

MORAL IMPLICATIONS OF EMERGENCY DEPARTMENT CROWDING

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## LIST OF ABBREVIATIONS

ACS: Acute Coronary Syndrome

CAH: Critical Access Hospital

CDU: Clinical Decision Unit

CPOE: Computerized Physician Order Entry

ED: Emergency Department

EMS: Emergency Medical Services

EMTALA: Emergency Medical Treatment and Labor Act

ER: Emergency Room

ESSC: Emergency Services and System Capacity

GP: General Practitioner

HRSA: Healthcare Resources and Services Administration

ICU: Intensive Care Unit

IOM: Institute of Medicine

IT: Information Technology

LOS: Length of Stay

NAS/NRC: National Academy of Sciences/National Research Council

NHS: National Health Service

PPACA: Patient Protection and Affordable Care Act

RCC: Rapid Cycle Change

TFAD: Time to First Antibiotic Dose

UK: United Kingdom

US: United States

## ABSTRACT

Emergency Department (ED) crowding, defined as “an extreme volume of patients in ED treatment areas, forcing the ED to operate beyond its capacity” has become a public health crisis in the United States. ED crowding can lead to compromised care which threatens the moral values medicine has been built upon (Cowan and Trzeciak 2005). This thesis offers a brief history of the development of hospital based EDs to demonstrate the origins of ED crowding, then moves on to analyze the moral dilemmas posed by crowding. It examines the causes of ED crowding and potential solutions to the issue, and concludes with brief remarks about how the health care system might be reformed to alleviate the burden of crowded EDs.

## INTRODUCTION

In this thesis, I argue that Emergency Department crowding causes negative outcomes for patients, physicians, and hospitals. I examine Emergency Department policy and consider possible measures and initiatives to address this problem. The thesis begins with a brief overview of the use and intent of the Emergency Department as a health care setting, describes how that use has changed over time, and examines the relationship those changes have to Emergency Department crowding. After evaluating the causes and moral consequences of Emergency Department crowding, I analyze potential solutions to these issues. I suggest a way to optimize the use of Emergency Departments and reduce crowding by maximizing the services Emergency Departments are more suited to provide and minimize less effective use through coordination with the other hospital departments, thereby improving throughput. I also argue for increasing access to primary care to prevent ED use for acute illness.

My first chapter serves as an introduction to hospital-based Emergency Departments. I review the types of medical care Emergency Departments (EDs) were designed to provide and what services they offer now, and then offer an analysis of what works well and what doesn't work as well in that particular health care setting. Prior to the last 20 years, hospital-based EDs mainly provided acute medical care in emergency situations (Moskop et al 2009a). After the enactment of the Emergency Medical Treatment and Labor Act of 1986 (EMTALA), many hospitals shut down their EDs, as they would have been forced to incur costs for treating patients who may not be able to pay (Moskop et al 2009a). A decrease in the number of emergency care facilities led to an increased census in those that remained open, thus contributing to ED crowding.

Recently EDs have become a catch-all of sorts, as they provide services to individuals who are unable to secure care elsewhere, offer public health measures, provide procedural and occupational care as well as primary care and employee health, and provide disaster preparedness (Moskop et al 2009a). Because of its expanded role, more and more patients present to the ED, and not necessarily for inappropriate reasons, straining the capacity of EDs to respond. I then evaluate what medical services the ED is well suited to provide, and which services might be secured more effectively elsewhere.

The second chapter focuses on outlining the moral implications of ED crowding on the patients, the physicians, the community, and the hospital. The most obvious effect on patients is the long wait times in the ED. This certainly has more consequences than simply irritation or minor discomfort from having their patience tested. These long wait times can lead to “adverse consequences, including patient harm, and decreased patient satisfaction” (Wiler et al 2011, 1371). Patients may become discouraged and leave before obtaining treatment, these decisions may decrease hospital revenue, forgo health benefits to the patient (possibly to disastrous levels), and leave a bad taste in the mouth of the community for the ED and the hospital. The adverse moral consequences of ED crowding do not occur as a result of long wait times alone; an overworked ED staff contributes to negative health and public relations outcomes as well. Since the flow of patients through the ED over the course of a day puts pressure on and may even exceed the capabilities of the ED, the staff must work quickly and efficiently to provide effective patient care. The question now becomes: is the staff more concerned with the well-being of the current patients occupying the treatment area, or maintaining a steady flow in order to

accommodate the many patients waiting to be seen? In attempting to optimize flow, a potential decrease in safety and patient benefit might occur. This chapter goes on to describe how ED crowding raises moral issues of nonmaleficence, beneficence, and justice.

In my third chapter I discuss the causes of crowding, using the Input-Throughput-Output model described by Asplin et al in 2003. It was previously thought that a large cause of ED crowding results from the use of the ED as “safety net care for indigent patients” (Moskop et al 2009a, 605). The high cost of primary medical care often leads individuals who lack insurance (and even those who are insured) to seek care elsewhere, often at the ED. Some experts consider the use of EDs for primary medical care to be a misuse of the services. The health care system in general must be considered when discussing the causes of ED crowding. In many cases the ED is only used when other options are unavailable. Rather than focusing on the "Input" aspect of the model through nonurgent use, this chapter describes how "Throughput" and "Output" factors play a much larger role in contributing to ED crowding. In particular poor administrative design contributes to the bottlenecks in throughput, including delays in diagnostics and treatment stemming from difficult communication between hospital departments (such as laboratory and radiology) and acquiring specialist consultation. The primary output factors correspond to moving patients from the ED to an inpatient unit; hospital crowding leads to boarding of ED patients which leads to ED crowding.

My fourth chapter reviews multiple methods that have been proposed and implemented to relieve the ED crowding problem. Finding a solution to the problem of ED crowding is complicated by the fact that “no standard definition of crowding exists”

(Wiler et al 2011, 1371). In order to study the crowding phenomenon more effectively, various methodologies for measuring and predicting ED crowding are explored.

I conclude in the fifth chapter by providing remarks as to what services the ED provides most effectively and offer ways to maximize their potential, while minimizing those uses that are not very effective in the ED setting. This analysis comes from evaluation of US initiatives as well as solutions other countries have implemented in their own hospital-based EDs. Emergency Department crowding poses a significant moral threat to the health care system and the patients who use the services. ED crowding must be addressed at a number of levels in order to first determine the root of the problem and then to fix the problem; fixes implemented by the ED alone will not add up to much in a broken system. The previous chapter examines solutions to be implemented in the ED, but other levels should be considered as well. A number of changes must be implemented at many different levels to address the issues that stem from ED crowding and provide the most effective treatment in a morally acceptable way.



## CHAPTER 1

### *Evolution of Hospital-Based Emergency Departments*

Emergency Department (ED) crowding did not transition from a rare occurrence to a national epidemic overnight. Many of the issues associated with crowding are the result of problems encountered in the larger U.S. health care system over the past quarter century. To appreciate the problem of ED crowding, it is worthwhile first to have a basic understanding of the origins and history of hospital-based EDs in the United States. This chapter will provide a brief description of that history.

