

## **1. TITLEPAGE**

**Title:** Conference Proceedings: Interventions to Improve Quality in the Crowded  
Emergency Department

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## 2. STRUCTURED ABSTRACT

**Purpose and Scope:** Emergency department (ED) crowding is a major public health problem in the United States, with increasing numbers of ED visits, longer lengths of stay in the ED, and the common practice of ED boarding.

**Methods:** In June 2011, a consensus conference was conducted in Boston, MA, by the journal *Academic Emergency Medicine* to explore the issue of how best to manage ED crowding. The title of conference was “Interventions to Assure Quality in the Crowded Emergency Department.” The goal the conference was to develop a series of research agendas to identify promising interventions to safeguard the quality of emergency care during crowded periods and reduce crowding through systemwide solutions.

**Results:** This was achieved through three objectives: 1) to review interventions to reduce crowding and summarize the evidence of their effectiveness on the delivery of emergency care, 2) to identify strategies within or outside of the healthcare setting (i.e., policy, engineering, operations management, system design, etc.) that may help reduce crowding or improve the quality of emergency care during episodes of ED crowding, and 3) to identify the most appropriate design and analytic techniques for rigorously evaluating ED interventions designed to reduce crowding or improve the quality of emergency care provided during episodes of ED crowding.

**Keywords:** Emergency department; crowding; overcrowding; interventions; research agenda

### **3. PURPOSE**

1. Review of interventions that have been implemented to reduce crowding and summarize the evidence of their effectiveness on the delivery of emergency care.
2. Identify strategies within or outside of the healthcare setting (i.e., policy, engineering, operations management, system design, etc.) that may help reduce crowding or improve the quality of emergency care provided during episodes of ED crowding.
3. Identify the most appropriate design and analytic techniques for rigorously evaluating ED interventions designed to reduce crowding or improve the quality of emergency care provided during episodes of ED crowding.

### **4. SCOPE**

#### **Background/Setting/Participants**

Emergency department (ED) crowding has been identified by the Institute of Medicine (IOM) as a public health problem.<sup>1</sup> ED crowding is caused by episodes of supply-demand mismatch within EDs that result in long waiting times to be seen, to have critical treatments, and to obtain inpatient bed placement. Over the past 10-20 years, there has been an increase in waiting times across U.S. EDs, even for patients with time-sensitive conditions, such as acute myocardial infarction.<sup>2,3</sup> Although ED crowding certainly leads to less timely care and lower patient satisfaction with the healthcare experience,<sup>4,5</sup> recent studies have found that crowding has a negative impact on critical outcomes of care, such as complication rates and mortality.<sup>6,7</sup> Solutions are needed at the ED, hospital, community, and national policy levels to reduce crowding and mitigate the impact of crowding on quality and outcomes.

To date, there is a paucity of rigorously designed studies that have tested interventions to reduce crowding and its negative impact on patient safety.

### Setting

In June 2011, 131 participants attended the *AEM* Consensus Conference, titled “Interventions to Improve Quality in the Crowded Emergency Department” in Boston, Massachusetts. Conference Co-Chairs included Drs. Jesse M. Pines and Melissa L. McCarthy, both of whom serve on the faculty in the Departments of Emergency Medicine and Health Policy at George Washington University. The overall goal of the conference was to develop a series of research agendas to identify promising interventions to safeguard the quality of emergency care during crowded periods and to reduce ED crowding altogether through systemwide solutions. The goal was achieved through three objectives: 1) a review of interventions that had been implemented to reduce crowding and summation of the evidence of their effectiveness on the delivery of emergency care, 2) identification of strategies within or outside of the healthcare setting (i.e., policy, engineering, operations management, system design, etc.) that may help reduce crowding or improve the quality of emergency care provided during episodes of ED crowding, and 3) identification of the most appropriate design and analytic techniques for rigorously evaluating ED interventions designed to reduce crowding or improve the quality of emergency care provided during episodes of ED crowding. The December 2011 issue of *Academic Emergency Medicine* contains detailed descriptions of the conference proceedings and includes the six research agendas developed surrounding the six IOM quality domains: efficiency, effectiveness, timeliness, patient-centeredness, safety, and equity.

This manuscript provides a background on ED crowding and a justification for the meeting; then, it briefly summarizes some of the key concepts that are described in more detail in the rest of the journal issue.

