 2009 Royal Australasian College of Surgeons Emergency Surgery – Acute and Trauma Surgery Workshop in Sydney (RACS 2009a). The type of clinical leadership that is being advocated for by these groups goes beyond the on-call consultant to a named surgeon that is responsible for the clinical leadership of the service.

ASGBI argue that hospitals should cultivate clinical leadership within their emergency surgical services by appointing clinical leaders that have sufficient understanding of the clinical process, who can command the respect of colleagues and demonstrate commitment to the provision of high-quality services (ASGBI 2009). Importantly, sufficient time and resources must be allocated to the clinical leader to enable him/her to perform the role effectively (ASGBI 2009; RACS 2009a).

Although this would require some investment, it is argued that this cost would be worthwhile given the value that would be generated by the existence of a committed clinical leader. However, it does not appear that any literature has yet been published testing this hypothesis.

What role should surgeons play in operational management of emergency surgery?

Increasingly, there is recognition of the value of consultant-surgeon leadership in emergency surgery. Consultant involvement during patient admission and assessment ensures that accurate, timely and consistent decisions are made for each patient, which has a positive impact on patient safety and ensures efficient use of resources. Consultant-led operational models of care have been shown to improve patient outcomes and increase the learning and development opportunities available to junior surgeons. Clinical leadership is also important to the broader management of an emergency surgical service because it can contribute to staff morale, patient safety and the optimisation of hospital resources.

3.4 How should patients be prioritised?

The question of determining patient priority is central to the management of emergency surgery. Decisions relating to patient priority take place within a high-pressure environment that involves nonnegotiable time stress, with potential for major personal consequences and adverse patient outcomes (Fitzgerald, Lum & Dadich 2006). Each patient's priority must be considered alongside that of others in the queue for emergency surgery, as cases are frequently 'bumped' or rescheduled to make way for those that are deemed more time critical.

It is widely recognised that standardised categories of clinical urgency would assist to determine patient priority and ensure greater consistency across the decision making process, thereby contributing to the quality of patient care. However, there is little consensus regarding how categories of clinical urgency should be defined. The variance between categories of urgency that have been developed in Australia and the international context demonstrate this challenge.

While the debate surrounding clinical urgency categories continues, the process of making patient priority decisions and effectively communicating these decisions to colleagues remains an important consideration for the management of emergency surgery. Certain trends surrounding patient priority decisions made by staff in particular roles suggest that anaesthetists could serve as a median point between nurses and surgeons in the patient priority decision making process. This approach may assist to ensure some consistency in decision making and improve communication around the allocation of theatre resources.

3.4.1 Standardised categories of clinical urgency

The clinical urgency of a case underlies every decision relating to patient prioritisation for emergency surgery. The consequences for performing a surgical intervention outside of the appropriate time frame may include loss of life or limb, loss of function, or loss of quality of life (Fitzgerald, Lum & Dadich 2006).

The concept of developing standardised categories of clinical urgency to aid the decision making process has emerged as a discussion point in both Australian and international literature. It is argued that standardised categories would facilitate more consistent decision making and reconcile differences in professional opinions relating to patient priority (Fitzgerald, Lum & Dadich 2006). In so doing, such categories would contribute to patient safety and quality of care. Defined categories of clinical priority would also have the benefit of addressing perceived inefficiencies that are associated with non-standardised decision making systems (Fitzgerald, Lum & Dadich 2006). However, at this stage there are few systematic investigations of this topic and very little consensus around how to define categories of clinical urgency.

Fitzgerald, Lum and Dadich (2006) conducted a survey of 198 decision-makers (including surgeons, anaesthetists and nurses) in NSW with the aim of developing a better understanding of decisions relating to patient queues on emergency theatre lists. In this study, respondents were asked to comment on what time frames they thought were ideal for a range of clinical procedures and conditions. From these responses, Fitzgerald et al. statistically identified three urgency categories and determined the characteristics of each patient group. These categories were then validated with clinicians through a structured interview process. An example of the three urgency categories that were tested during the validation process has been outlined below in Table 4.

Table 4: Clinical urgency in New South Wales

Urgency 1	Intervention commences within 60 minutes and definitely no more than six hours *(Examples: threatened airway; lower segment caesarean section; blood loss > 15 percent; ischaemic visceral organ; vascular repair)*
Urgency 2	Intervention commences within two hours and definitely no more than 12 hours *(Examples: compound fracture; threatened sensory loss; threatened loss of mobility; contaminated wound; unstable fracture)*
Urgency 3	Intervention commenced within seven hours and definitely no more than 45 hours *(Examples: threatened cosmetic outcome; unsuccessful suicide repair of tendon; closed fracture; terminally ill patient; diagnostic procedure)*

Based on Fitzgerald, Lum & Dadich 2006

The urgency categories identified by Fitzgerald et al. are distinct from many other category schemas that have been developed because they are based on empirical evidence, rather than arbitrary designation.

Fitzgerald et al.'s (2006) categories of urgency can be compared with the priority system for emergency surgery outlined in the NSW Health *Emergency surgery guidelines* (Table 5). Those definitions of clinical priority were developed as part of an initiative undertaken by the NSW Department of Health in 2009 to establish a set of principles that would guide emergency surgery reform and redesign. Although the NSW guidelines priority system is not based on the kind of empirical study conducted by Fitzgerald et al., they do provide a framework that has been endorsed by the NSW Surgical Service Taskforce.

Table 5: Clinical urgency in New South Wales – NSW Health *Emergency surgery guidelines*

< 15 minutes	**Immediate life threatening.** The patient is in immediate risk loss of life, shocked or moribund, resuscitation not providing positive physiological response.
< 1 hour	**Life threatening.** The patient has a life-threatening condition but is responding to resuscitative measures.
< 4 hours	**Organ/limb threatening.** The patient is physiologically stable but there is immediate risk of organ survival or systemic decompensation.
< 8 hours	Non-critical, emergent. The patient's is physiologically stable but the surgical problem may undergo significant deterioration if left untreated.
< 24 hours	**Non-critical, non-emergent, urgent.** The patient's condition is stable. No deterioration is expected.
< 72 hours	**Semi-urgent, not stable for discharge.** The patient's condition is stable. No deterioration is expected but the patient is not suitable to be discharged.

Source: NSW Health 2009

These definitions are by no means universal however. The scope of the urgency categories in both pieces of literature from NSW differs to that which has emerged elsewhere. For example, in the US literature Gabel et al. (1999) categorise emergency cases into those that should receive attention immediately; within 4–6 hours; and within 24 hours. In comparison, the NCEPOD in the UK classifies interventions as immediate, urgent, expedited and elective. For each of these categories, the respective target times to theatre from decision to operate is within minutes, hours, days or planned.

One element of consistency throughout most of the literature is the recognition that there is more disagreement around cases that fall between those categorised as most urgent and those categorised as least urgent emergencies (those that are categorised as urgency 2 according to the prioritisation system noted in Table 4) (Fitzgerald, Lum & Dadich 2006). There is general agreement that cases requiring immediate attention receive it, and those that are less urgent should give way to more urgent cases. It is the cases that lie in between these two groups that are the greatest cause for debate in terms of patient priority. A standardised system for categorising clinical urgency would be most beneficial in relation to these types of surgical cases.

3.4.2 Limitations of standardised categories of clinical urgency

The difference between the categories of clinical urgency outlined in the studies above reflects the fact that there are unavoidable challenges involved in identifying standardised categories of prioritisation. In current practice, standardised categories for clinical prioritisation of emergency surgery cases generally do not exist within most hospitals in Victoria or other international jurisdictions.

One of the key barriers to the development of standardised categories of clinical urgency is the fact that each patient is unique. Any number of variables may influence the time period in which surgical intervention can safely be undertaken, to some extent, such as the requirement of multiple surgical procedures or the presence of other comorbidities. Furthermore, the clinical condition of a patient

is dynamic. Shifts in patient stability are common and require a flexible approach to clinical urgency (Rowe, Lawrence & Fellows 2003). A standardised system of determining clinical urgency has obvious limitations given the range of shifting clinical variables that must be taken into consideration when determining patient priority.

Another limitation of standardised categories of clinical urgency comes with the practical implementation of such a system. The Western Canada Waiting List Project (2001) revealed the risk that there is a reluctance to adopt standardised criteria for decision making around patient priority, because decision-makers are embedded in their habits of exercising personal judgement. A similar issue was highlighted by a study in Norway, which found that decision-makers believed that policies relating to patient prioritisation were too restrictive (Martin & Singer 2003).

Thus any decision to introduce standardised categories of clinical urgency should also be accompanied by a long-term strategy for change management to ensure that the criteria are adopted in practice by decision-makers.

3.4.3 Patient priority decision making

Given that there is not widespread use of standardised categories of clinical urgency, decisions relating to patient priority depend upon the judgement and experience of key decision-makers. The literature identifies that patient priority is typically determined by staff in one or more of the following roles: the referring surgeon, the supervising anaesthetist or the theatre liaison nurse (or similar) (Fitzgerald, Lum & Dadich 2006). In addition, decisions may involve consultations with surgeons and registrars from different clinical streams, managers and administrators (Fitzgerald, Lum & Dadich 2006). The common process of decision making involves an initial assessment of clinical urgency by a surgeon, who then engages with the theatre liaison nurse, anaesthetist or other surgeons in order to discuss the priority of his/her patients.

One key complication in this process is the fact that individuals involved in this decision making process often have different perspectives on clinical priority. This creates potential for conflict and tension between surgeons and other staff involved in the process. The study undertaken by Fitzgerald, Lum and Dadich (2006) found that nurses tend to give patients a priority rating that is higher than average, while surgeons give a lower than average priority rating. Judgements of clinical priority made by anaesthetists are in between those made by nurses and surgeons. This finding led the authors to argue that supervising anaesthetists have a key role to play as an intermediary in making the final decisions around patient priority (Lum & Fitzgerald 2007).

Giving anaesthetists greater responsibility in patient priority decisions addresses some of the barriers to effective decision making that have been raised in the literature (Lum & Fitzgerald 2007). Anaesthetists have a neutral role between surgeons from different clinical streams. They are therefore well positioned to weigh up competing priorities and demands for available operating theatre sessions without bias towards particular craft groups. This can assist to reduce conflict and facilitate better communication between staff. However, there is insufficient evidence to conclude whether this approach is effective in practice.

How should patients be prioritised?

There is widespread support for the development of standardised categories of clinical urgency to assist with determining patient priority. Such categories would ensure greater consistency in decision making and contribute to patient safety and quality of care. However, there is little consensus around how to define these categories. Any number of variables may influence the time period in which surgical intervention can safely be undertaken, and the clinical condition of a patient can shift rapidly. As such, some literature highlights the limitations of standardised categories of clinical urgency and argues that of making patient priority decisions and communicating these decisions to colleagues. The role of anaesthetists in this process has gained particular attention, given that they have potential to make neutral decisions that are not influenced by bias for particular clinical specialties.