Hospital-based Emergency Departments began to emerge around the United States after World War II (WW II), as the U.S. health care system underwent major changes. As physicians gradually abandoned the practice of making house calls, and specialty fields such as surgery became more popular, medicine became more institutionalized. The 1920s marked the beginnings of physicians noting the importance of having hospital privileges and in 1947 general practitioners developed their professional organization of the American Academy of General Practice (AAGP). Outpatient clinics, physician offices, and hospitals thus replaced the home as the main sites of care. Separation of hospitals and physicians led to each party charging patients separate fees and the need for medical insurance arose. In large part, these changes occurred as a response to the growth of medical knowledge and to structural changes in

provider reimbursement from insurers, as payments were geared towards hospitals rather than home visits. In addition, the federal Hill-Burton Act of 1946 provided funding for construction of public community hospitals across the nation. This Act served as a middle ground between calls for national health care and a hands-off approach; it provided funding to establish or improve upon existing hospitals, primarily in rural areas, by creating “emergency room” (ERs), thereby increasing community access to health care (Zink). From military medicine, emergency medicine arose as a new specialty aimed at the treatment of emergent conditions arising from trauma. Beginning with WWII, “blood transfusions, rapid transport of injured patients...and advances in surgical care of injuries” became commonplace medical interventions. With government funds for hospital construction, and insurer incentives for hospital-based treatment, medical treatments developed for American soldiers during WWII, Korea, and Vietnam paved the way for a new specialty of emergency medicine. (Hospital-Based Emergency Care).

Many physicians who served in the military as a method of paying for medical school arrived in civilian hospitals after wartime service with the knowledge and experience the emerging field of emergency medicine needed. Prior to the establishment of the field, ERs were staffed by medical students, residents, and “outcast physicians” who were unfit to enter the dominant fields of primary care and surgery (Zink). The attitude of the time was to consider the ER an undesirable locale for practicing medicine, since the patients consisted largely of the poor, the uninsured, and individuals from minority groups, and more money could be made in private practice. Even so, many physicians were concerned that the least experienced and minimally trained physicians staffed the ER. Hospitals finally began to take notice when a negative public image of

ERs surfaced in the community. As a result, hospitals formed committees and task forces to establish plans for staffing and operating emergency rooms in a more efficient and competent manner. Two of these plans, the “Alexandria Plan” and “Pontiac Plan,” became models for full time and part time physician staffing of the ER, respectively (Zink).

When the volume of patients presenting to the Alexandria Hospital ER in Alexandria, Virginia, began to increase during the early 1960’s, extreme pressure was placed upon the nurses who primarily staffed that part of the hospital. In response, the president-elect of the medical staff, Dr. James Mills, Jr., began to work out a way to staff the emergency room in a more efficient manner. After considering a number of options, Mills decided to put together a group of physicians with a new kind of specialized training who would practice exclusively in what the hospital now called “the emergency department.”

After the birth of the “Alexandria Plan” in the early 1960’s, ERs around the country began to take notice of changes in patient attitude and presentation and looked to implement plans of their own. As mentioned previously, the Hill-Burton Act funded construction of new hospitals, but these hospitals were ill prepared to receive ED patients as they “had underestimated their ED census and lacked coordinated physician coverage” (Zink, p40). Pontiac, Michigan’s General Hospital faced these problems, and, after hearing about the Alexandria Plan, Drs. Gustafson and Wigent adapted the structure and regulation of the Alexandria Plan for the part-time, voluntary ED medical staff that was popular at the time. For this particular hospital, hiring a group of private practice physicians to rotate coverage of the ED was the best option. After the implementation of

both of these plans, hospitals around the country began to make similar alterations to their methods of staffing to provide more effective treatment in emergency situations (Zink).

Publication of the 1966 National Academy of Sciences/National Research Council (NAS/NRC) report “Accidental Death and Disability: The Neglected Disease of Modern Society” spurred the further modernization of emergency rooms by “declar[ing] death and disability...a public health problem.” This Report called for health professionals, the government, and the lay public to respond to the problem through education and funding of trauma systems consisting of trauma centers at hospitals, ambulances for transport of trauma patients, and a method of communication among patients, providers, and transporters (Mullins, 1999). The late 1960’s and 1970’s saw a marked, though inconsistent, increase in development and implementation of trauma systems in municipal hospitals. Development of trauma systems was a great achievement, as they were specifically geared towards addressing emergent issues resulting from injury--the number one cause of death in individuals between the ages of 1 and 44. Thus, trauma systems were developed with the primary goal of providing life-saving care immediately, or in a relatively short amount of time, after unexpected events that would otherwise lead to death (Hospital-Based Emergency Care). The two main medical conditions these centers were concerned with were cardiac events, mainly acute coronary syndrome (ACS), and trauma (Hospital-Based Emergency Care).

Armed with the knowledge that rapid provision of life sustaining interventions in medical emergencies significantly improves patient outcomes, and that few hospitals in America were well equipped to provide such care, the Emergency Medical Services

Systems Act of 1973 was enacted to provide funding to help hospitals develop EMS systems (which are similar in structure and function to trauma systems, but are more nonspecific in terms of availability and level of preparedness to offer specialty care for high acuity trauma). By further developing EMS systems, this legislation effectively ensured more availability and quicker response times of emergency responders and transportation to emergency care providers. However, it offered no support to EDs, the end point of the system, effectively neglecting the deficiencies in this health care setting, if not exacerbating them by bringing more patients into the ED without increasing the ED's resources.

ED utilization was pushed one step farther with the enactment of the Emergency Medical Treatment and Labor Act (EMTALA) in 1986 (42 U.S.C. §1395d). EMTALA requires hospitals EDs to evaluate the medical condition of any person seeking medical attention in the ED and to stabilize that patient in emergent conditions, regardless of ability to pay (McDonnell et al 2012). This legislation, which denies Medicare funding to any hospital failing to comply, arose out of concern “that EDs were refusing to treat uninsured patients with emergency conditions” (McDonnell et al 2012). While this act prevents hospitals from denying emergency care, it is also thought to promote over-utilization of the ED, as this is the only health care venue in the United States legally mandated to provide care, or at the very least evaluate whether care is needed (McDonnell et al 2012). Reports have shown that since implementation, the annual number of ED visits has markedly increased, and thus EMTALA correlates directly with ED crowding (McDonnell et al 2012). In fact McDonnell et al found that “substantial numbers of patients who use the ED are aware of EMTALA, and that those patients who

are aware of the law are more likely to make moderate or frequent use of the ED.” Because hospitals are forced to provide care without guarantee of payment, EMTALA imposes a financial burden on them. A 1996 report estimated the uncompensated costs EDs faced that year as a direct result of EMTALA to be around \$425 million, with additional costs arising as a result of admitting those patients to inpatient services (Zibulewsky 2001). This financial burden forced the closure of many hospital EDs, at a time when their utilization was highest, further escalating the severity of crowding. As more and more individuals sought treatment in EDs, and EMS systems were coordinated to improve the pre-hospital component of emergency medicine (including many necessary and beneficial measures such as initial assessment and stabilization of critically ill patients), EDs became less able to manage this increased patient load, and the problem of ED crowding emerged (Hospital-Based Emergency Care).

