

Assuring optimal trauma care: the role of trauma centre accreditation

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Optimal care of the injured patient requires the delivery of appropriate, definitive care shortly after injury. Over the last 30 to 40 years, civilian trauma systems and trauma centres have been developed in the United States based on experience gained in military conflicts, particularly in Korea and Vietnam. A similar process is evolving in Canada. National trauma committees in the US and Canada have defined optimal resources to meet the goal of rapid, appropriate care in trauma centres. They have introduced programs (verification or accreditation) to externally audit trauma centre performance based on these guidelines. It is generally accepted that implementing trauma systems results in decreased preventable death and improved survival after trauma. What is less clear is the degree to which each facet of trauma system development contributes to this improvement. The relative importance of national performance guidelines and trauma centre audit as integral steps toward improved outcomes following injury are reviewed. Current Trauma Association of Canada guidelines for trauma centres are presented and the process of trauma centre accreditation is discussed.

Pour traiter de façon optimale le patient traumatisé, il faut lui dispenser des soins appropriés et complets peu après le traumatisme. Au cours des 30 à 40 dernières années, des systèmes et des centres de traumatologie civils ont été établis aux États-Unis à partir de l'expérience acquise au cours de conflits armés, particulièrement en Corée et au Vietnam. Un phénomène semblable commence à prendre forme au Canada. Des comités nationaux de traumatologie des États-Unis et du Canada ont défini les ressources optimales nécessaires pour atteindre le but que constitue l'administration rapide des soins indiqués dans les centres de traumatologie. Ils ont lancé des programmes (vérification ou agrément) afin d'évaluer de l'extérieur le rendement des centres de traumatologie en fonction de ces lignes directrices. On reconnaît en général que l'implantation de systèmes de traumatologie réduit le nombre des décès évitables et améliore la survie après le traumatisme. On ne sait pas toutefois clairement dans quelle mesure chaque dimension de l'élaboration du système de traumatologie contribue à cette amélioration. Les auteurs examinent l'importance relative des lignes directrices nationales sur le rendement et de l'évaluation des centres de traumatologie en tant que partie intégrante de l'amélioration des résultats à la suite d'un traumatisme. Ils présentent les lignes directrices actuelles de l'Association canadienne de traumatologie qui s'appliquent aux centres de traumatologie et discutent du mécanisme d'agrément des centres.

In his seminal *Scientific American* article in 1983, Trunkey¹ described a trimodal frequency distribution for death after trauma and provided the scientific basis for what has been referred to as the "golden hour" in the Advanced Trauma Life Support Program. Of particular in-

terest to trauma care providers is the second peak of death, occurring 2 to 4 hours after injury and accounting for 30% of all deaths due to trauma. Analysis of the causes of death in this group revealed that most deaths were from treatable problems and were therefore considered potentially

preventable. Specific causes of death in this group included hemorrhage (from intra-abdominal solid organ injury, pelvic fractures, multiple long-bone fractures), thoracic problems (including tension or open pneumothorax) and expanding intracranial hematomas.

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Based on a presentation to the joint scientific meeting of the Australasian Trauma Society and Trauma Association of Canada, Sydney, Australia, March 2001.

Accepted for publication Mar. 20, 2002.

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The concept of preventable trauma death is now ingrained in the literature relating to improvement in trauma performance. Survival after injury is based on 4 determinants: injury severity (an event determinant); physiologic reserve (a patient determinant); appropriate intervention (a care determinant); and timeliness of care (a care determinant). Preventable death may occur if care is either inadequate or delayed. Preventable death in a given jurisdiction is measured by expert panel retrospective review or by using registry-based predictive models, which compare actual to predicted deaths based on historical local, national or international benchmarks.²⁻¹¹

Rationale for trauma systems and centres

Trauma systems attempt to match the needs of trauma patients to the appropriate level of care and to integrate multiple prehospital, acute care and rehabilitation services so as to optimize care at each phase and minimize delays in treatment. The more severely injured require early identification, stabilization and triaging with expedited transport to the nearest appropriate facility, preferably a trauma centre. Prehospital emergency services require a high level of preparedness and preplanning to achieve these goals along with the commitment of resources to optimize transportation times. Trauma centres likewise are expected to prioritize resources within the institution, again with high levels of preparedness, preplanning and resource commitment.