3.5 How can efficiencies be gained in emergency surgical services?

Efficiencies in emergency surgery can be realised in a number of different areas. By decreasing turnaround times in the operating suite, more cases can potentially be treated within a given time period; minimising length of stay can free up beds for new emergency surgery patients; well-designed infrastructure can speed up transfers of emergency surgery patients; and timely access to support services can result in more efficient patient diagnosis and treatment. Some of the literature relating to hospital efficiencies targets the elective surgical service, where it is typically easier to control schedules and processes. However, the key learnings can also be applied in emergency surgical care.

3.5.1 Decreasing turnaround times

The turnaround time of a surgical case is a key indicator of emergency surgery operational efficiencies. By decreasing turnaround times, staff overtime can be reduced and more cases can be scheduled during the day shift. This has potential to cut costs that will assist hospitals to maintain their operating margin and allow surgeons to increase their daily workload (Adams et al. 2004).

Lengthy turnarounds are associated with periods of non-operative theatre use that result from inefficient operating processes. A study in Israel highlights the importance of minimising ‘time-waste’ in operating theatres in order to provide more timely patient care and better control the costs of running operating theatres (Weinbroum, Ekstein & Ezri 2002). Weinbroum, Ekstein and Ezri note that the key drivers of cost in operating theatres are the expensive equipment and medication used, in addition to the cost of specialised nursing and medical staff (Weinbroum, Ekstein & Ezri 2002). These costs are only partially reduced during non-operative times. As a result, hospitals have an incentive to ensure that operating theatres are utilised effectively with efficient turnaround of cases to maximise their value.

The root causes of wasted operating theatre time can be a result of one or a combination of the factors that may include inappropriately prepared patients, unavailability of surgeons, delay in transport to the operating room and/or surgical cases running longer than their scheduled time (overruns) (Weinbroum, Ekstein & Ezri 2002). Good diagnostics are essential for the improvement of turnaround times, as it is important to understand the specific factors or combination of factors contributing to inefficiencies at each hospital. For example, the Valley Baptist Medical Centre in Texas was able to create sustainable change in turnaround efficiencies by first conducting a Six Sigma initiative to better understand root causes (Adams et al. 2004).

Once the root causes of turnaround inefficiencies have been identified, it is necessary to determine the best strategy for addressing them. The use of parallel processing has been found to be a useful strategy for improving turnaround times (Olmstead et al. 2007; Marjamaa et al. 2009; Serb 2008). In parallel processing, non-surgical aspects of the perioperative process are moved out of the operating theatre and into supporting spaces, such as an anaesthesia induction bay or a post-anaesthesia care unit (PACU). Parallel processing most commonly refers to concurrent induction of anaesthesia. There are different models used to do this, including: (1) the use of block rooms for epidurals or brachial blocks before surgery; (2) the use of induction rooms with additional personnel to provide anaesthesia inductions for one/several operating rooms; (3) surgeons administering local anaesthetics in a holding room while the operating room (OR) is prepped for surgery (Marjamaa et al. 2009).

The concept of parallel processing was developed to reduce turnaround times by adopting a new approach to the operating theatre workflow and workforce roles, focusing specifically on minimising non-operative theatre time. It involves a multidisciplinary approach to redesigning perioperative patient flow and work processes for maximum OR productivity (Sandberg et al. 2005). Many operating units in Europe already perform anaesthesia induction in parallel with the preceding procedure, with induction rooms being built in 81 per cent of the operating rooms in Switzerland and 94 per cent of the operating rooms in the UK (Torkki et al. 2005). Marjamaa et al. investigated a range of different parallel workflow models in Finland and found that all demonstrated better cost-efficiency than a model that used a traditional, sequenced workflow pattern (Marjamaa et al. 2009). This finding was mirrored by a study in the US that highlighted the turnaround efficiencies to be gained from providing a clear delineation of specific job functions in a parallel processing workflow model (Olmstead et al. 2007). Doing so saves time by avoiding repeated discussions of which tasks need performing and who will undertake them.

The key benefits of parallel processing include (Marjamaa et al. 2009; Serb 2008; Torkki et al. 2005):

- reduction in turnover times
- increased operating room efficiency and minimisation of non-operative time
- increased volume of cases performed throughout the day.

The extent to which some hospitals are capable of introducing parallel processes can be limited by their physical infrastructure. For example, the Massachusetts General Hospital created the ‘operating room of the future’ out of an old storeroom. They redesigned the architecture, the perioperative processes and the workforce roles so that activities that did not require the OR could take place in other areas where possible (Sandberg et al. 2005) (see section 3.5.3). Not all hospitals will have the available infrastructure or resources to be able to make such comprehensive changes. Another limitation of parallel processing is the increased cost of labour. However, three different studies from Marjaama et al., Torkki et al. and Sandberg et al. provide some evidence that these costs do not exceed the savings created by parallel processes. Instead, these studies report parallel processing to be either cost-neutral or more cost-efficient (Marjamaa et al. 2009; Sandberg et al. 2005; Torkki et al. 2005)

In the Victorian context more specifically, the ‘time out’ safety obligations may also pose a barrier to some aspects of parallel processing. Time out must occur when the patient is awake with the anaesthetist, surgical and nursing staff present. In some cases this may undermine parallel processing models where the anaesthetist administers anaesthesia to a patient before the surgeon has completed his/her previous operation. However, careful planning and work practice adaption can overcome this barrier to parallel processing.

Although parallel processing is typically associated with elective surgery, a study in Finland demonstrates that it can also generate benefits for the emergency surgical service. This example is outlined below, which takes place in the orthopaedic and trauma operating unit of the Helsinki University Central Hospital.

Parallel processing: Helsinki University Central Hospital, Finland

An induction team of an anaesthesiologist, an anaesthesia nurse and a circulating nurse performed parallel anaesthesia induction in the induction room of the OR, concurrently with the preceding procedure. By the end of the first case, the induction team will call for the next patient and perform anaesthesia induction. The anaesthesiologist will take care of all causes in the room, but should the induction of patient 2 overlap with the emergence of patient 1, another anaesthesiologist will assist with the emergence. When the OR cleanup is complete, the induction team will follow patient 2 into the OR while the nurse from case 1 will take their patient to the post-anaesthesia care unit and hand over and patient 3 will be called for anaesthesia to be started. Parallel processing reduced non-operative time and generated a faster turnaround time for orthopaedic trauma cases, enabling an extra case per day to be performed.

A more detailed case study is presented in Appendix 1.

Adapted from Torkki et al. 2005

3.5.2 Minimising length of stay

There is some evidence indicating that operating efficiencies can also be gained by minimising the length of stay. This argument is based on the premise that a faster patient turnover will reduce hospital costs even if the patient continues to receive care on an outpatient basis because such care is assumed to be less expensive (Taheri, Butz & Greenfield 2000).

In contrast, it has also been found that the length of stay actually has a minimal impact on the cost of hospital admission (Taheri, Butz & Greenfield 2000). Only a small percentage of the cost of each patient is generated by his/her final day in hospital; the initial period of hospital stay (including surgical intervention) drives the majority of each patient's cost. As such, Taheri, Butz and Greenfield (2000) argue that hospitals should focus resources on process changes that better use capacity and alter care delivery during the early stages of admission when resource consumption is most intense.

Taheri, Butz and Greenfield's argument is worth considering, but it is not necessarily applicable in many Victorian hospitals because it assumes that hospitals have excess capacity. In cases where there is no excess capacity, there is an additional incentive for efficient patient turnover because shorter lengths of stay enable more patients to be treated (Taheri, Butz & Greenfield 2000).

In considering how to reduce patient length of stay, the literature has demonstrated that more timely surgical intervention in femoral neck fracture patients contributes to a shorter length of stay (Shaw & Anderson 1999). A review of available empirical evidence found that patients with a fractured neck of femur that received surgical intervention within 12 hours from the time of fracture were shown to have a shorter length of stay than patients who waited longer for surgery. Further investigation may reveal that this finding is also applicable to other patient groups, which would suggest that more timely patient care has potential to generate reduced length of stays and greater operational efficiency.

3.5.3 Infrastructure considerations

Operational efficiencies can be undermined by inadequate infrastructure. Many strategies that will improve emergency surgery turnaround and increase patient through-put depend upon certain infrastructure requirements. For example, the parallel induction of anaesthesia requires an anaesthetic bay and the necessary equipment for administering anaesthesia, preferably collocated to the operating theatre suite. Similarly, improvements to transportation times will often depend upon the distance that a patient must travel from the ED or ICU to theatre. Without appropriate infrastructure, hospitals are limited in the strategies that can be adopted to improve operational efficiency.

The Massachusetts General Hospital launched a project titled the 'Operating Room of the Future' (ORF), which improved operating productivity by using a combination of technology, architecture and staffing models (Serb 2008).

Innovative infrastructure and processes: Massachusetts General Hospital, US

Massachusetts established a three-room operating suite that includes an OR, induction room and early recovery area (PACU). This infrastructure enables traditionally sequenced activities to run in parallel. Non-surgical activities are moved from the OR to support spaces. Induction of anaesthesia runs parallel with the room setup, and PACU transfer time is minimised by reporting to PACU personnel stationed in the suite in parallel with the last stages of surgery. The early recovery area in the suite also eliminated the need for anaesthesia and nursing personnel to travel to the PACU. The new workflow was supported by additional anaesthesia and nursing personnel. The newly designed infrastructure facilitated a parallel processing model that resulted in faster turnaround times, which allowed more cases to be operated on each day.

A more detailed case study is presented in Appendix 1.

However, the replication of this model will be limited by hospitals that do not have the opportunity to redesign the surgical suite in the same way that Massachusetts did. The ORF was carved out of an old storeroom and includes an induction room, operating room, early recovery room, and surgeon's work space, which maximises the potential for parallel processing. The improvements to turnaround times that were identified in this case are attributable to both the use of parallel processing and the use of innovative technology.

3.5.4 Timely access to support services

Support services, such as radiology and pathology services, are integral to emergency surgery patient care. An inability to access these services can have a negative impact on emergency surgery turnaround times and patient wait times. The RACS note that these services should be readily available, and that image sharing facilities are required that would allow hospital to hospital sharing (RACS 2009a).

How can efficiencies be gained in emergency surgical services?

Although research into operating suite efficiencies typically focuses on elective surgery, some literature presents strategies that are also relevant to emergency surgical services. Introducing initiatives such as parallel processing can decrease turnaround times in emergency surgical cases and increase the number of emergency surgery cases treated each day. Minimising the length of patient stay can increase patient turnover, thereby allowing more emergency surgical patients to be treated over a given period. Furthermore, the development of new emergency surgery facilities, or redesign of existing facilities, should ensure that the infrastructure is designed to maximise efficiencies in emergency surgical care.

4 Emergency surgery workforce considerations

The quality of an emergency surgical service is heavily dependant upon the availability and skills of the emergency surgical workforce. This workforce is formed by a wide range of staff with diverse skill sets, and can broadly be divided into the medical (including surgeons and anaesthetists) and nursing workforce.

Several reports have been published in Australia that highlight general health workforce shortages that are struggling to keep up with demand for health services. Among others, some of the key documents published include a number of reports by the AIHW (AIHW 2008c, 2009); *Australia's health workforce*, published by the Productivity Commission in 2005 (Productivity Commission 2005); and a report commissioned by the National Health Workforce Taskforce in 2009, titled *Health workforce in Australia and factors for current shortages* (Australian Health Workforce Advisory Committee 2003; National Health Workforce Taskforce 2009).