The Trauma Care Systems Planning and Development Act in 1990 led to wide development of trauma systems across the country. However, federal funding for trauma systems was eliminated in 1995, with a resulting lapse in federal leadership over the development of trauma systems. In 2001, the Trauma/EMS Systems Program as part of the Healthcare Resources and Services Administration’s (HRSA) Division of Healthcare Preparedness was developed and filled the gap in federal influence over trauma systems. Well-coordinated trauma systems allow for “patients to move seamlessly and expediently through the system” because they have established processes and resources that are utilized according to regional plans (Hospital-Based Emergency Care). One of the most important organizational features of trauma systems is that trauma centers are categorized according to the level of services they are equipped to provide (level I-IV). This allows

for trauma patients to be directed to the nearest and most appropriate hospital for their needs. If the patient were taken to an ill-equipped hospital for treatment for the particular condition, the process becomes much slower and may even stop (while awaiting a revised plan to administer appropriate care), decreasing efficiency, and more importantly worsening the health outcome of the patient, as such confusion decreases effectiveness of care. Trauma systems provide an organized method of linking interdependent services to “improve patient outcome by reducing mortality, complication rates, missed injuries, lengths of stay, and costs of care” through coordination of medical treatment along the steps from pre-hospital care to ED care, and finally to inpatient care (Ursic et al 2009). However, trauma specialists are low in number and trauma centers are not as prevalent as they once were. Because such specialists and centers come at a hefty price and are poorly compensated, the field suffers shortages. With fewer trauma centers and EDs available to provide care, those remaining feel more pressure due to increased incidence of patients requiring complex interventions, and crowding results. (Hospital-Based Emergency Care).

Prior to the last twenty years, hospital-based emergency departments (EDs) mainly provided acute medical care in emergency situations (Moskop et al 2009a). Recently, however, EDs have become a catch-all of sorts, as they provide a variety of health services to individuals who are unable to secure care elsewhere. According to the brief history of emergency medicine offered above, prompt treatment of acute medical conditions was the primary reason for the creation of emergency departments and trauma centers, and today’s EDs are well suited, in terms of design, equipment, and staffing, to offer care in those situations (or to transport patients to centers able to provide care).

Public health measures and disaster preparedness can be adequately handled by emergency departments, if they have the appropriate plans for such events. For the purposes of evaluating appropriate ED use and crowding, public health and emergency preparedness contribute little to impeding ED flow on a daily basis, considering the infrequent utilization of these services. Other health care services commonly provided in hospital EDs include “last resort” or “safety net” care, “after hours” primary care, employee health, and procedural and occupational care.

Primary care and the care of individuals lacking other options prove to be the two largest contributors to patient presentation, aside from those seeking care for emergency situations. “An extraordinary range of capabilities converge in the ED—highly trained emergency providers, the latest imaging and therapeutic technologies, and on-call specialists in almost every field...to the patient, it is convenient, one-stop shopping” (IOM, 2006). While nonurgent use is not the leading cause of ED crowding, it certainly contributes to the use of EDs, and more importantly prevents optimal patient health outcomes (IOM, 2006). In particular, individuals more likely to use the ED for nonurgent services are those populations that are already subject to systematic disadvantage: children, the elderly, and patients with public health insurance, and uninsured patients (Bond et al 1999). These populations are known to use emergency departments for routine care due to accessibility and convenience. However, Bond et al (1999) found different results after conducting a study to determine which population is more likely to use the ED routinely and during which times of the day. The majority of chronic use for nonurgent reasons was done during the hours of 0801 and 1600, by patients between the ages of 20 and 64 who were either uninsured, had public health insurance or were



underinsured (Bond et al 1999). This suggests that either these individuals do not have access to other options due to financial reasons or simply lacked access to a primary care physician (due to scheduling constraints, personal preference, or insurance related reasons).

Although experts do not agree on a standard definition of ED crowding, for the purposes of this thesis, crowding will be defined as “an extreme volume of patients in ED treatment areas, forcing the ED to operate beyond its capacity (Cowan and Trzeciak 2005).

Since the patient population of the ED has changed, should the structure and function of the ED also be modified to accommodate its current patient population? How are larger players, such as the health insurance system or the greater health care system, involved in the current problem of ED crowding? How do these health care system factors influence the ability of emergency care professionals to adhere to the moral principles of beneficence, nonmaleficence, and justice? I will explore these questions in subsequent chapters of this thesis.

## CHAPTER 2

### *Moral Implications of ED Crowding*

Even though few experts agree on the specific definition of ED crowding, significant consensus exists regarding the moral consequences resulting from this phenomenon. Most obviously, crowding in the emergency department leads to problems in upholding the moral principles most medical practitioners embrace in patient treatment: nonmaleficence, beneficence, autonomy, and justice. This chapter will explore the (un)ethical aspects of ED crowding as they pertain to patients, but also as they affect healthcare professionals, the hospital, and the community. Some of the relevant moral issues result from crowding alone, while many issues are intrinsic to EDs, but are exacerbated by an increase in patient volume. This chapter focuses on how the ED handles this jump in patient volume and what consequences arise as a result.

The six complications outlined in the rest of this chapter highlight the ethical dilemmas EDs face due to crowding, and demonstrate how crowding contributes to negative health outcomes. Patients in dire need of medical assistance, and even those whose circumstances are not quite that urgent, see a decrease in positive health outcomes when the amount of time before treatment begins is prolonged (Cowan and Trzeciak 2004). As the ED patient population increases, but the number of medical, nursing, and other professional staff remains the same, providing the care their patients require becomes more difficult. However, when the health care providers perform rapid

evaluation and treatment in order to expedite the process, efficiency and effectiveness may be compromised as a result. When the likelihood of good health outcomes decreases, all parties involved suffer moral consequences: the patient fails to receive safe, timely, and effective treatment, and clinicians fail to honor their commitment to provide beneficial care. When “crowding blocks access to emergency care...[it further] induces stress in providers and patients alike, and can lead to errors and impaired quality of care” (IOM, 2006). The Institute of Medicine outlines six goals of care (safety, effectiveness, efficiency, timeliness, patient-centeredness, and equity), all of which become more difficult to achieve in crowded EDs.

The remainder of this chapter explores six of the most commonly cited features of crowded EDs that lead to compromised care and, often, adverse outcomes for patients: increased wait times, boarding, ambulance diversion, medical errors, decreased confidentiality and privacy, and inequitable care.

#### *INCREASED WAIT TIMES*

ED crowding leads to longer wait times for patients to see a physician; increasing “input,” that is, patients presenting to the ED for treatment, while space and resources for treatment remain constant, creates a bottleneck to patient “flow,” or access to care. It is important to point out that waiting for ED services is not a novel concept: “emergency departments are places of waiting. Patients wait in triage, to be seen by care providers, wait for tests, and wait for explanations” (Agrawal, 2007). Even though waiting may not be new to EDs, crowding has exacerbated this problem. While the primary purpose of

EDs is to provide timely treatment in unforeseen emergencies, the majority of patients seeking care in the ED do not have emergent or life-threatening conditions (IOM, 2006). Because the ED responds first to patients with serious emergency conditions, those with less urgent complaints often experience increased wait times. These protracted wait times lead to delay in diagnosis and in alleviation of pain and suffering (IOM, 2006). Thus, denying patients the opportunity to receive timely treatment leads to poorer health outcomes, most notably prolonged suffering and increased risk of ineffective treatment when dealing with time-sensitive cases (which may lead to increased risk of more invasive treatment). In their 2011 article, Sills et al found that ED crowding correlated with a decrease in timely delivery of pain medicine to children presenting with bone fractures, with a 47% decrease in probability of receiving analgesics in a timely manner and a 17% increase in the risk of receiving less effective care (in this case whether or not pain medication was given). This study sought to determine how crowding influenced the six quality domains of care given to children in the ED during times of crowding, and found that "only the timeliness and effectiveness measures showed an association with crowding" and that association being an inverse relationship where as crowding increased, both the timeliness and effectiveness of the treatment decreased. (Sills et al 2011).

