

# Ongoing Evolution of Emergency General Surgery as a Surgical Subspecialty

Robert D Becher, MD, MS, Kimberly A Davis, MD, MBA, FACS, Michael F Rotondo, MD, FACS, Raul Coimbra, MD, PhD, FACS

Over the past 10 years, acute care surgery has become widely accepted as a distinct surgical specialty and practice paradigm, encompassing 3 areas of surgical practice: trauma surgery, emergency general surgery, and surgical critical care.<sup>1,2</sup> The recognition and formalization of the specialty continue to grow (Fig. 1), as evidenced by the increasing number of acute care surgery services at institutions throughout the US.<sup>3</sup> There are currently 20 non-ACGME, American Association for the Surgery of Trauma (AAST)-approved acute care surgery training fellowship programs, up from 7 just 5 years ago.<sup>4</sup>

Acute care surgeons provide time-sensitive care for both trauma and nontrauma surgical emergencies. There are multiple challenges in caring for these patients, including around-the-clock readiness for the provision of comprehensive care across a spectrum of disciplines, the constrained time for preoperative optimization of the patient, and the greater potential for intraoperative and postoperative complications due to the often-emergent, high-complexity, and high-acuity nature of care. Although the morbidity and mortality of acute care surgery patients, especially in the more mature disciplines of trauma and surgical critical care, have steadily improved, ensuring optimal outcomes of all patients continues to evolve. Improving outcomes will require an ongoing commitment from a diverse range of health care services, professionals, and organizations, and an emphasis on high-quality, comprehensive contemporary research.

Over the past 45 years, there has been a tremendous improvement in the outcomes of injured trauma patients in the US.<sup>5</sup> Since the 1970s, when injury was recognized as a widespread public health problem, 2 interrelated

factors have played a key role in optimizing the outcomes of injured patients: trauma-systems development and advances in trauma-related research.<sup>6</sup> Trauma has been well studied, and outcomes research has played an instrumental role in advancing trauma care. Coupled with creation and advancement of a comprehensive, standardized trauma registry called the National Trauma Data Bank (NTDB),<sup>7-9</sup> outcomes research has been crucial in defining patterns of injury, benchmarking, understanding and assessing risk-adjusted outcomes, improving trauma systems, and measuring processes of care for quality improvement.<sup>8,10</sup>

Emergency general surgery (EGS) currently finds itself in a position like that of trauma surgery 45 years ago. There are few, high-quality published studies outlining the determinants of EGS outcomes, there is an overall poor understanding about the systems of EGS care, and there is a paucity of rigorous scientific standards of practice. Perhaps no field in surgery today is better positioned to benefit from rigorous and innovative outcomes research than the maturing surgical specialty of EGS.

## EMERGENCY GENERAL SURGERY: A FIELD IN TRANSITION

Emergency general surgery is an under-recognized major public health concern. The incidence and prevalence of EGS conditions exceed those of other common, highly studied public health problems, such as new-onset diabetes mellitus and newly diagnosed cancers (Fig. 2). More than 3 million patients with EGS problems are admitted annually to US hospitals, representing more than 7% of all US hospitalizations. More than 25% of EGS patients require surgery during their index admission, and there are more than 850,000 EGS operations performed annually in the US.<sup>11</sup>

Underscoring EGS as a public health problem are the increasing recognition and acceptance of acute care surgery as an integral and valuable practice paradigm in modern health care. And yet, although acute care surgery services have been instituted at many hospitals in the US, a clear majority of emergent surgical patients are managed at institutions without such a specialized service. Surgical emergencies are therefore addressed by “on call” surgeons

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From the Departments of Surgery, Section of General Surgery, Trauma, and Surgical Critical Care, Yale School of Medicine, New Haven, CT (Becher, Davis); the University of Rochester School of Medicine and Dentistry, Rochester, NY (Rotondo); and the Division of Trauma, Surgical Critical Care, Burns, and Acute Care Surgery, University of California San Diego Health Sciences, San Diego, CA (Coimbra).