Some of the factors contributing to health workforce shortages include: improvements in technology that assist people to survive more complex health conditions; the ageing/growing population, which increases demand for health care services; different priorities affecting career decision making; different methods of service delivery that may be more resource intensive; and inadequate training and education positions for future practitioners. This is by no means an exhaustive list of factors contributing to health workforce shortages, which is a complex focus of study in its own right. However, trends in the broader health workforce have corresponding implications for the emergency surgical workforce more specifically. These trends are examined in this section.

4.1 Workforce trends

4.1.1 Surgeons

According to the AIHW, the surgeon workforce in Australia is increasing at a growth rate of 35.7 per cent (AIHW 2008c). This equates to a rate increase of four per 100,000 of the Australian population.

Young surgeons are increasingly following career paths that are considered to be more appealing than those typically associated with emergency surgery caseloads. There are a range of factors that contribute to this trend. Emergency surgery work has come to be associated with a poor work–life balance, involving work hours that are generally uncontrollable and socially disruptive (Sanchez & Sariego 2009). Emergency surgery frequently interferes with surgeons' elective or private practices (Parasyn et al. 2009). The need to compete for access to emergency operating resources is also discouraging to many, as are the high morbidity and mortality associated with emergency surgical work (Soreide 2009). In addition, there are often greater financial incentives in private practice or sub-specialisations that have predominately elective surgery caseloads (Esposito, Leon & Jurkovich 2006).

Evolving demographic trends have shown that these disincentives have serious implications for the emergency surgical workforce in future. The National Health Workforce Taskforce examined the motivations behind generation Y career decisions and noted that lifestyle, work–life balance and workplace culture are key drivers in career choices made by generation Y (generation Y refers to those born between 1980 and the early 1990s) (National Health Workforce Taskforce 2009). It is therefore unsurprising that careers in specialties that have high emergency surgery caseloads are becoming less popular among younger surgeons.

For this reason, the literature has tended to focus upon shortages of general and trauma surgeons more than shortages in other specialties. Research has identified a trend of increasing sub-specialisation within the surgeon workforce, which has contributed to shortages in broader specialties like general and trauma surgery. Sub-specialisation enables surgeons to gain more expertise in a specific surgical specialty, which can increase the quality of their skills and attract additional economic benefits (Sanchez & Sariego 2009). It is also associated with a better lifestyle and reduced on-call commitments (Soreide 2009). However, as surgeons become more specialised there is a risk that their skill set may no longer be broad enough to fulfil on-call duties for emergency surgery (Parasyn et al. 2009). A surgeon that is on-call must have sufficient skills to respond to the range of emergency cases that may occur after hours because there are fewer surgeons available out-of-hours if support is required. It is therefore likely that sub-specialisation may contribute to potential shortages of surgeons in future.

Potential shortages may be exacerbated by increases in the average age of the surgical workforce. A RACS workforce survey identified that the average age of the surgical fellowship in 2005 was 55.6 years (RACS 2005). As a result, a large portion of the current workforce is either decreasing their on-call commitments or planning for retirement (Parasyn et al. 2009). The ageing surgical workforce is therefore gradually reducing its commitments and gradually retiring, while some younger surgeons are pursuing career paths that are less relevant to emergency surgery. As a result of these trends, some gaps in the workforce may begin to emerge and need to be managed.

The first step towards managing these gaps is to train sufficient surgeons to meet the demand for emergency surgery. Because surgical qualifications require years of training, it is important to take a broader view of the timeline and ensure that sufficient numbers of surgeons are being trained for the future.

A body of literature has emerged that focuses on the potential for an acute care surgery (ACS) model in the US (Velmahos & Jurkovich 2007). This model should not be confused with the Acute Surgery Unit model discussed in section 3.3. The ACS model originated in the US and integrates three key service components that already exist: trauma, critical care and emergency surgery (Soreide 2009). Under this model, emergency surgery is absorbed by the trauma practice. Surgical emergencies are staffed by an in-house surgeon that has skills in critical care, trauma and emergency surgery. This differs to the traditional model in which a non-trauma general surgeon responds to emergency surgery and covers on-call duties (Earley et al. 2006). The ACS specialist is trained in a wider range of technically challenging operations than traditional general surgeons, and is therefore more able to respond to a wider range of surgical situations that present at hospitals (The Committee to Develop the Reorganized Specialty of Trauma, S. C. C. and Emergency Surgery 2005).

In the US the ACS model has been proposed as a future model of trauma practice because it attempts to provide part of the solution to the diminishing number of trauma and general surgeons in emergency surgery that result from sub-specialisation trends (Garland et al. 2007). An ACS curriculum has been developed in the US in an attempt to begin developing a workforce of surgeons that have been trained in a broad set of skills that are typically associated with emergency surgery, thereby filling emergency surgeon shortages. This model has already been adopted by a number of hospitals in the US such as the Santa Clara Valley Medical Centre and the Hospital of the University of Pennsylvania.

It is important to note that the ACS model is only effective if sufficient case volumes exist within a hospital. If the clinical volume is not high enough to support an adequate on-call pool, the amount of on-calls can become too onerous to deliver the lifestyle benefits associated with the ACS model (Garland et al. 2007). There have not been any studies published that have specifically examined the impact of ACS upon the workforce.

It is also worth recognising that this model of care is not necessarily suited to the Australian health system, where the majority of surgeons are employed on a VMO basis rather than a full-time agreement. Furthermore, the trend of sub-specialisation is well established in the Australian system, and the ACS model may not be compatible with current work practices and training models. Further investigation of the feasibility of the ACS model in Australia is required.

Acute care surgery: Hospital of the University of Pennsylvania, US

During this study, coverage of surgical emergencies alternated between the ACS model and the traditional model (TRAD) each month to compare the outcomes of each model of care on patients with appendicitis. The traditional model refers to a model in which a non-trauma general surgeon takes home calls. The trauma attending took 24-hour periods of in-house call and non-trauma general surgeon took calls from home, with all other aspects of care remaining unchanged. In patients with acute appendicitis, the ACS model decreased the time to operation, rupture rate, complication rate, and hospital length of stay. The ACS model therefore improves the outcomes of acute appendicitis compared with a TRAD home-call model.

A more detailed case study is presented in Appendix 1.

Adapted from Earley et al. 2006

4.1.2 Anaesthetists

According to the AIHW's health and community services labour force report, there was a 27 per cent increase in anaesthetists in Australia between 2001 and 2006 (AIHW 2009). The 2006 figures equate to a ratio of 13 anaesthetists per 100,000 of the Australian population (AIHW 2009).

This increase in anaesthetists can be traced to an Australian Medical Workforce Advisory Committee review of specialist anaesthesia workforce in Australia, which signalled there would be a growth in demand for the anaesthesia workforce between 2001 and 2011 (AIHW 2009). In response to these recommendations, the Australian and New Zealand College of Anaesthetists increased the number of anaesthetist trainees, facilitated the training of general practitioners, and developed new policies to meet government guidelines regarding overseas-trained specialists and area-of-need specialists (AIHW 2009).

Apart from the census and workforce data outlined above, the literature has provided minimal commentary on the anaesthetic workforce in relation to emergency surgery. There is far less information available in relation to trends in anaesthetists than that provided in the body of literature focusing upon the surgical workforce. In Australia, this could indicate there are fewer concerns for a shortage of anaesthetists in future because the steps taken to address this issue have been successful.

4.1.3 Nurses

The shortage and high turnover of nurses was perceived to be one of the most critical workforce issues facing emergency care at the Emergency Care Workforce Forum in 2003 (Australian Health Workforce Advisory Committee 2003). Although, anecdotally at least, these issues have become no less important since then, there have been few references to them in recent published literature. Nurse shortages in general have attracted more attention than nursing shortages that specifically relate to emergency surgery.

The AIHW recorded a total nursing workforce of 222,133 in 2006, which represented an increase of 14 per cent (28,366 workers) since 2001 (AIHW 2009). Of the total nursing workforce reported, 91 per cent were registered nurses; 4.9 per cent of those nurses who indicated their specialty were registered perioperative nurses. In 2006 the Australian Health Workforce Advisory Committee (AHWAC) predicted there would be increased demand for a skilled and flexible perioperative workforce, which is expected to arise as a result of the changing nature of surgical work that is driven by technological advances (AHWAC 2006). In addition, Australia has an ageing nursing workforce that is likely to create more gaps in meeting demand as more senior nurses retire.

AHWAC reported that the number of undergraduate nurses being trained is not likely to meet future demand or address current nursing shortages, despite increases in registered nurses over recent years (AHWAC 2006). This is attributed to mounting competition for nursing staff between perioperative services and other nursing specialties for new entrants, which is likely to continue to increase in future. One of the strategies put forward to address this issue is to provide undergraduate nurses with more exposure to the perioperative environment to encourage this career path (AHWAC 2006).

In many ways, gaps in the nursing workforce for emergency surgery need to be managed in the same way to those in the surgical workforce. Nurses must be trained in advance so that they are qualified for the future, ensuring there is sufficient supply of nurses to meet emergency surgery demand as it grows. It is also important to develop innovative strategies for making nursing careers in emergency operating theatres more appealing in order to continue renewing the workforce.

4.2 Supervision and training

The training and supervision of surgeons is critical to the maintenance of a highly skilled surgical workforce that has the capacity to meet the emergency surgery demand. The development of these skills requires both formal training opportunities and operative experience in time-critical cases.

In Australia most clinical training components of health courses involve public hospital placements. The trainers are either salaried employees or VMOs that generally provide their time on a pro bono basis on top of their regular work commitments (National Health Workforce Taskforce 2009). Funding of these training opportunities varies across professional disciplines and courses.

One of the barriers to training highlighted by the National Health Workforce Taskforce is that training is still heavily reliant upon the pro bono services of senior practitioners (National Health Workforce Taskforce 2009; Sanchez & Sariego 2009). Another key concern is the fact that there are insufficient hospital placements or patients to meet the demand for training opportunities from junior surgeons (National Health Workforce Taskforce 2009; Sanchez & Sariego 2009).

The availability of consultant supervision for junior surgical registrars has been highlighted by the NSW Health *Emergency surgery guidelines* as one of the principal objectives for clinical restructure (NSW Health 2009). These guidelines were informed by qualitative research, including studies conducted by Parasyn et al. (2009) and Earley at al. (2006). This objective has informed NSW Health's recommendation to adopt consultant-led models of emergency surgical care because it ensures that supervision is readily available for surgical registrars.

Emergency surgery workforce considerations

Supply of emergency surgery surgeons is likely to be affected by two key factors: the ageing surgeon workforce is reducing its on-call commitments and gradually retiring; and younger surgeons are increasingly pursuing careers that do not have high emergency surgery caseloads. The changing patterns in career choices reflect generation Y's response to a range of disincentives associated with emergency surgery, including poor work–life balance, socially disruptive hours, high morbidity and mortality of patients, inadequate reimbursement and the need to compete for access to theatre. Without early adoption of strategies to counteract these trends, it is likely that the supply of surgeons for emergency surgery will diminish over time.