In response to the problem of increased wait times, EDs have extended their resources far past their ideal capacity by placing stretchers in hallways, adding fast-track services, and even attempting to restructure triage protocols to accommodate more patients in a more efficient and timely manner (IOM, 2006). Many of these changes, however, have

compounded the bottleneck resulting from increased input, as they have not addressed the issue of “output,” that is, moving patients out of the ED to a more appropriate location for continuing treatment, or after appropriate treatment has been administered.

Regardless of the severity of the condition causing a patient’s presentation to the ED, delays in diagnosis and treatment may also compromise patient safety and inhibit positive health outcomes. In more serious complaints, such as “acute coronary syndrome, stroke, surgical emergencies, and septic shock...impediments to prompt critical care recognition and delivery in the ED setting could potentially represent a threat to patient safety” (Cowan and Trzeciak, 2004). Extended wait times also result in patients leaving without being seen by a physician. In these cases, the patient does not receive the care he or she seeks, and the patient may suffer serious health consequences as a result.

### *BOARDING*

One of the most common complications associated with ED crowding is that of ED boarding, or “holding a patient who needs to be admitted in the ED until an inpatient bed becomes available” (IOM, 2006). As I will discuss in Chapter 3, boarding is generally viewed as a major source of ED crowding, and this practice also poses its own moral hazards. While EDs are known to serve as de facto Intensive Care Units (ICUs) for critical patients until an ICU bed becomes available, such use does not promote safe and effective care. Typically, EDs do not have the staff or medical equipment necessary for attentive continuous monitoring of a critically ill patient for extended periods of time.

Unlike ED patients waiting in the ED waiting area to be seen by a physician or other practitioner, boarded patients wait in an ED treatment area until an inpatient bed becomes available for them. Since patients must remain in the ED when transfer to an inpatient bed is delayed, definitive treatment is often delayed while the patient remains in the ED. One ED physician comments “these patients can languish in the ED for hours—or days” (Agrawal 2007). Not only is the boarded patient not receiving the medical care best suited to her condition while she remains in the ED, she is also consuming ED resources and occupying a bed that could be used for other patients. Although initial decisions about diagnosis and the need for inpatient care have been made, the patient still remains in the ED and must be monitored and treated as necessary, even if definitive treatment will typically not be administered until transfer to an inpatient unit has occurred. Continuing this care taxes the ED staff that much further, making an already stressful environment all the more primed for “errors, delays in treatment, and diminished quality of care” (IOM, 2006). Although a major role of hospital-based EDs is to provide critical care, it is largely only to the extent of stabilization and not longer-term care. In fact, many EDs “do not have ICU-level resources for optimal longitudinal critical care delivery” (Cowan and Trzeciak 2005). These patients require one-on-one round the clock care from the nursing staff, expertise in critical care (and potentially in additional subspecialties), and invasive monitoring, which ED staff are simply not equipped to offer (Cowan and Trzeciak 2005). Liu et al describe epidemiologic points of boarding as a public health hazard with their 2009 study reviewing the outcomes of patients boarded in the ED of a level 1 trauma hospital. They report three main findings: 27.8% of boarded patients experience an “undesirable event” (i.e., a missed ED treatment, missed home

medication, or missed laboratory check), preventable adverse events were experienced by 3.3% of boarded patients, and elderly patients and individuals with comorbidities had a higher likelihood of experiencing an undesirable event (Liu et al 2009).

Boarding not only denies timely access to adequate medical care, but also prevents the delivery of patient-centered care, due to the limitations of the nursing staff and the excessive demands they face to provide care to numerous patients.

#### *AMBULANCE DIVERSION*

The increase in the number of patients presenting to the ED not only creates longer wait times, but also leads to a practice called “ambulance diversion.” Once a crowded ED reaches the point where it cannot receive new patients without compromising the safety of existing patients, as well as incoming patients, it may resort to sending patients to alternative health care sites. If an ED cannot perform at reasonable standards, “inbound ambulances may be diverted to alternative hospitals” to allow patients to obtain the proper care. At one point a rare occurrence, ambulance diversion has become all too common in the past decade. In fact, in 2003 approximately once per minute an ambulance was diverted in the United States, totaling to 501,000 ambulances diverted that year (IOM, 2006).

While done in the attempt to provide appropriate emergency care in times of great stress, ambulance diversion often compromises basic moral norms. Ambulance diversion poses threats to principles of nonmaleficence and autonomy. Patient safety is compromised by ambulance diversion, since it may increase the time to treatment. When

an ambulance must transport a patient to another hospital (one that is most likely more distant than the original destination), that ambulance will probably take a longer time to arrive at the second hospital, thus delaying treatment. In the interim, the health issues the patient suffers from continue and may even get worse. For time-sensitive conditions, ambulance diversion correlates directly with an increased mortality rate. One study found that when an ED experienced ambulance diversion "the patient experienced a higher death rate by about 3 percentage points than when that same ED was not on diversion" demonstrating an increase in 30-day mortality rate corresponding to ED crowding (Shen and Ilesia 2011).

When an ambulance is diverted from its original destination, the second hospital may not be the hospital where the patient would have chosen to receive treatment. The patient may have preferred being treated at a hospital where his doctors have privileges and his medical records would be readily available (Moskop et al, 2009a). Had the patient been aware of the situation, or been allowed to provide input, he may have made a different decision than the one that was made for him. Granted, in most medical emergencies the assumption that a rational individual would opt for the speediest and most effective treatment can and should be accepted, and some hospitals are not well-suited to treat the particular needs of the patient (i.e., for patients suffering from trauma or in need of specialty services that not every hospital would be able to provide). Not giving the patient a choice limits that patient's autonomy. It is worth noting, however, that in some cases patient autonomy may be limited for good reason. In at least some cases, diversion is not a serious threat to the health and well-being of the patient, and it may be necessary to uphold other moral principles. A final adverse consequence of



ambulance diversion occurs when an ambulance must take the patient to a more distant hospital, resulting in the ambulance being that much farther away from its home base, and causing the time to respond to subsequent emergencies to be extended (Moskop et al, 2009a).

### *MEDICAL ERRORS*

Medical errors not only compromise patient safety, but also negatively affect the reliability and quality of care the community can expect from the ED. Medical errors might occur as a result of a hurried pace to decrease wait times or of inadequate staff to deliver appropriate and well-monitored care. In their 2011 paper, Jo et al report a relationship between prolonged wait times in the ED and increased mortality for patients presenting with community-acquired pneumonia. The National Quality Forum established the guideline that antibiotics must be administered no more than 6 hours after presentation (Jo et al 2011). As such, the time to first antibiotic dose (TFAD), did not significantly affect the mortality outcomes of the study population since all patients were given medication within the accepted timeframe (Jo et al 2011). However, those participants in the high crowding group displayed a higher mortality rate than any of the other groups (Jo et al 2011). The exact cause of the higher mortality rates among the high crowding group of participants was unclear; the authors suggest that the increase may have been due to crowding since ED crowding is known to lead to a decrease in quality of care and higher instance of medical errors, especially for critically ill patients (Jo et al, 2011); in times of crowding patients "receive a lower quality of care because the available resources are stretched too thinly" (Richardson 2006).

Another example of medical errors contributing to decreased health outcomes in crowded EDs is that of blood culture contamination. Blood cultures are “a mandatory diagnostic test used to detect bacteremia and to identify the causative microorganism” (Lee et al 2011). When these cultures become contaminated, patients may be forced to undergo unnecessary medical treatment, thus compromising patient safety and the reputation of the institution. Hospitals are generally able to decrease the occurrence of contamination through the use of disinfectants, sterile technique, taking blood samples from different sites, and having well-informed staff perform the procedure (Lee et al, 2011). When emergency departments experience times of crowding, blood culture contamination rates can increase anywhere from 0.6% to 6% as a result of “a high severity of illness, the rapid turnover of staff, the lack of ongoing training, and the high work load” (Lee et al, 2011).