Trauma system effectiveness has been documented in numerous jurisdictions,²⁻¹⁰ and a recent review suggests a 15% to 20% improvement in survival after these systems have been implemented.¹² Trauma centres, an integral part of trauma systems, are hospitals designated to receive the more severely injured patients who are at risk for trauma-related death.

Outcomes for injured patients admitted to trauma centres are superior to those admitted to other acute-care facilities^{3,9,13} for a number of reasons. The role of performance standards for trauma centres^{14,15} defined and audited by national trauma committees is the primary focus of this article.

Improving quality of trauma care

Traditional department-based quality assurance activity forms the backbone of most hospital quality of care programs. The process is a retrospective audit, usually by nonphysicians, who identify errors or adverse outcomes based on predetermined criteria. Subsequent peer review, the basis of mortality and morbidity conferences, is focused on individual practitioner-related events and identifies outliers. The process is inherently focused on a limited fraction of total care delivery, and its impact on the general level of performance and outcomes is unclear.

Continuous quality improvement (CQI) was developed as an industry-based approach to quality management and was popularized by Juran.¹⁶ Errors are considered the product of complex care processes rather than individual practitioner-related events. CQI, therefore, attempts to simplify the care process by standardization, reduced variability among practitioners, automation of as much of the care process as possible through CQI products such as care paths, algorithms, practice guidelines and protocols. CQI is inherently process- and not practitioner-focused and addresses quality across the entire care process for all patients.

Errors in the delivery of trauma care are a significant cause of preventable death.¹⁷ Both quality assurance and CQI identify errors. Quality assurance identifies practitioner-related outlier events whereas CQI identifies process errors. In trauma care, for which timeliness of care is critical, delays in care can be as lethal

as errors. Trauma CQI must therefore identify both errors and delays to be effective in improving quality of care. Example identifiers include delays in getting the patient to the operating room, diagnostic evaluation, and errors in technique, judgement and communication. Errors and delays may be characterized as practitioner- or system-related to distinguish them from disease-related complications such as nosocomial pneumonia or intra-abdominal abscess.¹⁸ Recurrent process errors should result in targeted CQI initiatives designed to correct the process and eradicate the tendency to error.¹⁹ In the intensive care unit, perhaps the most complex of all health care delivery environments, errors prove particularly lethal and in one study contributed to half of all preventable deaths.¹⁷ CQI is required to simplify, standardize and automate care processes in these environments in order to reduce error rates and preventable death or morbidity.²⁰

Further advances in the conceptualization of quality in trauma care have led to the introduction of the term performance improvement. Here again is a focus on the care process but with an equal emphasis on outcome.¹⁴ A continuous, multidisciplinary effort is required to measure, evaluate and improve care with documented gains in process and outcome. To achieve this goal standard CQI tools are used, including evidence-based practice guidelines, protocols and care paths. Standardization of care with reduction in variance and attendant errors remains a primary goal. The American College of Surgeons Committee on Trauma has published a booklet outlining the principle steps of trauma performance improvement.²¹ Several trauma-related professional associations now develop and publish evidence-based practice guidelines on trauma care in an attempt to develop greater consistency in practice, not only institutionally but nationally.²² Some trauma centres are now beginning to report their performance in-

dicators on Web sites (www.crha-health.ab.ca/clin/rts/index/htm and www.trauma.org) as part of their commitment to ongoing performance improvement and to establish practice benchmarks.

Several US trauma centres release outcome data for their institutions and have documented incremental gains as trauma programs have consolidated.^{9,10,13,23} Integration of care and development of subspecialty expertise have been cited as important elements in achieving these results. The development of a trauma service led by fellowship-trained trauma surgeons and involved in all aspects of trauma care from resuscitation to discharge is one way to ensure integration of care. Further integration can be achieved by consolidating trauma patients into specific patient care areas or units and developing nursing and allied health expertise in trauma care. This model is the norm in US trauma centres and has been credited with incremental improvement in outcomes as hospital trauma programs mature.¹³ In Canada, this integrated model of trauma care is uncommon, and trauma directors have generally encountered difficulties in implementing this approach in their centres, particularly as resources become more constrained. Integration and coordination of care, therefore, become a challenge but are recognized as key elements to improving care.