The anaesthetist and nursing workforce is not addressed in the literature in as much detail as that given to the surgical workforce. Trends in anaesthetists that were identified in the literature tend to relate to the workforce more broadly, without considering anaesthetists in the context of emergency surgery specifically. Supply of the nursing workforce have been identified as one of the issues facing emergency surgery care. The training of nurses is viewed as a central strategy for increasing the nursing workforce, particularly by providing nurses in training with the opportunity to gain exposure to the perioperative environment.

5 Performance monitoring and evaluation

5.1 Overview

There is clear recognition that the capacity to monitor and evaluate performance is a critical building block for system-wide improvement of health care delivery and patient outcomes. Robust performance monitoring and evaluation processes incorporate data collection, analysis, review and communication. These processes contribute to the development of an evidence-based understanding of the quality of an emergency surgical service by measuring it against common standards of care.

Strong performance monitoring and evaluation mechanisms relating to health systems and hospitals more broadly already exist in Australian and international jurisdictions. Patient safety and quality of care has long been recognised as an important aspect of health care services. The key challenge is around ensuring that performance measures are able to generate an evidence-based understanding of emergency surgical services more specifically. The data that tends to be collected in relation to surgery is generally not disaggregated enough to distinguish between standards of care in emergency and elective surgery. In order to gain real insights into standards of emergency surgical care and identify areas for improvement, it is important to ensure that the appropriate performance data is collected.

Performance is monitored by using key performance indicators (KPIs), which are 'a statistic or other unit of information which reflects, directly or indirectly, the extent to which an anticipated outcome is achieved or the quality of the processes leading to that outcome'. (National Health Performance Committee 2001). KPIs are fundamentally evaluative criteria that may help to identify or flag further issues or questions. Indicators measure the rate of occurrence of an event but do not provide the answers; rather, they are designed to indicate areas that may need addressing, usually demonstrated by trends or variations within the results (Campbell et al. 2002).

The collection and analysis of KPI data forms one component of a performance-improvement process, which should also include strategies for reviewing performance regularly and communicating the findings from the information collected. A study in Switzerland found that a combination of 'uniform outcomes measurement, group benchmarking, and data-driven hospital-specific strategies for change' can facilitate the continuous improvement of emergency care (Schwappach et al. 2003). Communication of areas of good or improved performance also fosters momentum for increased improvements within a health care facility, as identified by a Six Sigma initiative conducted at the Valley Baptist Medical Centre in the US (Adams et al. 2004).

Key factors driving the trend towards improving performance monitoring of emergency surgical services are the increasing demands for health system accountability and informed patient choices (Smith, Mossialos & Papanicolas 2008). Health systems have a broad range of stakeholders that include patients, clinicians, health care providers, purchasers, regulators, governments and the general public. These stakeholder groups frequently request access to performance data from health care organisations to inform their decisions.

Given that emergency surgery stakeholder groups are so diverse, performance should be monitored and used at a number of levels including:

- the individual clinician level – to measure and improve the care provided by a clinician
- the clinical team or unit level – teams should discuss the data collected on each indicator and identify areas of practice variation that require investigation

- the organisation (hospital/health service) level – data can flag issues that will need organisational investigation using a scientific method and protocol alteration
- state/territory and national levels – for the purposes of identifying the need for improved government policy and strategies (Australian Council on Healthcare Standards 2008).

At each of these levels indicators may be used to benchmark performance with other like entities. This data can be used to track performance trends over time and devise more targeted strategies for improvement. More importantly, it can help to ensure that standards of patient safety are consistently met by emergency surgical services.

5.2 Patient safety and quality of care

Close monitoring and review of performance in emergency surgery can enhance patient safety by encouraging the maintenance of high standards within each health care facility. Performance review processes draw attention to standards that fall below expectations and assist staff to learn from each others' challenges and experiences.

NSW Health has developed a clinicians' toolkit to advise clinicians about methods of collecting information relating to the quality of care being provided to patients (NSW Health Department 2001). The activities outlined in this toolkit are fairly common practice for ensuring patient safety and quality of care, and are outlined in Table 6.

Table 6: Activities for monitoring patient safety and quality of care

Activity	Description
Facilitated incident monitoring	This involves identifying, processing, analysing and reporting incidents with a view to preventing their recurrence ('incidents' refer to unplanned events resulting in or having the potential for injury, ill health, damage or other loss).
Sentinel event management	A 'sentinel event' is an unexpected occurrence involving death or a serious physical or psychological injury and includes any process variation for which a recurrence would carry a significant chance of a serious adverse outcome.
The effective use of clinical indicators	The purpose of using clinical indicators is to identify areas of poor performance and flag areas for improvement. (This is discussed in more detail in the next section.)
Peer review meetings	This refers to a process of clinical performance review by peers that informs those present about the status of their own practices against their peers.
Morbidity and mortality meetings	A meeting held on a regular basis to review deaths and adverse outcomes in patients of a specified clinical group or specialty that enables the development of strategies to avoid repeating negative outcomes.
Ad hoc audits/ reviews	An ad hoc audit that involves the opportunistic survey of a specific practice prompted by the development of a related hypothesis by an observant clinician.

Source: NSW Health Department 2001

The regular occurrence of these activities contributes to a performance monitoring system that emphasises patient safety and quality of care. In order to ensure it is most effective, the *NSW clinician's toolkit* argues that a multidisciplinary approach should be adopted wherever possible (NSW Health Department 2001). Furthermore, the process should be transparent and accountable

across different stakeholders, including junior staff, other clinicians, health services managers and patients. Most importantly, any criticism should target the root systems issues rather than seeking to blame individuals for errors or perceived errors that may have occurred (NSW Health Department 2001). One step towards establishing this type of evaluation system is through the use of de-identified information, which encourages open and frank discussions of the issues raised around specific events (NSW Health Department 2001).

5.3 Key performance indicators

In order to monitor and improve performance in emergency surgery, it is necessary to collect KPIs. KPIs are used to assess, compare and determine the potential to improve quality of care (Howley & Gibberd 2003). Different kinds of performance indicators are used for different purposes. Internal indicators are used by health care providers to monitor and improve the outcomes of their care processes (Berg et al. 2005). Professionals and managers can use this data to investigate where potential problems lie so that the can develop strategies for addressing them. Internal indicators can also be used to monitor improvements to determine how effective these strategies really are. In comparison, external indicators are used by governments, patient organisations and payers to assess the quality of care of a health care provider, and to compare that quality to the performance of other health care providers (Berg et al. 2005). These principles apply to the collection of emergency surgery performance data.

It is important to recognise the distinction between internal and external indicators to ensure the right indicators are collected for intended purposes. Both Berwick, James and Coye (2003) and Berg et al. (2005) point out that 'measuring for improvement is not measurement for judgement'. Similarly, the New Zealand District Health Board (DHB) Hospital Benchmarking Information report asserts that 'long-term performance improvement is most likely when performance information forms part of open-ended quality improvement and learning processes within an organisation, rather than when it is wielded as a judgement or 'naming and shaming' tool by an external body' (New Zealand Ministry of Health 2009a.) It is therefore recognised that collection of data for external use is not necessarily going to be as useful for the purpose of improving performance within each hospital.
An awareness of the incentives and disincentives that influence data reporting is valuable to the process of designing performance monitoring systems.

Berg highlights some important considerations, which are summarised as follows (Berg et al. 2005).

- The more valid an indicator is the more work it is to construct and report on it. To ensure data validity across a disparate set of data, risk adjustment schemes have to be developed and all potential confounders have to be taken into account.
- Attempts to increase the validity of indicator data by using complex statistical procedures to make numbers more comparable across hospital sites actually decreases the transparency of an indicator. The number becomes less meaningful to the professionals or managers that were responsible for entering the data initially.
- The more you try to make indicators comparable, the more your claims are challenged because the number is no longer as meaningful to those who reported the data. This has potential to generate more defensive reactions and potentially less compliance with the performance monitoring system.

- The more direct and serious the consequences of having high or low scores, the more manipulations and perverse reactions you may expect. Performance monitoring systems that are less punitive and/or treat indicators less as a direct instrument for rewards or penalties will suffer less from such perverse effects.
- The most successful national quality improvement projects are designed to keep the identity of those supplying the data secret. Data that is hidden from the public reduces the incentive to skew data and ensures a more reliable dataset to use for performance monitoring and improvement. If hospitals want to make the data they own publicly available, they can do so themselves.

The way in which data is collected, used and shared therefore has clear implications for the quality and reliability of the information that is reported. Consequently, the above points should be considered when developing performance monitoring systems and indicators to ensure they will deliver the objectives of the performance monitoring exercise.

Although the themes that have been discussed thus far relate more to the performance of health care systems in general, they are equally applicable to the collection of data that is specific to emergency surgery. This discussion does not specifically focus on emergency surgery in reflection of trends in the literature. The literature demonstrates a clear focus on the KPIs used to reflect performance of health services more broadly, with few jurisdictions choosing to focus specifically on the performance of emergency surgical care. This will be evident throughout the remainder of the section.

5.3.1 Operational and clinical performance indicators

When developing performance indicators, it is helpful to consider them as falling within two major categories: operational indicators and clinical indicators. An operational indicator measures the operational performance of an emergency surgical service, such as patient wait times and patient turnaround times. A clinical indicator relates to patient safety more specifically and measures the 'clinical management or outcome of care' of patients, such as morbidity and mortality rates (Collopy 2000).

Both operational and clinical indicators may be collected for specific indicator procedures that can be used to gauge outcomes of an emergency surgical service. The indicator procedures used for emergency surgery have high volumes of cases and therefore provide a larger sample of data to use. Some potential indicator procedures may include:

- acute cholecystitis
- fractured neck of femur
- acute appendicitis
- infected wound.

An example of an indicator for individual procedures is the number of patients who have surgery within 48 hours of admission with fracture neck of femur.

The KPIs that have been identified in government policies or reports are outlined in the following tables, organised within the categories of clinical (Table 7) and operational indicators (Table 8). An example description of each performance target has been included based on information collected throughout the literature review. However, it is important to note that indicators and targets vary considerably between facilities, health services and jurisdictions. As emphasised in the discussion above, performance indicators must be appropriately tailored to specific contexts and purposes.

Table 7: Examples of clinical performance indicators for emergency surgery

KPI	Description	Example rates
Readmission to hospital	The total number of unplanned and unexpected readmissions with 28 days of discharge	1.68 per cent^ (Australian Council of Healthcare Standards 2008 benchmark rate)
Return to operating room	The number of patients having an unplanned return to the operating theatre during the same admission	< 0.36 per cent^ (ACHS 2008 benchmark rate)
Death	The total number of patient deaths following emergency surgery	0 per cent* – all deaths are audited individually; deaths are reported to the surgical mortality audit

^ The example rates for these two indicators are inclusive of all hospital admissions and thus not exclusive to emergency surgery. Incidents related to readmission to hospital and return to the operating theatre would be investigated separately at the local level to identify underlying reasons and inform quality improvement. While not reported externally, hospitals may collect aggregate data for these indicators related specifically to emergency surgery.