The hectic and high stress environment created by ED crowding primes this healthcare environment for medical errors. Overextended medical staff, combined with the higher severity of illness existing in the environment, often lead to contamination of diagnostic tests, signs and symptoms of critical conditions being overlooked, and adverse outcomes that may have been prevented otherwise. Such medical errors have been identified by the Institutes of Medicine as serious threats to public health. Fordyce et al "found that errors are relatively common in a busy ED, occurring in almost every aspect of care, although the majority of errors detected resulted only in brief delays and little or no patient inconvenience." A small number of serious adverse events do occur, however, and because of that changes must be implemented system-wide to promote patient safety (Fordyce et al 2003).

*DECREASED CONFIDENTIALITY AND PRIVACY*

ED crowding often results in patients being situated in any space remotely suitable for examination and treatment, including hallways. Patients in crowded EDs are very close together, and the ability to offer a sense of privacy is nearly nonexistent (IOM, 2006). Since the design of emergency departments and patient treatment areas often reflects a focus on visibility rather than privacy, often, “physicians and nurses find it nearly impossible to have a private conversation with a patient” (IOM, 2006). As a result two situations may occur: (1) private information is disclosed in a public manner, or (2) not enough information is disclosed to the patient so that patient can make an informed decision. In either case, the patient may not be comfortable discussing such private matters in the quasi-public setting of the emergency department.

The issue of privacy does not solely concern the privacy of information, but also physical privacy. Examinations are often done in close proximity to other patients, sometimes with only a curtain separating patients. When physicians attempt to perform an exam on a patient, “the exposure to others of intimate body parts and invasive treatments may evoke feelings of violation, acute embarrassment, shame, or resentment” thus compromising patient security and safety in the ED (Moskop et al, 2009a). However, the potential solution of keeping patients in waiting areas until more private treatment areas become available poses its own moral and health associated risks by increasing their waiting time (Moskop et al, 2009a).

Both the violation of privacy of information and physical privacy may strain an already uncomfortable relationship between patient and physician. Since in most cases,

patients and emergency physicians are meeting for the first time, a sense of ease in discussing sensitive matters will not be present. Because patients may not feel free to speak openly about their medical condition, physicians may be ill-informed as to the medical history of the patient, thereby leading to incorrect diagnosis and ineffective treatment. Emergency physicians may similarly choose to limit disclosure of confidential information about the patient's diagnosis and treatment options in order to prevent others from overhearing, but non-disclosure of this important information may compromise the ability of the patient to provide informed consent to treatment.

#### INEQUITABLE CARE

One reason seeking care in the emergency department is appealing to many is that all patients are guaranteed access to medical evaluation and emergency care regardless of ability to pay or other considerations that may lead to health disparities in other medical settings. However, in times of crowding, equitable care is far more difficult to ensure than it would be otherwise. This is because of the stress and pressure the staff may feel while trying to accommodate the increase in patients, leading to a more hurried pace which could potentially compromise the patient's interpretation of the quality of care he or she receives. In order to prevent this perception of inequity, health care providers should be mindful of the communication between themselves and their patients. Since ED crowding can be foreseen (considering the frequency of the phenomenon) EDs ought to have protocols in place to ensure that patients who are seen during peak crowding conditions receive the same level of care as patients who do not present at times of high

crowding. As one of the six quality domains outlined by the IOM, equity in health care must be upheld to ensure ethical practice by providers and ethical treatment of patients. Care in EDs already exists with innate disparities, as larger EDs are generally located in larger hospitals in urban settings, where a large number of racial and ethnic minorities reside. Individuals of lower socioeconomic status seek care in EDs in response to the difficulties in accessing and paying for medical treatment that exist in the current healthcare system in the US. These larger hospitals are more prone to crowding, ambulance diversion and patient boarding. However, when Congress enacted the Emergency Medical Treatment and Labor Act (EMTALA), it did so with the hope of leveling the playing field by ensuring that emergency care is provided to anyone asking for it; EMTALA mandates that any hospital receiving Medicare funding provide evaluation and treatment for emergency conditions (McDonnell et al 2009). This legislation has made the ED one of the most equitable settings in the U.S. health care system. This legislation has placed a great financial burden on many hospitals, however, and has led to closure of many EDs over the past two decades, causing a decrease in access (Hwang et al, 2011).

In summary, emergency department crowding has become so prevalent that it is a serious health concern (IOM, 2006). In the last decade, numerous studies have been published outlining the detrimental effects of ED crowding on patients and providers. While EDs have the inherent issues associated with providing critical care in times of great stress induced by trauma and disasters, crowding exacerbates these problems and brings many of its own inherent problems to the table. Most importantly, the quality of

care decreases as seen by rising morbidity and mortality rates, increased medical errors, and delay in pain control and treatment (Rabin et al 2012). Recognizing that these ethical norms are being violated by the growing problem of ED crowding is only the first step in solving the dilemma, the next chapter considers what factors contribute to this phenomenon.

## Chapter 3

### *Causes of ED Crowding*

As the lead provider of last resort care, often to patients who are unable to pay for medical services, the ED has become the “safety net” of the U.S. health care system (IOM, 2006). Thus, the ED offers medical care for millions of uninsured and underinsured Americans who “have no regular source of care and fail to realize the benefits associated with having a primary care provider” (IOM, 2006). This inability to access primary health care leads to decreased health outcomes for patients; without routine medical care, many manageable conditions go unnoticed until they become emergent. This use of the emergency department was not part of its original purpose, and it contributes to ED crowding. More importantly, however, it reflects a dysfunction present in the current health care system. Another contributor to ED crowding is that of hospital crowding in general and the imperfection associated with inpatient services. Such systemic problems greatly affect the degree to which ED crowding occurs.

To portray the flow of patients into and out of the ED and the relationship between the ED and other treatment settings, Asplin et al. propose a useful model, which they call “the input-throughput-output conceptual model of ED crowding,” in their 2003 paper “A Conceptual Model of Emergency Department Crowding” (Asplin et al 2003). Asplin et al. offer the following explanations of central concepts in their model:

INPUT- “any condition, event, or system characteristic that contributes to the demand for ED services”

THROUGHPUT: Triage, room placement, evaluation, diagnostics, and treatment.

OUTPUT: Discharge from the ED and movement of admitted patients to inpatient beds (Asplin et al 2003).

In this chapter, I will discuss causes of ED crowding occurring in each of these three stages of ED patient flow.

## **Input**

### **\*Nonurgent Use**

Providing a definition for “nonurgent use” of ED services proves quite controversial; regardless of medical input, a condition that prompts a visit to the ED is almost always urgent in the perspective of the patient (IOM 2006). Because of the lack of access to primary care, ED visits, particularly those falling under the “prudent layperson” standard (which refers to the fact that when faced with an emergency situation where “a prudent person might anticipate serious impairment to his or her health” medical evaluation would be obtained) are frequent (Raven et al 2013). Three particular groups present to the ED more frequently than the rest of the population for “nonurgent” visits: the elderly, children, and individuals who are either uninsured or insured through public programs. Often, their presentation results from inadequate or nonexistent access to primary care (Howard et al 2005). Individuals with access to more appropriate forms of



primary care, however, still choose to visit the ED, mostly due to the convenience of 24-hour care and to referral by their primary care physician (Redstone et al 2008).