Trauma centre accreditation

Trauma centres appeared in North America in the late 1960s and 1970s. San Francisco General and Cook County hospitals under the leadership of Blaisdell and Freemark, respectively, are generally credited as being the first US civilian trauma centres. The concept of the trauma system soon followed with the development of the Maryland Trauma System under the direction of Cowley. These services were based on military experiences and emphasized rapid evacuation of seriously injured

personnel to definitive care surgical centres.

In 1976, the American College of Surgeons Committee on Trauma released its first iteration of what has since become a standard reference on trauma care. The document, "Optimal hospital resources for the care of the seriously injured" and its subsequent iterations as "Resources for optimal care of the injured patient," has defined the resources and commitment necessary to optimize outcome after injury.¹⁴ The criteria have become increasingly evidence-based although they remain, in part, supported by consensus expert opinion. In 1987, the Committee on Trauma initiated its verification program for trauma centres. This is an external audit, performed by the Committee on Trauma, evaluating the trauma centre's compliance with criteria set out in the document. In 1993, the Trauma Association of Canada (TAC), defined similar guidelines for Canadian trauma centres.¹⁵ These criteria were based on the American College of Surgeons' criteria but were modified to accommodate differences in trauma caseload and practice patterns in Canada (see Appendices 1 and 2). In 1996, TAC offered its own audit program, termed trauma centre accreditation, again based on compliance with defined TAC guidelines. To date, approximately 15 Canadian trauma centres have been successfully accredited by TAC. Both the American College of Surgeons and the TAC have recently offered consultation visits to help trauma centres prepare for verification (US) or accreditation (Canada).

Trauma centre accreditation must be distinguished from designation. Designation is an operational and frequently political process whereby a health authority defines which hospitals will receive major trauma patients and which will not. Usually, inherent in the designation process is an expectation of the hospital's performance,⁹ and many designating authorities in the US perform their own

audit of trauma centres to ensure compliance with local and national performance guidelines. In some jurisdictions, however, designation of trauma centres occurs without any defined standards or local audit.²⁵

Accreditation, although it may be linked to designation, is a separate process involving an audit of a trauma centre's performance against established criteria, performed by a responsible recognized authority. In Canada, accreditation is performed by the TAC and evaluates compliance with its national guidelines for trauma care. Both verification and accreditation programs focus heavily on performance indicators and evidence of active performance improvement. Integration of care across the continuum of care is seen as an important component of any trauma program. Although there is an emphasis on the process of care during accreditation, outcomes are also audited. There is a basic assumption, however, that process of care indicators are directly linked to improved outcomes. The evidence for this assumption is far from conclusive but is steadily mounting.

Trauma centre accreditation is a stepwise process. Ideally, the initial request to the TAC for an accreditation visit should come from the responsible health authority rather than the hospital or trauma program itself. This ensures that accreditation and designation processes are linked and that the TAC avoids involvement in any local health care politics. The TAC accreditation program is divided into 2 regions: Western and Eastern Canada, coordinated out of Calgary and Toronto respectively. The appropriate regional office appoints a team of 2 trauma directors and a trauma program manager from outside the province under review. A standard questionnaire is sent to the trauma centre under review to determine its resources, the nature of its trauma program and its commitment to the provision of trauma care. This is followed up by a site visit to con-

firm information provided in the questionnaire, review performance improvement and quality assurance material, and meet with key stakeholders in the trauma program. The site visit often gives the best idea as to the hospital's true commitment to the trauma program and allows deficiencies to be assessed in nonthreatening private interviews. The purpose is ostensibly to ensure quality of care by verifying compliance with national guidelines. Practically, the process may also assist the trauma director and program manager achieve the desired commitment and resources necessary to provide optimal trauma care at their hospital. The reviewers submit a written report to the president of the TAC, which is then forwarded to the requesting health authority. Deficiencies identified in the accreditation process may be deemed critical in which case accreditation may be denied. Others may be seen as less important allowing accreditation to be awarded along with recommendations for improvement with or without a request for subsequent documentation of remedial action. Once awarded, TAC trauma centre accreditation is valid for 5 years.