* Although death can be the expected outcome from progression of an illness or disease, it can also be the ultimate adverse event associated with or resulting from health care delivery. It is reasonable therefore that the ideal rate be 0 per cent. It is appropriate for patient deaths occurring within a health care organisation to be analysed through clinical audit and review processes to facilitate identification and introduction of any necessary improvements in safety.

Table 8: Examples of operational performance indicators for emergency surgery

KPI	Description	Example
Patient wait times	Long waiting times for emergency surgery operations increase a patient's risk of postoperative complications and morbidity, and indicate how efficiently an emergency surgery service is being managed.	Number of patients with fractured neck of femur who are operated on with 24 hours of fracture (Shaw & Anderson 1999)
Patient length of stay	The length of stay shows how quickly a patient is treated and discharged, which not only reveals the quality of patient care but also provides some indication of the costs that are borne by the hospital per patient.	Number of cases that are discharged within 24 hours (Sorelli et al. 2008)
Postponement or cancellation of elective surgery	This can be used to gain insights into the effectiveness of an emergency surgery service by understanding the extent to which it impacts on elective surgery. Hospital-initiated postponements (HIPs) and patient-initiated postponements (PIPs) provide the reporting framework for these indicators.	Number of elective operations cancelled within 24 hours before surgery as a result of emergency cases (Berg et al. 2005)
Improved emergency theatre utilisation	Theatre utilisation data gives a sense of how much flexibility is available in the system, and provides an indication of wasted costs if theatres are not being sufficiently utilised.	Theatre utilisation rate of 70–85 per cent including turnaround time*
Rate of after-hours emergency surgery as a percentage of all surgery	Measurement of after-hours works shows how effective the theatre template is and gives more transparency around the working conditions for staff.	Number of emergency cases conducted between 12 am and 8 am (divided by total hours of surgery conducted) (Parasyn et al. 2009)
Turnaround times	Turnaround times that are specific to the efficiency of the emergency surgery operating suite.	Number of cases that commence < 15 minutes after the previous patient was taken out of the same operating theatre (Adams et al. 2004)

* Example sourced from consultation with participant in the international survey from the US, Kristi Kawamoto

5.4 International performance monitoring and benchmarking

Performance data is collected and used differently around the world. This section provides an overview of the way in which emergency surgery performance is monitored and benchmarked in Australia and internationally. Given that the collection of performance data is not always made publicly available, the contents of this section are limited to that which accessible to the public or gained through consultations with representatives in international jurisdictions.

5.4.1 Australia

In Australia, the Australian Council on Healthcare Standards provides a data repository, analysis and reporting service to its member organisations. Participating organisations submit indicator data for inclusion in the database. Data are analysed twice yearly and results are provided to organisations in a form that compares results across all contributing organisations as well as providing a comparison with 'peer' organisations. This data is provided back to the health care organisations and made publicly available through an annual report that provides aggregate results of individual indicators trended over a period of up to 10 years.

The Victorian Hospital-Acquired Infection Surveillance System (VICNISS) Coordinating Centre collects and analyses data (on some types of surgical site infection rates) from individual hospitals, and reports quarterly to participants and the Department of Health on aggregate, risk adjusted, procedure-specific infection rates (VICNISS 2009). This information contributes to the development of accurate and reliable benchmarks against which hospitals and health services can assess their performance.

Furthermore, the Royal Australasian College of Surgeons' Council is committed to a bi-national surgical mortality audit program. This program has been modelled on the successful Western Australian Audit of Surgical Mortality (WAASM) (Royal Australasian College of Surgeons & The University of Western Australia 2009). The program promotes voluntary surgeon participation in a confidential and peer reviewed audit. Mortality audits are now established in all Australian states. WAASM is part of the Australian and New Zealand Audit of Surgical Mortality (ANZASM), which provides a forum to support and guide the development of the audit in all states and New Zealand to ensure that both consistency and high standards are met. It is proposed that the first national ANZASM annual report be released at the college's annual Scientific Conference in Perth in May 2010.

The Victorian Audit of Surgical Mortality (VASM) also became operational in December 2007. VASM is a collaboration between the Department of Health, the Victorian Surgical Consultative Council and RACS (RACS 2009b). The VASM is based on the Scottish Audit of Surgical Mortality, the WAASM experiences and those in several other states. This audit process is designed to gather information on factors involved in the death of patients undergoing surgical treatment. The aim is to identify any system or process errors and develop strategies to redress these. To a large extent the focus of this audit is still on increasing hospital and surgeon participation. Particular data relevant to emergency surgery mortality is not yet published.

WAASM become operational in 2001 and has since published annual reports of surgical mortality. Data collection and reporting are therefore more developed and data related specifically to emergency admissions and emergency surgery mortality is presented in the WAASM report. Also noteworthy is that surgeon participation in WAASM has steadily increased from 62 per cent in 2002 to 95 per cent in 2008 (Royal Australasian College of Surgeons & The University of Western Australia 2009).

All information collected during the audit process is protected by Commonwealth Qualified Privilege legislation. It is intended that ANZASM will release an annual report providing a summary of findings on all deaths for Victoria will be published and be available to the general public.

5.4.2 Canada

Performance data in Canada is collected at the provincial level. Each province has different strategies for improving performance and uses different benchmarking systems, some more developed than others. Ontario and British Columbia have the most developed performance monitoring systems within the jurisdiction. Consequently, the majority of the literature available in Canada relates to these two provinces.

Performance data relating to wait times has been a particular focus of the health care system in Canada. The Western Canada Waiting List (WCWL) Project has undertaken extensive research into waiting lists since 1999, and the Ontario Ministry of Health and Long-Term Care collects and publishes wait time performance data online (WCWL Project 2001). Although the key focus of these studies is elective waiting list performance, emergency surgical cases are included in part of the data collected.

In Ontario, data is collected for five clinical areas: cataract surgery, hip/knee replacement, cardiac-bypass surgery, MRI/CT scans, and cancer surgery (Ontario Ministry of Health and Long-Term Care 2009). There are performance targets in each of these clinical areas that include priority 1 cases, which are considered to be emergency surgery patients. All the other priority groups (priority 2–4) are for elective patients. The wait time target specified for priority 1 is 'immediate' and therefore does not accurately reflect the variation in emergency surgery case priority that exists. These performance data is therefore more relevant to elective surgery, not emergency surgery. Apart from wait times, Ontario does not collect performance data that are specific to emergency surgery.

British Columbia also collects wait time data in the BC Surgical Patient Registry (Provisional Health Services Authority 2009). This registry collects information from 34 different operating room booking systems in use across the province and sorts the information into higher level provincial categories. This allows for consistent, comparative data analysis and reporting at the provincial level.

Canada therefore focuses more upon elective surgery in its considerations for performance improvement that are included in the literature. Wait times are the primary indicator used to assess performance, but these do not necessarily reflect detailed wait times for emergency surgery patients.

5.4.3 United Kingdom

The UK's NHS publishes information relating to the performance of individual hospitals and health services on their website, NHS Choices (NHS 2009a). The general public can compare services and select a hospital according to characteristics that include location, waiting times, reputation, clinical performance, visiting policies, parking facilities or other patients' comments. This dataset is not specific to emergency surgery but it does provide a model for sharing performance data with the public in order to create incentives for hospitals to provide high standards of patient care, which has been a strategy used in the UK for some time. However, this model has been criticised for creating incentives for data to be skewed or misreported (Berg et al. 2005). High performance rankings result in financial and managerial benefits, while low rankings may result in punishments. There is therefore high pressure to represent each health care facility in a positive light, which may contribute to reporting inaccurate performance data.

One of the key drivers behind the development of publicly available performance monitoring and benchmarking in the UK was a working party report by the Royal College of Surgeons of England in 1988, which highlighted 'serious deficiencies in the management of severely injured patients' (Royal College of Surgeons of England 1988). This report sparked increased focus on the care of trauma patients in the UK, resulting in the establishment of the Trauma Audit and Research Network (TARN).

The aim of TARN is 'to collect and analyse clinical and epidemiological data and thereby provide a statistical base to support clinical audit to aid the development of trauma services' (NHS 2009b). Hospitals throughout the UK submit data on clinical outcomes to TARN, which is then published online and made publicly available for comparison of survival rates at different hospitals. The website also provides information to local health commissioners about the trauma workload and its management. However, TARN is predominately focused on clinical performance indicators not operational performance indicators.

Both clinical and operational performance data are collected in the UK through the National Confidential Enquiry into Patient Outcome and Death (NCEPOD), which was established in 1988 to replace a 1982 joint venture between surgical and anaesthetic specialties named the Confidential Enquiry into Perioperative Deaths (CEPOD) (NCEPOD 2009). NCEPOD expanded upon this initiative and now reviews outcomes of patients from all specialties including surgical patients (NCEPOD 2009). The purpose of NCEPOD is to 'assist in maintaining and improving standards of medical and surgical care for the benefit of the public by reviewing the management of patients, by undertaking confidential surveys and research, and by maintaining and improving the quality of patient care and by publishing and generally making available the results of such activities' (NCEPOD 2009). Some of the reports that have been published by NCEPOD in the past 10 years in relation to patient safety and quality in emergency surgery include *Trauma: who cares?* (National Confidential Enquiry into Patient Outcome and Death 2007), *Who operates when?* (National Confidential Enquiry into Patient Outcome and Death 2003), and *Changing the way we operate* (National Confidential Enquiry into Patient Outcome and Death 2001).

5.4.4 United States

The US does not have an overarching performance benchmarking system that is used across the jurisdiction. This is due to the fact that the health care system in the US is largely owned and operated by the private sector, not the government. Most health insurance options are private, and many private health insurance companies operate health care facilities to provide services to their members. Federal, state, county and city governments do own certain facilities but health care is predominately a private system. As a result, there is no nationwide system for monitoring performance in emergency surgery. Performance data is collected in the private hospitals, but this is considered to be commercial-in-confidence and is therefore difficult to access. Consequently, it was more challenging to collect literature relating to performance benchmarking in the US than for other jurisdictions.

However, a generic policy for scheduling surgical procedures and block allocation does exist that is used to assist hospitals develop operating theatre schedules and guide their performance framework. This document provides an example of the type of performance data collected in the US and the targets that are used.

The American College of Surgeons established the National Surgical Quality Improvement Program (ACS NSQIP) to provide a national program to measure and improve the quality of surgical care (American College of Surgeons 2009). This program uses a database to quantify 30-day risk-adjusted surgical outcomes, allowing valid comparison of outcomes among all hospitals in the program. Data is collected on 136 variables, including perioperative risk factors, intra-operative variables, and 20-day postoperative mortality and morbidity outcomes for patients undergoing major surgical procedures in both the inpatient and outpatient setting. Data is collected from a broad cross-section of specialties, including those that have a high volume of emergency surgery cases. Hospitals participating in this program use the data collected to monitor and improve performance. Participants are also able to request the aggregate program data for their use, which does not identify hospitals, patients or health care providers. The NSQIP program is not a nationwide initiative. Hospitals must apply to be included in this performance monitoring initiative.