Such nonurgent use not only contributes to the increasing number of visits to the ED, but also takes its toll on the limited resources the ED has to offer, including the time and energy of ED medical and nursing staff. While nonurgent matters take considerably less time to diagnose and treat than true emergencies do, and turn-around time for space in the ED is relatively short, ED professionals must still provide effective and efficient treatment to these patients. This has led the staff to place more emphasis on performing in a more “task-oriented” manner, rather than focusing on patient well-being and catering to emotional as well as physical needs (Howard et al 2005). While in one regard this attitude may contribute to patients obtaining timely medical attention, in another regard the patient may be deprived of higher standards of care and establishment of a respectful provider-patient relationship. When a patient misses out on these things, the quality of the care is reduced.

#### \*Emergency Use

Over the past two decades, the number of visits to the ED for emergent reasons has increased, significantly contributing to the surge in ED crowding (Asplin et al 2003). In addition to natural disasters and unforeseeable accidents, higher severity of illness and the growing number of chronically ill individuals has led to a “sharp rise in critical patients” and contributed to higher frequency of ED crowding and boarding (Trzeciak and Rivers, 2003). As Moskop et al note in their 2009 paper, ED crowding results from over-abundance of ill patients, and not from “inappropriate use” (Moskop et al., 2009).

## Throughput

### \*Poor administrative design

Delayed implementation of diagnostic and treatment processes prevents the movement of a patient through the ED, causing a bottleneck in flow. Pitts et al recently demonstrated an increase in occupancy rates in the ED that strongly correlates with a related increase in level of treatment the patient requires. The intensity of diagnostic evaluation required by these visits causes more of a problem for EDs than other health care settings because they do not have the luxury of scheduling tests in advance (Pitts et al 2012). Recent studies have shown that in addition to measuring ED crowding through frequency of ED boarding, one of the primary indications of crowding is that of increasing occupancy rates, “defined as the number of patients in an ED at a single point in time divided by the number of standard treatment spaces” (Pitts et al 2012). Due to the increasing “intensity” of diagnostic procedures and treatment measures, patients experience a longer length of stay in the ED, keeping beds occupied for longer periods of time (Pitts et al 2012).

Visits requiring advanced imaging (particularly CT scanning) greatly increased over the past ten years, which adds to the problem of moving patients through the ED because these visits “required substantially more time (median length of visit 235 minutes) than other ED visits (median 137 minutes)” (Pitts et al 2012). This further adds to the complication of decreasing throughput time; not only do bottlenecks occur in moving patients from ED areas to inpatient areas, bottlenecks occur in evaluating the patient’s condition before a decision can be made regarding further treatment, and in

providing more invasive treatments. More importantly, these conclusions add support to the claim that nonurgent complaints do not contribute significantly to ED crowding. The study mentioned above found that lower-acuity visits do not demonstrate a correlation with the rise in crowded EDs, nor do those visits account for a large proportion of time spent in the ED (Pitts et al 2012). In fact, patients presenting with nonurgent complaints generally spend a shorter amount of time in the ED than higher-acuity visits (Pitts et al 2012).

In addition to the impossibility of anticipating and scheduling incoming patient needs, some of the problem comes from inadequate physical space, or improper design of the space, and an understaffed department. In fact, one study notes that EDs face a “lack of treatment space, on-call specialists, and language translation services” among a myriad of other problems (Burt and McCaig 2006). While most experts agree that “an increase in the number of beds, or a significant increase in staffing” may be the most obvious solution to crowding, “these are not solutions that are feasible in most hospitals” (Ontario Hospital Association 2010, p 11). In fact, in most metropolitan hospitals, nursing shortages occur frequently in the ED, leading to an increase in the number of patients one nurse has at any given time and a decrease in the number of patients who can be seen in a safe and efficient manner (Burt and McCaig 2006).

Next to nursing shortages and limited patient capacity in the ED, availability of on-call specialists greatly affects the flow of patients through the ED (Burt and McCaig 2006). In particular, surgical consultations are particularly hard to come by in many EDs, especially when requesting plastic and hand surgeons (Burt and McCaig 2006). Delays in acquiring a specialist consultation prolongs the time the patient spends in the ED, thereby

keeping that treatment space occupied longer, hindering the EDs ability to provide timely and efficient care to both the patient waiting to see the specialist, and the patients waiting for ED treatment.

Better options for solving this dilemma will be explored in Chapter 4, but it is important to note that one of the heaviest contributors to ED crowding is inadequate physical space and staffing of the ED, as this limitation reduces the efficiency of the ED and impedes output. During times of crowding “emergency physicians and other healthcare personnel are increasingly being asked to be effective in an environment that puts stress on fixed institutional resources that is characterized by heavy patient demands” (Randeau and Francescutti 2005). Crowding causes an imbalance between the demands of the patient and the available resources, resulting in a bottleneck in patient throughput. The inadequacy of available resources, including staff, has only been exacerbated by staff downsizing and reduction of inpatient treatment space resulting from cuts in hospital funding (Randeau and Francescutti 2005).

## **Output**

\*Delays in transfer from ED beds to inpatient beds

The most substantial delays in ED care correlate directly with output factors, including high inpatient census and consequent boarding in the ED of patients waiting for an inpatient bed to become available (McCarthy et al 2009). The primary output factor in ED crowding pertains to ED boarding, with one expert noting that even though “no single factor could explain why ED crowding occurs, the inability to transfer ED patients to inpatient beds was found to be the single most common factor” (Fields 2003). When

patients are held in the ED while waiting for inpatient beds, fewer ED beds are available to incoming patients. A 2006 report by the Institute of Medicine notes that “the most common cause of ED crowding is the boarding of admitted patients in the ED” (p 40). To this effect, many experts agree that much of the issue of ED crowding pertains to seriously ill patients needing extensive testing and subsequent hospitalization having to remain in the ED long after initial ED diagnostic and treatment services have been completed. In addition, “admitted patients typically require more diagnostic and treatment resources (including time in a treatment bed)” (Asaro et al 2007). Therefore, boarded patients affect ED crowding not only in terms of occupying treatment space, but also in terms of utilization of medical and nursing staff. Patient flow through the ED and subsequently through the hospital at large, is limited by the decreasing number of available inpatient beds as hospitals continue to downsize and close floors in efforts to control costs (Trzeciak and Rivers 2003). The desire to maintain a high census, driven by purely financial reasons, creates a medical environment prone to “treatment delays and bad outcomes” (Trzeciak and Rivers, 2003).

Many countries around the world face ED crowding to the same extent that it occurs in the US, primarily resulting from ED boarding. In Australia, “boarding patients represent around one-third of ED occupancy” (Pines et al 2011). In order to prevent the exacerbation of ED crowding, Hong Kong hospitals do not allow ED boarding for more than a few hours (Pines et al 2011). This concept, similar to the “4-hour rule” in the UK, seeks to quickly move patients from the ED to inpatient beds so as to prevent the tying up of ED resources as well as medical errors that frequently occur as a result of boarding, such as missed medications (Pines et al 2011).