Linking accreditation with improved outcomes

The challenge for all involved in the provision of health care is defining what is truly effective in improving health and meaningful survival. Professional trauma associations have been wrestling with this issue since the original American College of Surgeons' document was published in 1976. Many of the original recommendations were based largely on the expert opinion of the time and have required ongoing questioning and testing by subsequent generations of trauma care providers to sort dogma from fact. Given that preventable trauma deaths occur if care is delayed or suboptimal, accreditation criteria focus on an integrated

process of care delivery and evidence of system delays or inconsistencies (errors) in care.

Although the case for compliance with accreditation guidelines resulting in improved outcome has yet to be proven, reports are beginning to accumulate that the process of preparing for accreditation and the formal accreditation process itself both yield gains in performance.^{13,23,25-27}

We have seen both these effects.^{23,25} The decision to pursue accreditation is often a defining moment for the trauma program. It requires a commitment from the responsible health authority that the hospital is designated as a trauma centre and will be resourced as such. It requires the hospital and medical staff to commit to a prioritization of trauma care within the institution, and it requires a commitment to achieve national standards set out by TAC guidelines. That decision alone often raises the profile of trauma in the institution and facilitates the work of the trauma director and program manager. This facilitation is furthered if the health authority mandates accreditation as part of the process of designation.

The greatest challenge for nascent trauma programs in Canada is changing a fragmented model of trauma care into a coordinated and integrated model. Process indicators will need to reflect the challenges and document gains in performance during the transition period. The precise model of care will be institution-specific, but the development of practice guidelines, ensuring consistency and reducing delays and errors are integral to success and need to be documented and available for review by the accreditation team. We reported on our own progress 1 year after the initiation of a new trauma program and a commitment to meet TAC accreditation guidelines.²³ We were able to document several gains in performance resulting in reduced delays in disposition (transfer to the operating room or out of the Emer-

gency Department), and improved integration of care with almost 100% compliance with trauma team activation and consultation criteria. We were also able to demonstrate outcome gains, including improved survival of trauma patients and reduced length of stay. More recently, we have demonstrated significant differences in outcomes for trauma patients within a regional trauma system, depending on whether they were admitted to a trauma centre that met TAC guidelines or one that did not.²⁵ In this study, designation of trauma centres without defined performance standards or audit failed to improve outcome. Conversely, performance gains were demonstrated with the implementation of the Quebec Trauma System and designation of trauma centres. Unlike what has happened in British Columbia, an inherent expectation in this system was that trauma centres meet American College of Surgeons Committee on Trauma criteria based on their designated level.^{9,10}

Most US trauma systems link designation to an immediate expectation to meet their local and national guidelines. Separating the effect of designation (i.e., consolidation of trauma caseload) from the effect of verification (i.e., an audit of compliance with national guidelines) has, therefore, been difficult. What evidence exists suggests that outcomes are superior in verified trauma centres.^{13,26,27} Preparation for trauma centre accreditation or verification has been shown to result in performance gains.^{23,26} Further consolidation and integration of trauma care have been shown to result in additional gains.^{7,10,13} Published outcome data for blunt trauma patients from established, verified, US trauma centres currently exceeds performance reported by any Canadian centre. The reason for this remains to be elucidated but is probably related to the high degree of integration, consolidation and development of subspecialty multidisciplinary expertise in US centres.^{13,28}

Summary

Both the US verification program and the Canadian accreditation program have been associated with improved outcomes for seriously injured patients. The programs define common, national guidelines for resourcing and performance of the trauma program and audit compliance with these expectations. National guidelines permit program directors and managers to hold their departments, hospitals and health ministers accountable and facilitate the needed prioritization of trauma care within the hospital. Both programs emphasize integration and coordination of the process of care and look for evidence of a committed performance improvement program. Successfully accredited trauma centres have been able to document significant performance gains. "Noise" in the health care system generally, particularly that relating to resource constraints, may obscure documented improvement in outcomes such as length of stay, although most demonstrate some survival benefit.

The future challenge for the TAC and its accreditation program is to refine the criteria based on newly acquired and scientifically rigorous evidence and to define clearly the performance criteria that result in better outcomes. What evidence we have to date strongly supports the current program and the goal of integrated trauma care. We feel that the preliminary reports from Canada and the US provide sufficient justification for all major Canadian trauma centres to pursue, obtain and maintain TAC accreditation.