5.4.5 The Netherlands

The Dutch Health Care Inspectorate developed a set of hospital performance indicators relating to patient safety and clinical effectiveness in early 2003 (Berg et al. 2005). This is a nationwide performance monitoring system that consists of three data subsets: hospital-wide indicators; indicators for the emergency ward, operation theatre and intensive care units; and condition or intervention-specific indicators. Within the second subset of data are indicators that specifically monitor the performance of a hospital at different stages of the emergency surgery patient journey.

The Dutch system is not designed to publicly compare or rank hospitals, but instead strives to instigate improvements in the quality of care being delivered. The purpose of the system is to identify hospitals that may require additional investigation, not to draw conclusions about performance using the data alone. There are several distinct features of the Dutch system that reflect this goal (Berg et al. 2005):

- Incentives for improvement are tied to the implementation of best-practice initiatives. These initiatives are clearly specified and hospitals are rewarded for introducing them.
- A national ranking of hospitals is not produced. It is considered to be more important to trace improvements over time within hospitals than it is to make comparisons between hospitals.
- Hospitals and professionals can compare themselves with their direct competitors, but competitor data is usually made anonymous.
- Hospitals can choose how to report their data depending on their preference – for example, through a website, a separate report or integration in yearly reports already produced. The only conditions are that the information is complete, on time, and that the Inspectorate should be informed about where the data can be found.
- To emphasise that the data is from (and largely for) the hospital itself, the Inspectorate only uses information directly from the hospital itself. It does not use national registries or patient surveys that are not ‘owned’ by individual hospitals themselves.

The indicators that are used to monitor performance in the emergency ward, operating theatre and intensive care units are outlined in Table 9.

Table 9: Dutch performance indicators for the emergency ward, operating theatre and intensive care unit

Indicator	Process	Outcome
1. Postoperative pain	1.1 Percentage of postoperative patients having received standardised pain measurements	1.2S Percentage of patients whose pain score is less than four within the first 72 hours
2. Volume of high-risk interventions	2.1 Volume of repairs of unruptured abdominal aortic aneurysm 2.2 Volume of oesophageal resections for oesophageal carcinoma	
3. Laparoscopic surgery	3.1aS Ratio of laparoscopic versus open cholecystectomy 3.1bS Ratio of laparoscopic cholecystectomy in day care versus inpatient laparoscopic cholecystectomy	3.2S Percentage of conversions from laparoscopic to open cholecystectomy
4. Cancelled operations	4.1 Number of elective operations cancelled within 24 hours before surgery	
5. Unplanned re-operations	5.1a Percentage of unplanned re-operations 5.1b Top three unplanned re-operation indications	
6. Intensive care	6.2 Mean and median number of artificial respiration days per patient requiring artificial respiration	

Source: Berg et al. 2009

Literature has not been identified that provides evidence of whether the Dutch performance monitoring system has achieved its objectives. The reason for this could be that the system is still under investigation.

5.4.6 New Zealand

New Zealand does not have a national performance measurement framework that is specific to emergency surgery, and as such the literature on this topic is minimal. New Zealand does, however, capture more general performance data for health care facilities via the DHB Hospital Benchmark Information quarterly report (New Zealand Ministry of Health 2009a). Although the KPIs do not target the performance of emergency surgical services specifically, some of the indicators do include emergency surgery patients. For example:

- **Triage rates.** 100 per cent of triage 1 patients should be seen immediately; 80 per cent of triage 2 patients should be seen within 10 minutes; 75 per cent of Triage 3 patients should be seen within 30 minutes.
- **Acute patient readmissions.** This measures numbers of readmissions within seven days per 1,000 discharges.
- **Average length of stay.** The average number of days (measured at midnight) spent in hospital by inpatients is measured.

The New Zealand Ministry of Health provide the report to DHBs to use in enhancing their own performance (New Zealand Ministry of Health 2009a). This data is, however, more relevant to emergency departments and hospitals in general than emergency surgery. There has been little other information published in relation to New Zealand's performance measurement framework.

Performance monitoring and evaluation

The monitoring and evaluation of performance is an essential component for improving health care delivery and patient outcomes in emergency surgery. Both clinical and operational indicators contribute to the understanding of the quality of emergency surgical services.

While many different types of performance monitoring frameworks are used to monitor health care around the world, the vast majority do not incorporate specific indicators for emergency surgery. The key challenge is therefore around ensuring the appropriate performance data is collected to inform developments in emergency surgical care. Different kinds of performance indicators are used for different purposes: internal indicators are used by hospitals to monitor and improve their own services; and external indicators are used by governments, patient organisations and payers to assess the quality of a health care provider.

The intended purpose of a data collection exercise can have a clear influence on the reliability and quality of the data that is submitted. It is important to be aware of the impact of particular disincentives or incentives on the data that will be submitted when designing a framework for performance monitoring and evaluation. For example, data that is not identified is likely to ensure a more reliable dataset than data used to publicly rank hospitals.

There is no consensus around specific performance targets for clinical and operational KPIs because these will inevitably vary according to specific contexts and purposes. It is therefore important that any KPI targets that are developed are tailored appropriately.

Appendix 1: Emergency surgery models of care: case studies

1. Introduction

As hospitals around the world confront the range of challenges associated with providing emergency surgical care, new approaches are tested in an attempt to improve the quality of care being delivered to the public. This appendix presents some examples of innovative models of emergency surgical care that have been identified throughout the course of the literature review. The models of care that are presented have been selected because sufficient evidence exists linking these operational models to positive outcomes in emergency surgical care. A broad overview of each model of care is provided, along with summaries of relevant case studies and supporting evidence from different international jurisdictions.

Literature from Australia, the US, the UK, New Zealand, the Netherlands and Canada was reviewed in order to gain insights into innovative approaches to the management of emergency surgery that exist internationally. Case studies were only selected for inclusion if the literature presented sufficient evidence to demonstrate the practical outcomes of each initiative. The US and the UK have published the majority of the literature relating to this topic; accordingly, these two jurisdictions have a higher representation in the case studies presented in this appendix. Those jurisdictions that are not represented in the case studies have only been excluded because the review of the literature did not identify studies within these jurisdictions that had sufficient data for inclusion. Despite the absence of this literature, these jurisdictions may well be using innovative approaches to emergency surgical care in practice.

Some of the models of care outlined in this appendix are interrelated and thus should not be viewed in isolation. For example, the dedicated emergency consultant-surgeon model, which involves the appointment of a dedicated emergency surgical consultant with no elective surgery commitments, is an approach that is incorporated into other models of care such as the surgical assessment unit (SAU). Similarly, a SAU is one component of the acute surgery unit (ASU) model that has been adopted in some hospitals in Australia. The ASU builds upon the SAU model by also including an acute surgical ward and an acute surgery operating theatre, thereby addressing more stages in the surgical patient journey than an SAU does in isolation.

On the other hand, the ASU just described should not be confused with the Acute Care Surgery (ACS) model of trauma care that is emerging in the US and Europe, despite the similarity of the language used in the literature to describe these two models. The ACS model refers to the development of a new specialty in emergency care, which incorporates three service components: trauma, critical care and emergency surgery. It reflects a new way of thinking about the fields of trauma and general emergency surgery, and has been accompanied by the development of a new training curriculum and career path for surgeons in the US. The ACS model is therefore quite distinct from the ASU found in Australia, which focuses more specifically upon the logistical and operational management of acute surgery. Similar names do not necessarily mean similar things, even though there are some inter-related components.

When considering each of these models of care it is important to keep in mind that each hospital has a unique caseload in terms of volume and complexity, and operates within different resourcing, policy and infrastructure constraints. The applicability of a particular model of care to any given hospital will be influenced by these variables.

2. The dedicated emergency surgeon model

1.1. Case study 1: Charing Cross Hospital, United Kingdom

Hospital profile	• General acute hospital that houses the serious injuries centre for west London; tertiary referral centre for neurosurgery, with 627 beds (in 2005)
Model of care	• A dedicated emergency surgery consultant was appointed to provide a weekday emergency surgery service between 8 am and 5 pm for admissions from all surgical specialties. • The dedicated emergency surgeon had no fixed elective commitments. • A 15-bed surgical assessment unit (SAU) was established (see case studies 2 and 3). • The consultant roster was divided between eight surgical consultants (6.5 EFT) to cover between 5 pm and 8 am. • Daytime registrar cover is available either from a registrar solely committed to emergency work or the registrar carrying the general surgery on-call bleep. If unable to see the patient within 30 minutes, the dedicated consultant surgeon is called. • All patients are assessed by a consultant/specialist registrar within 30 minutes of referral. At this point a decision is made either to admit the patient to the SAU or discharge back to GP care. Investigations are instigated. • A dedicated emergency surgery theatre is available. • All minor emergency operations are performed with 12 hours of admission.
Outcomes	These outcomes compare a nine-month period (Feb–Nov) in 2005, during which a dedicated emergency surgeon was appointed, with the same period in 2004, in which there was no dedicated emergency surgeon. • The number of patients that were operated on increased by 11 per cent, from 258 in 2004 to 286 in 2005. • There was an increase in daytime operating from 57 per cent in 2004 to 74 per cent in 2005, with a consequent decrease in after-hours operating from 43 per cent to 26 per cent. • There was an increase in consultant-supervised operations from 14 per cent in 2004 to 52 per cent in 2005. • There was an increase in discharges within 48 hours from 41 per cent in 2004 to 53 per cent in 2005. • Approximately £90,000 per annum was saved as a result of increased early discharges and improved quality of care.
Conclusions	The appointment of a dedicated emergency surgery consultant has resulted in an increase in daytime consultant-supervised operating, shorter hospital stay for emergency admissions, improved training for surgical trainees, as well as providing potential financial savings for the trust.

Adapted from: New Zealand Ministry of Health 2009a

2. Surgical assessment unit (SAU)

2.1. Case study 2: Medway Maritime Hospital, United Kingdom

Hospital profile	• Largest hospital in Kent, treating around 40,000 patients each year • ED receives 200 patients a day • Associate teaching hospital
Model of care	• A surgical assessment unit (SAU) was established to provide a fast-track route for assessing acute general surgery and urological referrals only. • The SAU was created in a bay on the general surgical ward. It includes six trolleys on which patients can be assessed and a waiting area for six additional patients. • The unit is staffed 24 hours a day by at least one registered nurse, who is assisted by a nursing assistant/auxiliary. • Members of the surgical team rostered to the SAU, including consultants, have no elective commitments while on call. • An operating theatre was made available during work hours exclusively for acute patients presenting to the SAU.
Outcomes	During an eight-week period from 15 November 2003 to 10 January 2004: • The SAU had 550 referrals of which 196 (36 per cent) came via the ED; the other 354 (64 per cent) came from GPs or other hospital departments. • All patients were seen by a registered nurse within five minutes of arrival at the SAU. • 68 per cent of patients were seen by a doctor within an hour of arriving. • 68 per cent were either discharged or admitted to the main surgical ward within four hours. • Median duration of stay at the SAU was 3.25 hours.
Conclusions	The study showed that throughout the course of a year the SAU had potential to divert 2,301 patients away from the ED. 64 per cent of patients arriving at the SAU came from sources other than the ED. Without the SAU, these patients would have had to be seen in the ED, which was already struggling to meet demand. The SAU provided a strategy for streamlining the emergency surgery patient journey by ensuring they received rapid assessment and management by senior surgical staff.