Correspondence address: Raul Coimbra, MD, PhD, FACS, Division of Trauma, Surgical Critical Care, Burns, and Acute Care Surgery, Department of Surgery, University of California San Diego Health Sciences, 200 W Arbor Dr #8896, San Diego, CA 92103. email: [rcoimbra@ucsd.edu](mailto:rcoimbra@ucsd.edu)

**Abbreviations and Acronyms**

AAST	= American Association for the Surgery of Trauma
ACS	= American College of Surgeons
ACS	= American College of Surgeons Committee on
COT	Trauma
EAST	= Eastern Association for the Surgery of Trauma
EGS	= emergency general surgery
NTDB	= National Trauma Data Bank

with varied backgrounds, including the spectrum of general surgery specialties and subspecialties. Such a divergent system of managing this unique, physiologically abnormal patient population may result in delays in care, widespread practice variation, and disparate outcomes.<sup>12-15</sup>

Emergency general surgery patients present intraoperative and perioperative challenges, which are compounded by a dearth of evidence-based guidelines and protocols. For example, the absence of collective EGS investigation prevents the ability to separate the contribution of suboptimal care from that of complex physiology, contributing to poor outcomes.<sup>14,15</sup> Although the first wave of EGS outcomes research has demonstrated that patients requiring emergency surgery represent a distinct population with a unique physiology compared with patients requiring similar but elective operations,<sup>11,14-18</sup> robust scientific standards of practice still need to be developed.

The maturation of EGS as a surgical specialty will require in-depth, risk-adjusted analyses of outcomes and an evidence-based approach to improving care. For these

initiatives to be valid, ongoing, and successful, and to advance the entire science of acute care surgery, we should examine the lessons learned from the trauma experience. Identification of predictors of mortality and surgical complications has led to substantial improvements of outcomes in trauma, as has a longstanding history of conducting valid trauma outcomes research. This body of investigation has allowed trauma surgeons to track and improve outcomes, create performance metrics, and ensure high-quality care.

The lessons learned in the field of trauma outcomes research over the past 4 decades have greatly advanced the discipline. Four specific lessons should now be applied to the field of EGS to ensure its ongoing evolution: the importance of leadership and research support; defining EGS and EGS study populations; using quality data and creating evidence-based practices; and ensuring stakeholder support and developing partnerships.

**LEADERSHIP AND RESEARCH SUPPORT**

The first lesson is that high-quality trauma outcomes research requires forward-thinking leadership; this came especially from the American College of Surgeons Committee on Trauma (ACS COT). Early on, the ACS COT established a firm commitment to monitor and research the outcomes of injured patients, as evidenced by the creation and development of trauma registries.<sup>8</sup> Over many succeeding years, this leadership, and ACS COT's investment in trauma outcomes research led to an improved understanding of injured patients and major advancements in their management.

**Historical Timeline**

2003 - Joint meeting of ACS, AAST, WEST and EAST addressing problems of access to emergency surgical care and the future of trauma surgery. AAST forms Ad hoc committee to develop the reorganized specialty of Trauma, Surgical Critical Care and Emergency Surgery.

2005 - ACEP survey nearly 75% emergency departments identify inadequate on-call specialty coverage

2005 - AAST renames previous ad hoc committee - Acute Care Surgery Committee

2006 - IOM report- Future of Emergency Care, confirms shortage of on call specialists

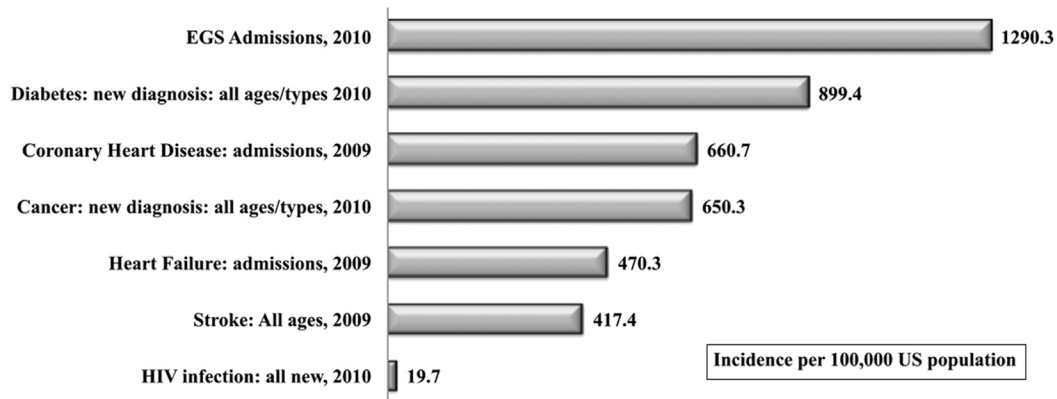
2007 - AAST retreat; Development of curriculum, competency tools, case registry, certification criteria, site visits

July 2008 - First formal AAST Acute Care Surgery Fellowship program begins

2014 - Refinement of operative case requirements

Currently there are 20 fully accredited ACS programs to date with several other programs in various stages of the accreditation process.