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Appendix 1

Trauma Association of Canada Trauma System Accreditation Guidelines (Approved Sept. 9, 1993): Criteria for Pre-Hospital Care

Criteria	Type of service		
Local ambulance service(s):			
a) Formal liaison between the tertiary trauma centre and pre-hospital care system			E
b) Field triage			
• authority/approval to bypass local hospitals			E
• criteria established for pre-hospital care workers to identify severely injured patients in the field			E
• protocols established for the transport of severely injured patients directly to tertiary trauma centre			E
• training program with tertiary trauma centre participation			E
• quality management program to evaluate efficacy of triage criteria and protocols			E
• definition of geographic limits within which the protocols and criteria are to be applied			E
c) Treatment protocols			
• protocols for the field treatment of trauma patients			E
Inter-hospital transport			
a) Formal liaison between tertiary trauma centre and regional/provincial critical care transport program			E
b) Guidelines to defining responsibilities and composition of transport teams of accompanying personnel			E
c) Appropriate training for accompanying personnel specifically relating to the inter-hospital transport of trauma patients			E
Records			
a) Regular quality review of pre-hospital care records			E
b) System to ensure availability of pre-hospital care records to tertiary trauma centre staff and to trauma registry			E
c) Record linkage identifier on pre-hospital care records to allow linkage to in-hospital records and other data sources in the trauma registry			E
*E = essential.			

Appendix 2

Trauma Association of Canada Trauma System Accreditation Guidelines (Approved Sept. 9, 1993): Criteria for Tertiary, District and Primary Trauma Centres

Criteria	Type of trauma centre		
	Tertiary	District	Primary
Hospital governance			
a) Demonstrated commitment to priority treatment of severely injured patients	E*	E	E
b) Assure adequate resources and staff	E	E	E
c) Be committed to the trauma system	E	E	E
Medical/surgical director			
a) A physician or surgeon responsible for the medical and specialty services providing trauma care within the hospital	E	E	E
Medical services			
a) A multiprofessional trauma system within the hospital providing priority service (i.e., operating room, laboratory, diagnostic imaging, nursing and critical care)	E	E	—
b) 24-h trauma team response to include:	E†	E	—
• Trauma team leader (maximum 20-min response time)			
• General surgery consultation (maximum 20-min response time)			
• Other surgical consultation as required (maximum 30-min response time)			
c) 24-h coverage by the following surgical services (response time 30 min):			
• Neurosurgery	E	O	—
• Pediatric surgery	E	O	—
• Urology	E	O	—
• Vascular surgery	E	O	—
• Plastic surgery	E	O	—
• Thoracic surgery	E	O	—
• Orthopedic surgery	E	D	—
• Cardiac surgery	D	—	—
• Gynecology and obstetrics	D	O	—
• Ophthalmology	D	—	—
• Otolaryngology	D	—	—
• Oral surgery	D	—	—

Appendix 2 continued

Trauma Association of Canada Trauma System Accreditation Guidelines (Approved Sept. 9, 1993): Criteria for Tertiary, District and Primary Trauma Centres