Adapted from: Mohamed & Mufti 2005

2.2. Case study 3: Eastbourne District Hospital, United Kingdom

Hospital profile	• Provides a service for a catchment population of 255,000. • Receives approximately 3,200 emergency general surgery and urology admissions per year.
Model of care	• The SAU was built as a separate unit within the surgical directorate. It includes six trolleys and five beds. • The SAU is a 24-hour service for general surgery and urology patients. Patients requiring specialist care were transferred to an appropriate bed in the main surgical wards after assessment in the SAU. • A surgical registrar is on call, designated solely to the SAU. • 17 nursing EFT are dedicated to the SAU. • The SAU targets include: – to discharge 20 per cent of patients within 12 hours – patients have initial assessment with a registered nurse within 15 minutes of arrival – patients are seen by a doctor within one hour of arriving to initiate investigations – a care plan decision is made within 12 hours of arrival. • The SAU functions as a short-stay unit that takes adult emergency general surgical and urological patients referred directly from local GPs or the ED. Maximum length of stay is usually < 24 hours, but some patients may be discharged within 48 hours. • Patients who have an anticipated longer length of stay or require specialist care are transferred to an appropriate bed on the main surgical wards after assessment in the SAU. • The SAU has rapid access to the investigative facilities required for assessment, including laboratory investigations, X-ray, ultrasound and CT scanning.
Outcomes	During the period between 14 January and 31 December 2002: • 3,378 patients were assessed in the SAU • 22 per cent of patients were discharged within 12 hours. • The SAU reduced the admission rate to main surgical wards by 34 per cent. • The number of emergency operations between 2 and 5 pm increased by 9 per cent. • The number of evening operations between 6 and 11 pm decreased by 9 per cent.
Conclusions	The SAU improved the efficiency and management of surgical emergencies at Eastbourne District General Hospital by ensuring rapid investigations and assessment of emergency surgery patients. The 22 per cent discharge rate contributed to hospital cost savings and increased availability of beds, which had a flow-on effect on elective surgery by reducing wait times. The SAU enabled more urgent cases to be completed on the day of arrival.

Adapted from: Rowe, Lawrence & Fellows 2003

3. Acute surgery unit (ASU)

3.1. Case study 4: Prince of Wales Hospital, Australia

Hospital profile	• One of 13 principal referral hospitals for adults in New South Wales • 440 beds
Model of care	• An acute-care ward of four beds and an operating theatre was placed under the control of the rostered acute-care surgeon (ACS). • Patients treated in the acute-care theatre were drawn from a wide range of specialties including paediatrics, neurosurgery, orthopaedics, plastic surgery and vascular and transplant surgeries; obstetrics emergencies were excluded. • The ACS roster was shared by eight general surgeons who provided on-site service from 8 am to 6 pm Monday–Friday and on-call service after hours. The first rostered surgeon covered between Monday 8 am and Wednesday 12.30 pm; the second covered Wednesday 12.30 pm to Friday 6 pm; the weekend reverted to pre-existing on-call arrangements. • A formal handover process occurred between duty periods. • The sole commitment of the ACS was to treat and manage patients and the acute-care theatre for the duty period. S/he was also responsible for conflict resolution between specialties. • The ACS, duty anaesthetist and theatre management staff met at 3 pm every weekday to select the first case to be scheduled at 8 am in the acute-care theatre the following day. • The acute-care team consisted of the ACS, an acute-care registrar (a senior basic surgical trainee) and an acute-care resident. • All patients with an acute general surgical illness who did not require high dependency or intensive care were planned for admission to an acute surgical ward. These patients came from a range of specialties (excluding obstetrics).
Outcomes	Over a 79-week period that commenced in September 2005: • In-hours emergency theatre utilisation increased from 57 per cent to 69 per cent. • The first operation of the day has commenced 14 minutes earlier than pre-project. • There was an 11 per cent reduction in acute-care operating after hours, and 26 per cent fewer emergency cases were handled between midnight and 6 am. • 40 per cent of patients who were seen by the ED and deemed not for admission by the ACS would have been admitted by the registrar had the consultant not been on site and reviewing patients. This created a potential saving of 114 bed days, or $142,000.
Conclusions	The ASC model resulted in a more efficient use of the entire theatre block, including high theatre utilisation rates and a decrease in cases handled after hours. It enabled on-site consultant-driven surgical leadership that provided a significant positive change to the provision of acute surgical care and enabled better supervision of junior staff. In addition, the ASU model improved the lifestyle of the surgeons and was unanimously accepted by those involved as a better model of care that the previous on-call system.

Adapted from: Parasyn et al. 2009

4. The acute care surgery model for trauma care

4.1. Case study 5: Santa Clara Valley Medical Centre, United States

Hospital profile	• Academic, country-based, level 1 trauma centre • In 2005 there were 2,963 trauma activations resulting in 1,712 admissions of 12 hours or longer. • Majority of traumas consist of blunt trauma, with less that 10 per cent consisting of penetrating traumas.
Model of care	• A dedicated on-call surgical attending of the week (AOW) is responsible for all emergency general surgical patients admitted in the seven-day call cycle and responds to all major trauma activations in the daytime hours. • The nighttime trauma call service is provided by a call pool, which included seven core full-time trauma surgeons and a group of 4–5 part-time community and military surgeons. • Each of the seven full-time trauma surgeons maintains an elective surgery practice that consists of 1–2 half days of outpatient surgical clinic. Each surgeon has at least one designated block of time in which elective cases can be scheduled. • A single surgical service covers the elective patients as well as the ACS/trauma patients with an AOW providing support during major care decisions for elective patients. • The surgical resident teams, under the supervision of the AOW, is responsible for all critical care and trauma patients. • A compensation plan was developed that provides incentives for after-hours trauma call and offers an hourly wage, except for the AOW who receives a flat fee if s/he is called in for a complex case after hours. • An elective block of time is maintained for the AOW to accommodate urgent cases that do not need to be performed in the middle of the night. • An urgent operating room is also used on a first come, first served basis.
Outcomes	During the period between 1 January 2005 and 31 December 2005: • 2,276 surgical cases were completed. Of these cases, 65 per cent were elective general surgery; 32 per cent (796) were emergency/urgent general surgery; and 4 per cent were emergency trauma surgery. • Non-trauma surgeries allowed the team to increase individual surgical experience to an average of 312 a year. • Only 23 per cent of cases were performed after 7 pm.
Conclusions	The ACS model delivered a high standard of patient care that incorporated trauma surgery, critical care and emergency surgery services. This model increased consultant satisfaction as a result of the capacity to maintain a healthy elective practice and have access to a greater breadth of surgical experience.

Adapted from: Parasyn et al. 2009

4.2. Case study 6: Hospital of the University of Pennsylvania, United States

Hospital profile	• Urban, academic, level 1 trauma centre
Model of care	*Note: During this study, coverage of surgical emergencies altered between the ACS model and the traditional model (TRAD) each month to compare the outcomes of each model of care on patients with appendicitis.* • Prior to September 1999, the trauma service provided care only to patients with traumatic injuries. A separate general surgery service performed all emergency general surgery and unassigned elective general surgery. From 1999 to 2002 the trauma services participated in the evaluation and care of emergency general surgery patients on a monthly basis. • The traditional model refers to a model in which a non-trauma general surgeon takes call at home for general surgery emergencies. • The ACS model refers to the model where qualified trauma surgeons responded to general surgery emergencies. Under the ACS model, the trauma attending took 24-hour periods of in-house call. • All other aspects of hospital care, including the resident complement, remained unchanged during this time. • General surgery consults were initially evaluated by a PGY-3* in all cases, and reviewed with a senior resident (PGY-4 or PGY-5). The case was then discussed with an attending surgeon.
Outcomes	• During a three-year period, 294 patients were admitted for acute appendicitis. Of these patients, 167 were attended to under the ACS model, and 127 under the TRAD model. • The time from consultation to OR was significantly decreased in the ACS model (ACS = 3.5 hours; TRAD = 7.6 hours). • The total time for ED presentation to OP was significantly shorter in the ACS model (ACS = 10.1 hours; TRAD = 14 hours). • Using appendicitis as a clinical indicator, rupture rates were decreased in the ACS model (ACS = 12.3 per cent; TRAD = 23.3 per cent).
Conclusions	In patients with acute appendicitis, the ACS model decreased the time to operation, rupture rate, complication rate, and hospital length of stay. The ACS model therefore appears to improve the outcomes of acute appendicitis compared with a TRAD home-call model.

Adapted from: Earley et al. 2006

* 'PGY' refers to 'postgraduate year'

5. Parallel processing

5.1. Case study 7: Helsinki University Central Hospital, Finland

Hospital profile	• Average of 5,000 urgent and emergent procedures performed yearly
Model of care	• The study took place in the orthopaedic and trauma operating unit and included urgent orthopaedic trauma cases only. This unit consisted of four operating rooms (ORs), two of which were allocated for urgent and emergent trauma cases only. • A team of two nurses and one anaesthesiologist was added to one OR. This induction team consisted of one anaesthesiologist, anaesthesia nurse, and one circulating nurse. • This team performed parallel anaesthesia induction in the induction room of one OR concurrently with the preceding procedure. • By the end of the first case of the day, the induction team will call for the next patient and perform anaesthesia induction. • Should the induction of patient 2 and the emergent of patient 1 overlap, the anaesthesiologist will ask a colleague to help with the emergence. Otherwise, s/he will take care of all cases in that room. • When the OR cleanup is complete, the induction team will follow patient 2 into the OR and proceed with the positioning, surgical preparation and the procedure. • The nurse from case 1 will take their patient to the post-anaesthesia care unit and hand over. One nurse will go on break and two others will call for patient 3, anaesthesia will be started, and so on. No extra personnel are required to give team members breaks.
Outcomes	These outcomes refer to data generated under the parallel processing model of care compared with data measured prior to the introduction of the new model. The old model used a traditional induction-in-the-OR model. • The mean non-operative time was reduced by 45.6 per cent, but surgery time remained the same. • As a result of reductions in non-operative time, one additional case was performed during the seven-hour working day. • Monthly overtime hours of the operating unit decreased from 196 to 190 hours. • The theoretical labour cost-efficiency showed an improvement in cost-efficiency of 16 per cent.
Conclusions	Parallel processing of anaesthesia induction reduced non-operative time and generated a faster turnaround time for orthopaedic trauma cases. This enabled an extra case per day to be performed and improved the efficiency of the operating unit.