**Figure 1.** Historical timeline of acute care surgery. AAST, American Association for the Surgery of Trauma; ACS, American College of Surgeons; EAST, Eastern Association for the Surgery of Trauma; WEST, Western Trauma Association. (Reprinted from the American Association for the Surgery of Trauma, with permission. Available at: <http://www.aast.org/AcuteCareSurgery.aspx>.)



**Figure 2.** Disease burden of emergency general surgery vs other public health concerns. EGS, emergency general surgery. (Reprinted from: Gale SC and colleagues,<sup>11</sup> with permission from Wolters Kluwer Health, Inc.)

The field of EGS as a surgical discipline has begun to thrive because of comparable progressive leadership, which has come from 3 surgical organizations: the AAST, the Eastern Association for the Surgery of Trauma (EAST), and the American College of Surgeons. The AAST developed the paradigm of acute care surgery 12 years ago and is building the infrastructure necessary to train fellows and perform research in this field. The Acute Care Surgery Committee of the AAST has developed the educational platform for fellowship training, and promotes EGS-based outcomes research.<sup>19</sup> The EAST has formed an Emergency General Surgery Section for Professional Development,<sup>20</sup> in part to “encourage research endeavors into...emergent general surgical conditions,” as well as an Emergency General Surgery Task Force<sup>21</sup> committed to creating evidence-based EGS guidelines for patient care. For many years, the ACS has been a leader in outcomes research, highlighted by the advent of the NSQIP. This expertise has been extended to EGS, with the recent creation of the EGS NSQIP pilot program. This database is unique, as the first national registry to capture patients managed both operatively and nonoperatively (see section on data and databases below).<sup>22</sup>

The previously mentioned organizations have prioritized EGS outcomes research, with the goal of generating evidence to inform clinical decisions. In the past 3 years, each of these organizations has financially committed to supporting EGS outcomes research: the American College of Surgeons via the Thomas R Russell, MD, FACS, Faculty Research Fellowship award<sup>23</sup>; the AAST annually awards the Emergency General Surgery Scholarship<sup>24</sup>; and the EAST Multicenter Trial Junior Investigator Award has been awarded to EGS proposals.<sup>25</sup>

There is widespread acceptance that the modern ecosystem of health care can thrive only with research from both basic scientists and clinical investigators.

Commensurate with this, the NIH has allocated nearly 50% of its research awards to applied research.<sup>26</sup> This is encouraging because improving EGS outcomes will be resource intensive and financially costly. Accordingly, there are multiple governmental and nongovernmental career-level funding sources for EGS outcomes researchers, including the NIH, the Centers for Disease Control, the Agency for Healthcare Research and Quality (AHRQ), and the Patient-Centered Outcomes Research Institute (PCORI).

Moving forward, organizational leadership and the ongoing support of EGS outcomes research, including development of an EGS research agenda, will be vital to the advancement of the field and to improving and protecting public health. There is much we do not yet know about the optimal care of the EGS patient. In this respect, EGS is not an outlier; across all disciplines of medicine the scientific community is not generating the quality evidence needed to support the health care decisions that patients and their doctors make every day. To put this into perspective, less than 15% of guideline recommendations are supported by high-quality evidence.<sup>27</sup> Emergency general surgery is no exception because many EGS clinical decisions are not supported by evidence or grade 1 recommendations.<sup>28</sup> This translates into well-intentioned, but potentially flawed, pathways of care. To create high-quality EGS practice guidelines, develop EGS performance measures and applicable benchmarks, and establish and expand EGS systems of care, we need high-quality EGS outcomes research.