The causes of ED crowding lie in multiple categories that overlap: input, throughput, and output, with the most emphasis being placed on output, primarily that of ED boarding. While the number of patients arriving at the ED for treatment leads to crowding in the waiting areas, this aspect does not heavily influence crowding in the ED as a whole. Instead, most research points to slow throughput and restricted output of ED patients as the primary issues. One study found that the substantial growth in ED use likely resulted from “decreased access to primary health care for all patients and an aging population” causing patients to present to the ED with ailments that don’t fall into the “nonurgent” category (Horwitz and Bradley 2009). These patients require more extensive workups and care plans than less urgent patients and often require admission to an inpatient bed. If the hospital is at or near full capacity, these patients designated for admission remain in the ED until an appropriate inpatient bed becomes available. When patients must be boarded in the ED while waiting for transfer to inpatient facilities, flow becomes impeded and causes the crowding epidemic EDs face.

Since the causes of ED crowding occur in response to systematic issues within the hospital or the greater health care system, solutions to crowding must focus on more than the ED itself. As discussed in this chapter, causes of crowding are multifaceted and will take more than simply the efforts of ED staff or structural changes in the ED to solve. The next chapter explores some solutions hospitals around the United States have already put into place.

## Chapter 4

### *Solutions to ED Crowding*

The patient's progress from arrival at the ED to discharge or admission to the hospital may encounter any number of bottlenecks along the way; from crowded waiting rooms causing delays in triage, to over-extension of medical staff and limited resources such as beds in the ED itself, and finally to crowding of the hospital in general, delaying transfer from the ED to inpatient facilities. Many solutions have been suggested to improve patient flow and decrease length of stay in the ED. Many of these solutions, however, address specific causes of crowding that are only part of the problem. This chapter describes the most commonly utilized and extensively studied solutions to ED crowding in the United States.

#### **Throughput**

##### *Triage-Room*

- **Immediate Bedding:** The patient is immediately placed in the care of a medical team, with the primary nurse performing the triage assessment, and registration occurs at the bedside. This method allows for rapid assessment and placement of the patient into the ED system. (Wiler et al 2010).

- Triage-based care protocols: Standardized pathways developed for specific diseases allow diagnostics and treatment to be initiated without waiting for an ED bed to become available. (Wiler et al 2010).
- Physician at triage: Placing a physician at triage allows for a more complete evaluation of symptoms at triage and for testing to be initiated in a timelier manner. It also has the added benefit of direct discharge for more minor complaints (Wiler et al 2010).
- Bedside Registration: Differing from the traditional method of registration while in the waiting room, bedside registration occurs after the patient has been placed into an ED bed, usually after assessment, and possibly treatment, has begun. This method reduces the wait time to be seen by a physician by expediting the triage process (which is quickly done in the reception area upon arrival, and before movement to the treatment area), since the patient does not spend time registering before being placed on the waiting list (IOM 2006). This shorter waiting time to see a physician correlates directly with a shorter length of stay (LOS) in the ED as it allows treatment to begin sooner (Takakuwa, Shofer, Abbuhl 2007). One study found that bedside registration decreased “triage-to-room” time by 21 minutes for nonurgent patients and by 9 minutes for urgent patients. This decrease in delays in registration leads to decreased throughput times (Takakuwa, Shofer, Abbuhl 2007).



- **Fast Tracks:** Many EDs have designated areas for patients presenting with more minor illness and injury so as to keep other areas open for more emergent cases. These fast track areas “can reduce delays in care for both urgent and nonurgent patients, thereby improving patient flow across the ED” (IOM 2006). Typically staffed by physician assistants and other health care professionals who work under the supervision of doctors, fast tracks free up resources needed for those more seriously injured or ill. Fast tracks have been shown to decrease ED length of stay, increase patient satisfaction, decrease instances of patients leaving without being seen, and improve the overall patient flow through the ED (Quattrini and Swan 2011). One hospital in Georgia reduced throughput time by 57% through the use of fast track services, however the effectiveness of this system varies according “to the specific circumstances of each ED, such as volume, patient mix, and severity-of-illness levels” (IOM 2006).

#### *Room-to-Disposition*

- **Clinical Decision Units (CDUs)/Observation Units:** Initially developed to monitor patients displaying signs and symptoms of acute myocardial infarction, CDUs have become places for “the efficient management of patients” who must be observed before a decision about the necessity of admission can be made (IOM 2006). These units serve as an intermediary between the ED and an inpatient floor, and essentially provide a place for patients whose treatment needs are uncertain to be monitored until more informed decisions can be made. Such units prevent unnecessary hospital admissions, while allowing for optimal and efficient

care to be provided without tying up inpatient space and other hospital resources, thereby decreasing the frequency of ED boarding. A study done to evaluate the impact of recently developed CDUs in Ontario found that these units offered the potential for better coordination among hospital departments and allow for more timely patient care, as well as freeing up ED resources (Salkeld et al 2011). In some hospitals, CDUs offer acute care and case management as well, particularly to ambulatory patients who present to the ED with chronic conditions. For instance, a diabetic arriving at the ED with a case of hyperglycemia, requiring care to avoid hospitalization, would benefit from acute care as well as case management (i.e., provision of primary care and information regarding the condition) so that future ED visits may be avoided (IOM 2006).

- **Zone Nursing:** This method of patient placement puts all of the patients assigned to a particular nurse in the same general area, so as to facilitate easier access by each nurse to his or her assigned patients. Boston Medical Center found that utilization of zone nursing reduced throughput time by 70 minutes (IOM 2006).
- **Unit Assessment Tools:** Based on the idea that if all parts of a system run efficiently in and of themselves, then the system as a whole runs more efficiently as well, unit assessment tools “can be used to determine and monitor the capacity of various units throughout the hospital system” and allow for better coordination among units. Monitoring the capacity at which each unit runs is a resource manager who provides assistance and allocates resources in response to

status changes (IOM, 2006). This method might help to alleviate ED crowding through the evaluation of how the ED works with pathology, radiology, and inpatient floors. If communication and coordination were managed better between the ED and these units, bottlenecks in flow might occur less frequently.

- **Use of Information Technology:** Improved information technology (IT) allows for the enhancement of quality and efficiency in the ED. Such developments as electronic patient records, patient tracking systems, scheduling programs for referrals and follow-ups, as well as technological advancements in diagnostics and imaging, allow for ease of accessing patient files and communicating information among care providers. Automated triage, discharge, and referral systems also help to alleviate ED crowding through coordination and organization of patient information, as well as improving communication in the ED and across the hospital system (IOM 2006). Computerized Physician Order Entry (CPOE) allows for the reduction of medical errors, more timely completion of procedures and tests, leading to overall improved efficiency and decreased LOS (Spalding et al 2011). Regarding discharged ED patients (as opposed to those admitted to inpatient floors), average ED LOS decreased by 23 minutes after implementation of CPOE at an urban academic level 2 trauma center (Spalding et al 2011). Other data suggest that ED LOS would decrease for all patients, regardless of discharge/admission status, as a result of merely improving the efficiency of diagnostic and laboratory orders through electronic communication (Spalding et al 2011).

These systems keep track of all patient information, including status, complaints, acuity, diagnostic and treatment notes, and discharge instructions and serve to improve ED work flow by improving communication among medical personnel. Hospitals have also begun to use automated communication devices such as touch screen kiosks to assist with the intake of ED patients. Patients have even been given "smart cards" that contain "medical history, allergy information, organ donor status, emergency contact information, medication, prenatal information, do not resuscitate status, and personal insurance data" to carry so that such information is readily available to care providers. (Wiler et al 2010).