### **Context/scientific need for the meeting**

ED crowding is a frequent and serious problem in more than 90% of the EDs in the United States.<sup>8</sup> ED crowding is a problem of a periodic mismatch between available ED services—in the form of staff and space—and the demands for patient care. ED crowding is not an “all the time” problem in most EDs but rather is a state that occurs when the ED system is so congested that new, potentially ill patients must wait, sometimes for unsafe periods, for critical lifesaving healthcare services.<sup>9,10</sup> The causes of ED crowding have been well described.<sup>11</sup> Crowding typically occurs during episodes of the greatest demand for services, which include afternoon to evening hours, and during specific days (i.e., Mondays). ED crowding on Mondays and on early days in the week is worsened more by the fact that peaks in ED demand coincide with peaks in demand for elective post-procedure surgical beds.

Increases in ED demand include higher numbers of ED visits; between 1995 and 2005, ED utilization increased nationally by 20% from 97 to 115 million visits.<sup>12</sup> In 2008, there were 124 million ED visits.<sup>13</sup> In addition, increased demand also includes a higher severity of patients in the ED who require more services. This is partially driven by increasing numbers of older adults coming to EDs with larger numbers of chronic medical conditions, an increased complexity of illness, and higher levels of technology that are available for routine use (like CT, MRI, and other advanced testing and treatments).<sup>14,15</sup> The other side of ED crowding is the supply issue. Increases in demand

for ED services have been commensurate with a reduction in hospitals. A recent study found that 27% of non-rural EDs have closed over the past 20 years.<sup>16</sup> Higher aggregate demand coupled with a shrinking supply of space leads to frequent episodes in which the ED system is operating at full capacity. When patients continue to arrive into a system operating at full capacity, the result is long wait times to be seen. This is exacerbated even more when there is insufficient bed capacity in the hospital, which leads to boarding, in which patients will spend long periods of time waiting for inpatient beds in the ED. Boarding is a primary cause for crowding because, as the number of boarders increases, the ED capacity for new, undifferentiated patients is lower.<sup>17</sup> Furthermore, the situation worsens as ED crowding itself can result in patients waiting even longer to get through the system, resulting in more severe crowding.

In her comments during the moderated panel, Dr. Sandra Schneider, President of the American College of Emergency Physicians, highlighted the importance of reducing boarding as the key to reducing ED crowding. She also stated the need to communicate with outside stakeholders regarding boarding being the major cause of ED crowding. Recent studies have found that patients being treated for asthma spend over an hour more in the ED during the most crowded times compared with the least crowded times, and patients with abdominal pain wait 1.5 hours longer for CTs to be completed.<sup>18,19</sup> Finally, artificial variation in bed demand in hospitals is a third cause for ED crowding that is less well described in the literature. Artificial variation occurs in the elective procedure schedule, which tends to peak on Monday to Thursday and is lower on Friday and over the weekend.<sup>20</sup> When peak demand for scheduled beds coincides with high daily demand

for inpatient beds from ED patients, this variation leads to more severe systemwide congestion, which ultimately overflows in the ED and manifests as ED boarding.<sup>21</sup>

ED boarding, along with ED length of stay and left-without-being-seen rates, is a quality measure that soon will be reported publicly by Health and Human Services.<sup>22</sup> However, there are many factors that can influence the flow, as well as the overall quality, of care provided in EDs. Some of the factors are intrinsic to the ED, such as access to on-call specialists, the use of decision support tools, staffing levels, and experience and training of ED providers. Emergency care is also heavily influenced by the hospital and surrounding community, because these external forces contribute significantly to the demands that EDs face both in the initial evaluation of patients and when patients are discharged and require follow-up care. Hospital factors that influence the quality of care provided in the ED include inpatient bed capacity strategies, electronic information systems that are fully integrated across all inpatient and outpatient services, and policies that incentivize quality and optimal patient outcomes and community factors (particularly the availability of primary and specialty care). Therefore, the effectiveness of an ED depends on its success in dealing with major organizational challenges, including coordination and control of work efforts, availability and proper allocation of professional and other resources, maintenance of suitable work arrangements, and adaptation to the external environment. EDs must learn how to operate more efficiently, to use information technologies to support process management, and to employ high-reliability design principles that result in the routine provision of high-quality care. Until recently, the healthcare system, and particularly the ED, has not looked to other industries for potential strategies that may improve its service delivery.