## DEFINITION OF EMERGENCY GENERAL SURGERY AND STUDY POPULATIONS

The second lesson is that generalizable trauma outcomes research is the product of a consistent, reproducible

definition of the patient population under study.<sup>29</sup> For EGS outcomes research to be practice changing, we need to ensure a consistency of patient populations across studies and a transparency to inclusion and exclusion criteria. One methodology is using unique ICD-9 and ICD-10 diagnosis and procedure codes. This was first successfully done at the institutional level<sup>30</sup> and has since been researched using a nationally representative sample,<sup>18,31</sup> although no widespread accepted definition of an EGS patient exists. Standardized use and clear reporting of such codes to identify patients and define inclusion/exclusion criteria are vital to comparing the results of EGS studies.

The use of ICD-9 and ICD-10 codes for individual research studies does not address the bigger picture of defining the scope of EGS practice. Putting boundaries on this scope of practice is a challenge, for a handful of reasons: EGS encompasses both operative and nonoperative practice; the urgency of intervention is varied, ranging from emergent to elective; patient's physiologic derangement may be severe or absent; and EGS practice varies widely across institutions and the scope of practitioners caring for the patient may be varied, involving the spectrum of both medical and surgical providers.

Heterogeneity of the patient population, and the scope of practice, defines present-day EGS.<sup>30</sup>

Even with such variability, inclusion of these patients into a broader definition of the EGS patient population—and into EGS outcomes research studies—is essential. This heterogeneity will only make EGS outcomes research stronger. This is evidenced and supported by the underpinnings of the NIH's new Precision Medicine Initiative (PMI),<sup>32</sup> which puts an emphasis on studying very large populations of people across a spectrum of biologic, environmental, and behavioral influences to define and identify new ways to treat and prevent disease.

Studying patient populations that are vastly different, with varied degrees of illness severity, physiologic derangement, and comorbidities should characterize EGS outcomes research. Overall, outcomes research evaluates the results of interventions and health care processes in real-world conditions ("effectiveness" studies); this is very different from randomized controlled trials (RCTs), which are controlled experiments under controlled conditions in populations comparable on every level except the intervention being studied ("efficacy" studies). To address these differences in EGS study populations, risk adjustments will be necessary to allow accurate comparisons among such disparate patient populations.

Not knowing how best to risk adjust with such patient variability is 1 major limitation in the EGS outcomes

literature to date. This is a very important issue for EGS outcomes research moving forward, as accurate comparisons among disparate patient populations with varied degrees of risk requires accurate adjustment strategies. Risk adjustment strategies can be very simple or very complex<sup>33</sup>; the important aspect is that they are well validated. This has not yet been done for EGS patients, as the datasets used to study EGS do not allow comprehensive risk adjustment. This quandary derives from the fact that the type of patient databases one uses for outcomes research determines what type of risk adjustments can be made (see next section on data and databases).

A similar issue, also driven by the heterogeneity of the EGS patient population, is benchmarking EGS surgical outcomes and performance. Benchmarks are defined by leading medical and surgical organizations to establish standards of care and ensure surgical quality. Groups defining these measures include the Agency for Healthcare Research and Quality (AHRQ) and the National Quality Forum (NQF). As the discipline of EGS becomes increasingly studied and defined, these benchmarks will be valuable for establishing national norms and standards of care. To date, however, given the poor methodologies at risk adjustment, EGS benchmarking attempts are inconsistent or lacking in the literature. As a result, despite the known heavy burden of EGS disease, little is known in the way of adjusted risk factors, complication rates, and predictors of EGS outcomes.<sup>34</sup>

The measurement and analyses of EGS metrics is a key opportunity for investigation. One group that is leading an effort to develop and validate grading systems to measure anatomic disease severity in EGS illness is the AAST Injury Assessment and Outcomes Committee.<sup>35</sup> To date, a handful of grading systems have been created, and one for acute colonic diverticulitis has been validated.<sup>36</sup> These grading systems will allow for measuring and assessing quality of EGS care through risk-adjusted patient outcomes, and will help in the valid creation and interpretation of EGS health services research.