Adapted from: Torkki et al. 2005

5.2. Case study 8: Massachusetts General Hospital, United States

Hospital profile	• 900 beds • Level 1 adult and paediatric trauma and burn centre
Model of care	• Three-room operating suite that included an OR, an induction room and an early recovery area (post-anaesthesia care unit or 'PACU'). • Traditionally sequenced activities were run in parallel and non-surgical activities were moved from the OR to the supporting spaces: – Induction of anaesthesia runs in parallel with room set up. – PACU transfer time in minimised by giving a report to PACU personnel stationed in the operating suite in parallel with the last stages of surgery. – The provision of an early recovery area in the operating suite eliminates the need for anaesthesia personnel to travel to the PACU. • The new workflow was supported by additional anaesthesia and nursing personnel, including a perioperative nurse, who admits patients to the suite and provides early recovery care, allowing anaesthesia personnel to move to induction of the next patient promptly. • The attending supervision ratio was 1:1.
Outcomes	These outcomes compare data generated by the new model with that under the traditional, sequenced activity model. • Non-operative time was reduced from 67 minutes to 38 minutes per case, which equates to 40 per cent of the pre-intervention non-operative time. • Operative time decreased by 5 per cent. • Turnover time was reduced by approximately 14 minutes. • OR anaesthesia time was reduced from 13 minutes to 3 minutes per case. • Surgeons performing shorter cases were able to complete extra cases in fewer hours. • Hospital and anaesthesia costs per case increased, but the increased throughput offset costs and the global net margin was unchanged.
Conclusions	The new parallel processing model introduced at Massachusetts General Hospital resulted in more cases per day than the traditional model and used less time per case. Restructuring the perioperative processing model has a particular impact when shorter cases are performed because it reduces the non-operative time contributing to longer turnarounds.

Adapted from: Sandberg et al. 2005

Appendix 2: Snapshot of practice in five international jurisdictions

1. Canada

What innovative models of care exist?	• CritiCall. A call centre that includes an emergency referral service for physicians across the province of Ontario (CritiCall Ontario 2009). This service is not specific to emergency surgery; however, if an emergency surgery patient presents at a hospital that does not have the capacity to treat the patient, CritiCall assists physicians to organise a transfer to a hospital with the required resources. • Resource Allocation Methodology (RAM). This Vancouver system calculates operating room (OR) allocation by surgeon, specialty and site (British Columbia Ministry of Health Services 2009). RAM looks at all measurable demand for OR time, including emergency, urgent, elective and specially funded, and does a gap analysis of supply and demand.
Are there standardised categories of prioritisation?	There are no standardised categories of prioritisation across the jurisdiction.* Health care systems are managed at a provincial level, and therefore standards vary between each province. One example can be found in Ontario, where surgeons developed a set of standardised priorities. These include: priority 1 – emergency; priority 2 – urgent; priority 3 – semi-urgent; and priority 4 – elective.
What kind of performance measurement framework is used across the jurisdiction?	A common performance measurement system is not used across the jurisdiction. Ontario and British Columbia are the most developed provinces in terms of data collection. However, the focus of the performance data collected does not relate to emergency surgery, focusing specifically on wait times for elective surgery.
Does emergency surgery performance affect funding?	Funding is provided to hospitals from provincial governments and therefore has different conditions attached. In Ontario, funding for surgery is attached to a set of requirements that must be achieved, which predominately relate to achieving wait-time targets. Although there is no bonus tied to these funds, if hospitals do not perform well then the government will recover the funds at the end of the year. In this way, there is an incentive for hospitals to meet performance targets.*
Overview of relevant literature from jurisdiction	Minimal published literature has emerged in Canada. Most of the literature that has been identified throughout this review can be described as grey literature, conference proceedings or website material. This is due to the fact that Canada does not appear to be as advanced as the UK or the US in terms of its approach to emergency surgery, and focuses more on improving elective surgery.

* According to consultations with Lidia Canetti from the Ontario Ministry of Health & Long-Term Care

2. The Netherlands

What innovative models of care exist?	*Information not available at time of writing.*
Are there standardised categories of prioritisation?	*Information not available at time of writing.*
What kind of performance measurement framework is used across the jurisdiction?	The Netherlands has adopted a nationwide performance target measurement framework that has been implemented by the Dutch Health Care Inspectorate (Berg et al. 2005). Three data subsets are collected, including one that contains performance indicators for emergency wards, operating theatres and intensive care units.
Does emergency surgery performance affect funding?	*Information not available at time of writing.*
Overview of relevant literature from jurisdiction	The Netherlands has published a number of articles that provide simulation models that focus on achieving efficiencies in the operating suite (Olmstead et al. 2007; Wullink et al. 2007). Although these models have not been implemented and therefore lack real-world evidence, they provide useful insights in that can assist with the management of emergency surgery, particularly in relation to the balance between elective and emergency surgery demand (Hans et al. 2008). Literature relating to the performance measurement system is also valuable.

3. New Zealand

What innovative models of care exist?	• Short stay recovery unit (SSR). For pre- and post-theatre. If a patient is due to go into theatre within the next four hours they will be pulled out of the ED and into the SSR (New Zealand Ministry of Health 2009b). • CapPlan. New Zealand has invested in a demand management software program called 'CapPlan' to help model future demand. This program uses forecasting to match demand for beds with staff and the number of resourced beds, which has resulted in better phasing of beds including those for emergency surgical patients (New Zealand Ministry of Health 2009b).
Are there standardised categories of prioritisation?	New Zealand does not have standardised categories of prioritisation for emergency surgery patients at the national level. Some individual hospitals may have developed specific criteria for use.
What kind of performance measurement framework is used across the jurisdiction?	New Zealand does not have a national performance measurement framework that is specific to emergency surgery. However, the District Health Board (DHB) Hospital Benchmark Information quarterly report publishes general performance date on health care facilities nationally (New Zealand Ministry of Health 2009a). Although the KPIs do not target the performance of emergency surgical services specifically, some of the indicators are inclusive of data relating to emergency surgery. These include triage rates, acute patient readmissions and length of stay.
Does emergency surgery performance affect funding?	Not specifically – funding incentives are tied to elective surgery. In order to maximise funding, the emergency surgical service should have minimal impact on the elective surgery performance indicators.
Overview of relevant literature from jurisdiction	Minimal literature has emerged from New Zealand relating specifically to emergency surgery operating models and performance measurement frameworks. The main sources of information on emergency surgery care are government websites and reports, but these too have limited information (New Zealand Ministry of Health 2009a, b, c). The most relevant journal articles that have been recently published assert that New Zealand needs to develop an acute care strategy (Ardagh 2006; Bhagvan & Civil 2009).

4. United Kingdom

What innovative models of care exist?	• Surgical assessment unit (SAU). SAUs receive emergency surgery patient referrals and provide rapid diagnosis and investigation of emergency surgery patients (Mohamad & Mufti 2005; Rowe, Lawrence & Fellows 2003). • Dedicated emergency surgeon model. A dedicated consultant surgeon with no elective commitments is rostered on to cover emergency surgery. This ensures access to prompt emergency surgery, leadership, supervision and quality of care (Sorelli et al. 2008). • Treatment centres (TC). Treatment centres are dedicated to elective surgery patients to allow better management of the balance between emergency and elective surgery (UK Department of Health 2008).
Are there standardised categories of prioritisation?	The National Confidential Inquiry into Patient Outcome and Deaths (NCEPOD) published a classification of interventions (excluding obstetrics) that categorises patients as immediate, urgent, expediated and elective (NCEPOD 2004). Each category is accompanied by a description, target time to theatre, example scenarios and typical procedures. These classifications are used as a guide throughout the NHS. They were revised in December 2004 and were due to be reviewed again in May 2010.
What kind of performance measurement framework is used across the jurisdiction?	The NCEPOD collect clinical and operational performance data from all specialties including surgical patients (NCEPOD 2009); the Trauma and Research Network (TARN) collects data on clinical indicators relating to trauma patients (TARN 2009); and the NHS collects information relating to the performance of hospitals and health services on their website, NHS Choices. (NB: This information is not specific to emergency surgery (NHS 2009).) All of this performance data is made publicly available to create incentives to provide better care.
Does emergency surgery performance affect funding?	Performance funding in the UK is tied to funding, but KPIs do not specifically target emergency surgery.
Overview of relevant literature from jurisdiction	A significant body of research has been published in the UK in relation to emergency surgery. The concept of consultant-led models of care is prevalent throughout the literature. This reflects the UK Government recommended consultant-led models of care after the first NCEPOD was published in 1987 (Buck, Devlin & Lunn 1987). NCEPOD is responsible for a vast collection of research since 1987, which also contributes to the strong set of literature that exists. A number of innovative models have also emerged in the UK, including SAUs and the use of TCs for separating emergency and elective surgery UK Department of Health 2008).

5. United States

What innovative models of care exist?	• Operating Room of the Future (ORF). Massachusetts General Hospital established the ORF, which adopts innovative technological and perioperative processes to enhance emergency surgical care (Sandberg et al. 2005). • Acute care surgery (ACS) model. The US is leading the development of this model as a new approach to the trauma and general surgery specialties to enhance the provision of emergency surgery. A curriculum has been developed in the US to train new surgeons in ACS (Earley et al. 2006; Garland et al. 2007; The Committee to Develop the Reorganized Specialty of Trauma, S.C.C. and Emergency Surgery 2005).
Are there standardised categories of prioritisation?	There are no standardised categories of prioritisation across the jurisdiction as a whole. However, individual hospitals may use case definitions that are similar to the example provided in the generic policy for scheduling surgical procedures and block allocation.* These definitions include: emergent (life or limb threatening surgical intervention required without delay); urgent (may be life or limb threatening if surgical intervention does not in occur within eight hours); LOS urgent (inpatient length of stay will be prolonged as a result of scheduling, not patient physical condition); and elective (not life or limb threatening).
What kind of performance measurement framework is used across the jurisdiction?	Performance data in the US is often considered to be commercial-in-confidence due to the fact that the hospital system is largely private. Although the individual hospitals or insurance companies that run the hospitals collect performance data, there is no overarching performance measurement framework across the jurisdiction. A generic policy for scheduling surgical procedures and block allocation exists that is used to assist hospitals and is tailored to their specific needs. This policy document outlines some targets that give an example of the type of performance data collected, including targets for patient wait time, patient morbidity/mortality rates, patient readmissions and rates of elective case cancellations for unplanned surgery.*
Does emergency surgery performance affect funding?	*This information is currently being collected via participants in the international jurisdiction survey.*

Overview of relevant literature from jurisdiction	The body of literature relating to emergency surgery that is published in the US is one of the largest in all of the international jurisdictions. A large portion of this is specific to emergency surgery operating models, which can be attributed to the fact that a number of US hospitals have adopted innovative and experimental approaches to emergency surgery care. For example, Massachusetts General Hospital (Sandberg et al. 2005; Serb 2008), Hospital of the University of Pennsylvania (Earley et al. 2006), and Santa Clara Valley Medical Centre (Garland et al. 2007). Some of the literature relates more specifically to emergency surgery scheduling (Jones & McCullough 2007; Lebowitz 2003a, b) and improving the efficiency of the operating suite (Adams et al. 2004; Taheri, Butz & Greenfield 2000). In addition, a number of journal articles emerging from the US focus on the ACS model outlined in section 4.1.1, which is reflected by the position of the US as one of the international leaders in the development of this approach to trauma and general emergency surgery (Britt 2004; Esposito, Leon & Jurkovich 2006; Sanchez & Sariego 2009).

* Sourced from consultation with participant in international survey from the US Kristi Kawamoto.

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