A key component of the conference was to discuss how well-tested strategies and management principles from other industries apply to the ED. This was done by bringing together the leading ED crowding researchers and managers with professionals who have experience applying operations principles to ED quality improvement and by proposing a series of research agendas for the specialty centered on patient flow and quality.

## **5. METHODS and 6. RESULTS**

A 2006 report by the Institute of Medicine on the Future of Emergency Care in the U.S. health system characterized hospital EDs as “at the breaking point.”<sup>1</sup> Emergency medicine as a specialty finds itself at a similar point in time as that of anesthesia 20 years ago. At that time, many patients were suffering from anesthesia-related mishaps because of a poorly designed system. Although ED patients are not dying in great numbers, they are experiencing significant delays in evaluation and treatment for emergent and urgent conditions because of the same reason: a poorly designed system. To improve the quality of anesthesia care, the specialty borrowed heavily from techniques and lessons learned in the aviation industry and created basic standards for monitoring during anesthesia. In his comments during the lunchtime panel, Dr. Peter Viccellio, Vice Chair of Emergency Medicine at SUNY Stonybrook, described the importance of how emergency medicine should focus the conversation about crowding on patient safety rather than complaining that external forces need to fix the problem. This conference also exposed ED clinicians, administrators, and researchers to strategies from other industries to redesign the emergency care system to improve the quality of care provided.

However, despite the need for operational improvements in the delivery of ED care, there have been relatively few rigorous evaluations of operational interventions in



the ED setting. Many EDs have tried interventions, such as immediate bedding, bedside registration, physician at triage, advanced triage protocols, inpatient bed capacity protocols, point of care testing, etc., to improve operational efficiency.<sup>23</sup> However, most interventions tried to date have not been carefully designed and evaluated, so their value remains unclear; more importantly, their value compared with each other remains unclear. For example, it is not currently known which interventions are most effective, so it is often a challenge for ED managers to choose where to invest time and energy. In addition, similar strategies may be implemented, such as fast tracks, that are successful in some environments, but not in others—the difference being leadership and management support. In his comments during the lunchtime panel, Dr. Randy Pilgrim, Chief Medical Officer of the Schumacher Group, described several situations in which similar interventions were implemented at different hospitals with varied success. The major success factors were ED leadership and the buy-in from hospital management. This was echoed by Dr. Bruce Siegel, who spoke at the moderated panel. Dr. Siegel described the work of Urgent Matters, a multi-year ED quality improvement project aimed at improving flow. During his work on Urgent Matters, Dr. Siegel highlighted the importance of objective measurement and the role of bringing in senior management in successful throughput improvement interventions.

One of the objectives of the conference was to emphasize the importance of rigorous operations research in the ED setting and to encourage EDs to embrace a process of continual evaluation and improvement that encompasses the important role of leadership and management in any quality improvement intervention. Bringing in outside disciplines in the fields of organizational behavior and industrial psychology may be

helpful in improving our understanding of the leadership and teamwork required for successful interventions.

Several sessions in the meeting served to stimulate ED clinicians, administrators, and researchers to think boldly and innovatively about improving the quality of emergency care. For example, Dr. Christian Terwiesch, Professor of Operations Management at the Wharton School, presented a basic vocabulary for operations research and proposed that, through operations research principles, three basic levers can be used to improve crowding: eliminating waste, reducing variability, and improving flexibility. This provided a framework to conceptualize ED crowding interventions. Most operational research to date has focused on relatively small process changes to the existing system rather than proposing fundamental changes to care delivery systems. As another example, there has been little attempt to standardize emergency care despite a number of well-validated clinical decision rules. If EDs adopted and routinely used clinical decision rules, such as the Ottawa Ankle Rule or the Pulmonary Embolism Rule-Out Criteria, ED length of stay and crowding may be reduced, as patients may stay in the ED for shorter periods of time, requiring fewer resources. Another area of research that may help EDs is the development of optimal resource capacity models. Crowding occurs because of a mismatch between demand and capacity. Relatively little research has been devoted to examining the relationship between the number and type of staff present and ED service completion times. In his talk, Dr. Terwiesch also spoke about the role of matching supply and demand. Hospital practices can negatively impact ED operations. It is well understood that boarding is a major cause of crowding, yet few hospitals have implemented a systemwide solution to eliminate it. Dr. Brad Morrison, Assistant

Professor of Management at Brandeis, and Dr. Jenny Rudolph, Associate Director of Simulation at Harvard Medical School, discussed the role of systems dynamics in understanding complex systems and explored the session focused on high-reliability design principles, design of work systems, decision theory, measuring workload, and organizational performance to improve the quality of emergency care. Finally, patient safety is an important issue in emergency medicine, but most research to date has been descriptive. Relatively few investigators have conducted interventional research in the ED setting to improve patient safety with fewer resources.