Criteria	Type of trauma centre		
	Tertiary	District	Primary
d) Nonsurgical specialties, 24-h schedule			
• Radiology (maximum 30-min response time)	E	E	D
• Pediatrics (maximum 30-min response time)‡	E	O	O
• Anesthesia (maximum 30-min response time)	E	E	O
• Critical care (maximum 30-min response time)	E	E	—
• Cardiology	E	D	—
• Respiriology	E	D	—
• Gastroenterology	E	O	—
• Hematology	E	D	—
• Infectious disease	E	D	—
• Internal medicine	E	E	—
• Nephrology	E	O	—
• Pathology	E	D	—
• Psychiatry	E	D	—
• Neuroradiology	E	—	—
Specialty services within the hospital			
a) Emergency Department			
1) Personnel			
• designated chief, fellow of Royal College of Physicians and Surgeons of Canada	E	D	—
• 24-h coverage by an emergency physician with appropriate training	E	E	—
• medical personnel in hospital	E	E	—
• dedicated nursing personnel in hospital	E	E	D
• surgical residents in-house 24 h/d in university hospital	D	—	—
2) Equipment			
• advanced airway management equipment (adults and children)	E	E	D
• multichannel monitoring of blood pressure, pulse rate, oxygen saturation, body temperature	E	D	D
• electrocardiograph monitor and defibrillator	E	E	O
• dedicated portable or in-place radiography equipment	E	E	O
• dedicated equipment for communication to ambulance services	E	E	E
• equipment for chest tube placement and pericardiocentesis	E	E	O
• equipment for fracture stabilization and traction	E	E	E
• resuscitation room	E	D	—
• rapid infusion warmer	E	D	—
• surgical equipment (i.e., for abdominal lavage, wound closure, cricothyroidotomy, insertion of central venous and arterial lines, pericardiocentesis)	E	D	—
b) Intensive care unit			
1) Personnel			
• medical director of intensive care	E	E	—
• 24-h in-hospital medical attendance	E	D	—
• dedicated intensive care unit nursing	E	E	—
• treatment conjoint with attending surgeons	E	E	—
2) Equipment			
• electrocardiographic monitoring and recording	E	E	D
• cardiac resuscitation cart	E	E	D
• cardiac pacemaker equipment	E	D	—
• cardiac defibrillator	E	E	E
• airway control equipment	E	E	—
• mechanical ventilators and monitors	E	E	—
• oxygen supply and saturation monitor	E	E	D
• arterial catheters, peripheral and central venous	E	D	—
• priority laboratory analysis (blood gas, pH, hemoanalysis, urea nitrogen, electrolytes, etc.	E	E	E

Appendix 2 continued

Trauma Association of Canada Trauma System Accreditation Guidelines (Approved Sept. 9, 1993): Criteria for Tertiary, District and Primary Trauma Centres

Criteria	Type of trauma centre		
	Tertiary	District	Primary
2) Equipment (contd.)			
• multichannel monitoring equipment	E	D	—
• pulmonary artery catheters	E	D	—
• bronchoscope and gastroscope	E	E	—
• chest tube, cricothyroidotomy, cut-down trays	E	E	—
• intracranial pressure equipment and monitor	E	—	—
• portable light source	E	E	E
• weighing equipment	E	E	E
• special care bed (i.e., isolation)	E	D	—
• special intensive care unit beds and stretchers	E	D	—
• hemodialysis program in hospital or	E	—	—
• protocols for transfer of hemodialysis patients	E	E	E
• immediate access to laboratory equipment and reports	E	E	D
c) Burn unit (or transfer agreement with burn unit)	E	O	—
• medical director	E	O	—
• protocols for transport and transfer of burn patients	E	E	E
d) Radiology			
• technician available within 10 min	E	D	D
• 30-min attending staff call-in	E	E	E
• angiography	E	D	—
• ultrasonography	E	E	—
• computed tomography	E	—	—
• access to magnetic resonance imaging and digital subtraction angiography	D	—	—
e) Rehabilitation			
• assigned medical director of rehabilitation program	E	—	—
• protocols for referral for rehabilitation	E	E	E
f) Operating room			
• 24-h operating-room availability for immediate surgery with the necessary equipment and personnel	E	E§	—
g) Laboratory system			
• available 24 h/d	E	D	D
• blood bank system capable of providing unmatched blood within 10 min	E	E	O
h) Quality improvement programs and trauma registry			
• evidence of continuous multiprofessional quality improvement process	E	E	E
• trauma registry participation with recognized severity indices	E	E	E
• review of deaths, yearly report	E	E	E
• review of morbidity, yearly report	E	E	E
i) Communication system for external support			
• a system for physician-physician communication and transport for referred trauma cases	E	E	E
• participation in pre-hospital care as appropriate to local circumstances	E	E	E
j) Public education			
• programs for public education in injury prevention	E	E	E
k) Trauma research programs	E	—	—
l) Continuing education programs for:			
• doctors in the hospital	E	E	E
• nurses	E	E	E
• allied health personnel	E	D	D
• medical education within the community/region	E	D	D
• residency medical education as appropriate to university affiliation	E	—	—
<p>*E = essential, D = desirable, O = optional, — = not required. Services indicated as desirable (D) and pediatric surgery may be provided at a dedicated alternate site or with consultation on-site within 30 min. †Two in-hospital physicians capable of providing advanced airway management and initial resuscitation should be available at all times. ‡May be provided at a dedicated alternate site. §With maximum 30-min response time</p>			