## QUALITY DATA AND EVIDENCE-BASED PRACTICE

The third lesson is that high-quality data lead to high-quality outcomes research. High-quality, specialty-specific databases often come from registries. Trauma registries, such as the National Trauma Data Bank,<sup>8</sup> exist at verified trauma centers in the US for research, clinical documentation, and quality control purposes. The Trauma Quality Improvement Program (TQIP) uses National Trauma Data Bank-collected data to provide risk-adjusted mortality and morbidity analysis, allowing participating trauma

centers to track outcomes and improve patient care.<sup>37</sup> These datasets include the pertinent medical records outcomes for each patient over a range of variables, including anatomic injury measures, physiologic parameters, and comorbidities. The more accurate the data, the better the analyses, and in turn, the more valid the statistical conclusions. These registries, therefore, have rigorous data collection methodologies outlined in detailed data-dictionaries, and have been validated through inter- and intra-coder agreement analysis to further ensure the quality of data collection.<sup>38</sup>

The field of EGS is moving to address the need for quality, comprehensive data. Work is underway to create a national EGS data-dictionary, and a pilot project has been conducted for an EGS registry modelled after NSQIP.<sup>10,22</sup> If structured as a consecutive-capture dataset (as opposed to one that only samples patients) that includes all types of EGS patients, both operative and nonoperative, then this database has the potential to provide a powerful, risk-adjusted tool for research to the field of EGS. It would allow for EGS-specific benchmarking, validating severity scoring systems, and performance improvement information. The EGS registry should also allow for considerable room for growth and advancement; the EGS patient population would greatly benefit from an ability to predict various contemporary and patient-reported outcome metrics, such as cost-utility, comparative effectiveness, appropriateness of care, satisfaction with care, and functionality.<sup>39-42</sup>

At present, much of the EGS outcomes research has used administrative datasets such as the Nationwide Inpatient Sample (NIS). Administrative databases exist primarily for billing purposes and are not meant for research. In many cases, administrative databases will have diagnostic and procedure codes as well as some comorbidity information, but seldom do they have physiological data—so important for risk adjustment in the EGS population.<sup>43</sup> Even with these limitations, administrative data-based investigations have helped to define estimates of the EGS disease burden, including incidence, complications, mortality, and cost.<sup>11,34,44</sup> Other datasets used at present to study EGS include NSQIP, institutional-specific datasets, and Vizient (formerly University Health System Consortium) data, among others.

## STAKEHOLDER SUPPORT

The fourth lesson taken from 45 years of trauma outcomes research is the fundamental need to establish support from all EGS stakeholders; this support is the foundation of a successful EGS research program. The AAST, EAST, and the American College of Surgeons

are providing the necessary leadership. Moving forward, it is critical that EGS research initiatives be coordinated, multi-institutional efforts by many health care providers—both academic and community—all with a uniform goal of improving EGS care. Having a robust multi-institutional EGS research database may prove to be as important as the development of a national EGS registry. Eventually, as data improve and our understanding of EGS outcomes deepens, stakeholders should come together to define an informed, expansive research agenda. The overall aim is a healthy ecosystem of EGS researchers and clinicians, collaborating, corroborating, and cooperating to lessen the burden of the EGS public health crisis, and promoting the advancement and innovation of EGS care.

## CONCLUSIONS

As acute care surgery grows, so too will its EGS component mature as a distinct surgical subspecialty. Acute care surgery and the field of EGS, evolved to address the national crisis in emergency surgical care,<sup>45,46</sup> the surgical workforce shortages,<sup>46</sup> and the increased burden on emergency departments to manage surgical patients.<sup>47,48</sup> Adequately addressing these issues will depend on maturing EGS outcomes research initiatives. Emergency general surgery outcomes research will advance the science of acute care surgery, improve EGS patient outcomes, and facilitate multi-institutional collaboration. It will also assist in the creation of EGS standards of care, and the potential implementation of a verification review process, similar to those of the American College of Surgeons in multiple other surgical subspecialties.<sup>49</sup> Emergency general surgery needs a rigorous evaluation of its outcomes, as well as creation of evidence-based benchmarks, the ongoing improvement of its care, informed performance improvement initiatives, and analyses of its systems of care. This will take energy, resources, and time, the widespread commitment of all acute care surgery stakeholders, and the continued progressive leadership of the AAST, EAST, and the American College of Surgeons.

## Author Contributions

Study conception and design: Becher, Davis, Rotondo, Coimbra  
 Acquisition of data: Becher, Davis, Rotondo, Coimbra  
 Analysis and interpretation of data: Becher, Davis, Rotondo, Coimbra  
 Drafting of manuscript: Becher, Davis, Rotondo, Coimbra  
 Critical revision: Becher, Davis, Rotondo, Coimbra

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