One of the major focuses of this conference was to identify different strategies that may reduce crowding and/or mitigate the negative effects of crowding, which are currently not being employed or are underutilized, in EDs and hospitals. The keynote speech with Dr. Suzanne Mason, Professor of Emergency Medicine at the University of Sheffield in the UK, described the UK 4-hour rule and, more specifically, how it was implemented and why the UK has ultimately decided to move away from strict times in the ED. In addition, another session, conducted by Dr. Howard Ovens, Associate Professor in the Department of Family and Community Medicine at the University of Toronto, and Dr. John Heyworth, President of the College of Emergency Medicine in England, discussed policy solutions to ED crowding in the UK and Canada. In the province of Toronto, Canada has implemented a pay-for-performance initiative to incentivize hospitals in Ontario to reduce ED length of stay as part of a comprehensive approach to improving emergency flow that involves all sectors of the healthcare system. Although these policy interventions have been implemented in countries with a national healthcare system, there are still many lessons to learn from them regarding their

potential impact if employed in the U.S. The conference also explored engineering and operations management strategies for reducing crowding and improving quality of care. Dr. Michael Carter, Professor of Mechanical and Industrial Engineering at University of Toronto, discussed the use of computer simulation and forecasting as well as demand-capacity management strategies.

A second major focus of the conference was to review methodological issues that are important to the proper conduct of operations research in emergency medicine. Drs. McCarthy and Pines discussed statistical models that can be used to measure patient flow, the appropriate handling of time series data, the inclusion of time-varying covariates, and hierarchical models that allow for correlation among patients nested within providers and/or EDs. The session also reviewed alternative study designs when randomized controlled trials are not feasible, including matching methods, propensity scores, and regression discontinuity.

The afternoon sessions of the conference focused on developing a series of research agendas to identify promising strategies to improve the quality of emergency care in all six IOM domains. Each of the domains was led by an individual with expertise in the field who worked to frame the issue of improving ED crowding in the context of his or her particular IOM domain. Then, the group created a series of prioritized questions that represented the next logical steps to move the state of science forward for that particular domain. For example, the safety group, which was led by Dr. Christopher Fee, Associate Professor of Emergency Medicine at University of California, San Francisco, divided the questions into basic science (i.e., what are the best measures for ED patient safety?) and applied science (i.e., do checklists improve ED safety at more

crowded times?). Similarly, Dr. Michael Ward, Operations Research Fellow and Assistant Professor of Emergency Medicine at the University of Cincinnati, posed some fundamental questions, such as “What measures can be used to understand and improve the efficiency and quality of interventions in the emergency department?” He also posed more specific questions on informing interventions, such as “How do specific elements of ED technology, structure, and design impact ED efficiency?” Detailed research agendas are published in the December 2011 issue of *Academic Emergency Medicine*.

### **The Road Ahead**

The June 2011 conference, “Interventions to Improve Quality in the Crowded Emergency Department,” and the resultant works in the December 2011 issue of *Academic Emergency Medicine* serve to move the conversation forward on ED crowding interventions by bringing together diverse disciplines around a central goal, fostering important discussion on the practicalities and challenges of this important field, and framing the next important questions that should be answered to inform the work of hospitals, policymakers, and researchers in the coming years. This conference came at a vital time in the development of emergency care in the United States. It is a time in which greater focus is placed on quality and throughput, as several of the measures of ED crowding and flow become national quality measures. It is also a time when the changes in insurance coverage through the Accountable Care Act are nearly ready to be implemented; these changes will insure 30 million more Americans through Medicaid. Given the experience of Massachusetts, where ED visits increased after universal coverage, it is likely that EDs will be even more crowded, making interventions to reduce crowding even more important. It is our hope that the discussions, research questions, and collaborations resulting from this conference will be a valuable addition

to the understanding of flow in the ED and how this can be improved at the hospital, system, or government policy levels.

## **7. LIST OF PUBLICATIONS and PRODUCTS**

The following list of papers was published in the December 2011 issue of *Academic Emergency Medicine*. This includes both conference proceedings and original contributions related to the conference.

1. Pines JM, McCarthy ML. Executive Summary: Interventions to Improve Quality in the Crowded Emergency Department. *Acad Emerg Med* 2011;18:1229-33
2. Mason S. United Kingdom Experiences of Evaluating Performance and Quality in Emergency Medicine. *Acad Emerg Med* 2011;18:1234-8
3. Ovens H. ED Overcrowding: The Ontario Approach. *Acad Emerg Med* 2011;18:1242-5
4. Morrison JB, Rudolph. Learning from Accident and Error: Avoiding the Hazards of Workload, Stress, and Routine Interruptions in the Emergency Department. *Acad Emerg Med* 2011;18:1246-54
5. Schiff G. System Dynamics and Dysfunctionalities: Levers for Overcoming Emergency Department Overcrowding. *Acad Emerg Med* 2011;18: 1255-61
6. Soremkun C, Terwiesch C, Pines JM. Emergency Medicine: An Operations Management View. *Acad Emerg Med* 2011;18:1262-8

7. McCarthy ML, Ding R, Pines JM et al. Comparison of Methods for Measuring Crowding and Its Effects on Length of Stay in the Emergency Department. Acad Emerg Med 2011;18:1269-77
8. Pines JM, Pilgrim R, Schneider SM et al. Practical Implications of Implementing Emergency Department Crowding Interventions: Summary of a Moderated Panel Acad Emerg Med 2011;18:1278-82
9. Fee C, Hall K, Morrison JB, et al. Consensus-based Recommendations for Research Priorities Related to Interventions to Safeguard Patient Safety in the Crowded Emergency Department Acad Emerg Med 2011;18:1283-8
10. Pham C, Trueger NS, Hilton J, et al. Interventions to Improve Patient-centered Care During Times of Emergency Department Crowding Acad Emerg Med 2011;18:1289-94 Acad Emerg Med 2011;18:1295-1302
11. Ward MJ, Farley H, Khare RK, et al. Achieving Efficiency in Crowded Emergency Departments: A Research Agenda Acad Emerg Med 2011;18:1303-12
12. Kocher KE, Shane SA, Venkatesh AK, et al. Interventions to Safeguard System Effectiveness During Periods of Emergency Department Crowding Acad Emerg Med 2011;18:1313-7
13. Hwang U, Weber EJ, Richardson LD, et al. A Research Agenda to Assure Equity During Periods of Emergency Department Crowding Acad Emerg Med 2011;18:1318-23
14. Singer AJ, Thode HC, Viccellio P, Pines JM. The Association Between Length of Emergency Department Boarding and Mortality Acad Emerg Med 2011;18:1324-

15. Sills MR, Fairclough DL, Randade D, et al. Emergency Department Crowding Is Associated with Decreased Quality of Analgesia Delivery for Children with Pain Related to Acute, Isolated, Long-bone Fractures Acad Emerg Med 2011;18:1330-8
16. Liu SW, Chang Y, Weissman JS, et al. An Empirical Assessment of Boarding and Quality of Care: Delays in Care Among Chest Pain, Pneumonia, and Cellulitis Patients Acad Emerg Med 2011;18:1339-49
17. Rowe BH, Villa-Roel C, Guo X, et al. The Role of Triage Nurse Ordering on Mitigating Overcrowding in Emergency Departments: A Systematic Review Acad Emerg Med 2011;18:1349-57
18. Pines JM, Hilton JA, Weber EJ, et al. International Perspectives on Emergency Department Crowding Acad Emerg Med 2011;18:1358-70
19. Wiler JL, Griffey RT, Olsen T. Review of Modeling Approaches for Emergency Department Patient Flow and Crowding Research Acad Emerg Med 2011;18:1371-9
20. Kennebeck SS, Timm NL, Murtagh E, The Association of Emergency Department Crowding and Time to Antibiotics in Febrile Neonates Acad Emerg Med 2011;18:1380-5
21. Felton BM, Reisdorff EJ, Krone CN, et al. Emergency Department Overcrowding and Inpatient Boarding: A Statewide Glimpse in Time Acad Emerg Med 2011;18:1385-91



22. McClelland MS, Lazar D, Sears V, et al. The Past, Present, and Future of Urgent Matters: Lessons Learned from a Decade of Emergency Department Flow Improvement *Acad Emerg Med* 2011;18:1392-8

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