Hospitals face severe financial costs in addition to the moral dilemmas posed by ED crowding. One estimate of lost revenue directly stemming from crowded conditions maintains that each patient leaving without being seen by a provider costs the hospital between \$300 and \$500, another \$3,000 in lost revenue for each ambulance that must be diverted, "and for every 75 out of 100 unsatisfied patients, expect that they will share their unhappy experience with 465 potential patients who may chose a different provider" (Hitchcock 2012). Simply by implementing more comprehensive methods of electronic information systems, such as CPOE, the improvements in patient flow, satisfaction, and patient health outcomes correlate to significant financial gains. MedWest-Hayward, a MedWest Health System affiliated with Carolinas Healthcare, saw a 9.5% increase in revenue, a net increase of over \$3 million through the use of more comprehensive information technology (Hitchcock 2012).

- **Timely Support for Consultants and Procedures:** Better coordination and communication among health care professionals allows for more timely consultation for procedures requiring specialists; a lack of adequate consultant staff and consultation protocols leads to delays in patient care and contributes to crowding (IOM 2006). In fact, patients waiting for specialist consultation account for 7.6% of patients being held in the ED, with 36% of EDs reporting 2 or more patients waiting for consultants at any given time (Schneider et al 2003).
- **Admission/Discharge Units:** Similar to coordinated discharge of inpatients, discharge units in an ED allow for patients to be discharged in a safe environment without taking up space in the treatment area and allowing that area to be used by the next patient. This space, which is separate from the primary ED treatment area, allows for monitoring of ED patients while they are being prepared for discharge from the hospital, in addition to serving as space for patients waiting for an inpatient bed to become available and provides an expandable ward in times of extreme crowding (IOM 2006).

## **Output**

- **Coordinated surgery schedule:** As elective surgery is one of two of the most common routes to hospital admission (with ED visits being the other), better coordination of scheduled surgeries “adds organization to the rate and flow of scheduled elective OR admissions...[and] also allows hospitals to smooth out variables in ED and OR patient flow—an effect that serves to alleviate ED crowding” (IOM 2006). Unplanned surgeries place an additional burden on

hospital services and lead to ED crowding, so in addition to creating a balanced surgery schedule many hospitals have taken measures to improve the flow of unplanned surgeries. The most frequently employed measure is that of designating one operating room specifically for surgical cases referred by the ED (IOM 2006). Artificial variation in bed demand can be lessened by coordination of elective surgeries, as demonstrated by one study whose findings show that 70% of delays in admission to ICU beds correlated with peaks in elective surgeries (Handel et al 2010). Distributing elective surgery patients more evenly across the week can prevent the high bed demand associated with peak surgery periods and the resulting increase in ED boarding during those periods.

- Coordinated bed management: This method involves designating an individual or forming a team of employees to monitor hospital census and ensure timely bed turnaround. The “bed czar” has the responsibility of keeping track of inpatient beds, working with housekeeping to quickly prepare beds for impending admissions, and notifying staff of bed shortages. This method offers the hospital “a consistent, timely mechanism through which hospital staff can be notified about bed status; a centralized patient placement process; and improved ability to anticipate bed needs across multiple settings” (IOM 2006). Many hospitals have used this method to decrease ED crowding; for example, wait times were cut from 150 minutes to 47 minutes at The Regional Medical Center in Memphis, TN through utilization of coordinated bed management. (IOM 2006).

- Full-Capacity Protocols: In times of extreme ED and hospital-wide crowding, some hospitals implement “full-capacity protocols” in which ED patients are relocated to makeshift spaces in inpatient units, even though no beds are available on those units. This method alleviates the burden placed on EDs by including the entire hospital in an effort to reduce ED crowding. (IOM 2006). One possible argument against the transfer of boarded patients to inpatient hallways and other areas while they wait for an inpatient bed to become available is that of decreased patient safety and monitoring. However, this process “does not create undue patient mortality or emergency ICU upgrades . . . [these occurrences] most likely reflect a different level of acuity and complexity” in the patient’s condition (Viccellio et al 2009).
- Coordinated Patient Discharge: A discharge coordinator (having similar function to the aforementioned “bed czar”) monitors patient charts and determines and expedites the discharge process by working with case managers and the nursing staff, offering more rapid bed turnaround. In addition to a discharge coordinator, some hospitals use “discharge units” in conjunction with a discharge coordinator. Through the use of coordinated patient discharge, the average length of stay for patients can be reduced, “with concurrent reductions in ED crowding rates” (IOM 2006). One method of coordinated discharge attempted to implement guidelines of discharging patients before noon in order to accommodate anticipated admissions in the afternoon and evening, however, computer simulation of this model led to an increase in boarding hours (Handel et al 2010). This study instead found that a “uniform discharge plan . . . between noon and midnight, along with

one that matches the timing of admissions to discharges, significantly decreased boarding hours” (Handel et al 2010).

Each of the solutions described above holds some potential for reducing the prevalence of ED crowding. The effectiveness of these different strategies, however, will heavily depend on an individual ED’s ability to finance and adapt to the structural changes. Over the past ten years, many solutions have been proposed and evaluated, each one focusing on a different potential cause of crowding, both internal and external to the ED. The above strategies have proven effective in the setting in which they were evaluated, however the degree of success that can be expected from the solution, as well as the difficulty of implementing and the costs associated with them, vary from ED to ED. In my opinion, no single strategy will eradicate the issue by itself. Each individual ED must evaluate its strengths and weaknesses in patient flow and in the safety and efficacy of the care delivered, and what it can afford financially. From there a plan for reduction of crowding should be customized, perhaps consisting of some of the above potential solutions and even some of their own (based on the needs of that ED).

To take just one example, rural EDs in particular may find themselves unable to implement many of the solutions outlined above because they lack the resources. To offset the disadvantage rural hospitals find themselves in, a federal initiative enables rural hospitals with a large proportion of Medicare patients to apply for Critical Access Hospital (CAH) designation (Van Vonderen 2008). To be classified CAH, hospitals must “be located in a State that has established a State rural health plan for the State Flex Program,” be in a rural area that is medically underserved, and have 24-hour emergency



care services available 7 days a week (Department of Health and Human Services 2013). This designation allows these hospitals to receive higher Medicare reimbursement rates, while at the same time limiting the number of acute care beds the hospital can maintain to between 15 and 25 (Van Vonderen 2008). In addition to applying for CAH status, rural hospitals have been encouraged to find alternate ways to decrease the burden of ED crowding, mostly through the referral of patients to other care sites such as a primary care or community health centers (Van Vonderen 2008).

Although not traditionally discussed as experiencing ED crowding, rural EDs serve “nearly 21% of the US population...[and] face overcrowding just like their urban counterparts” due to the increasing number of underserved and underinsured patients, as well as having fewer monetary resources with which to fund solutions (such as increasing beds, and medical and nursing staff) (Van Vonderen 2008). The most effective way of reducing the occurrence of ED crowding in rural EDs is to “focus on increasing the number of rural healthcare providers in primary care, as well as in emergency departments” (Van Vonderen 2008). By improving the primary care system, not only does the reliance on EDs as safety net primary care decrease, but patients will have more comprehensive care options, and preventive care will be held in more esteem thereby helping to decrease the instances of illness in the future. This concept holds true in urban areas as well as rural ones, and more efforts should be placed on improving the primary care system in the United States. The next chapter will explore that concept.

## Chapter 5

### *Moving forward*

As discussed in the previous four chapters, ED utilization continues to increase while the resources available to this particular health care venue remain stagnant. In fact, EDs serve as an ideal place to obtain medical care in the case of emergencies, in response to trauma, and in public health crises, yet they find themselves struggling to handle a steadily increasing patient load in recent years. As depicted in chapter 1, outcry from both the public and from health care providers transformed emergency rooms from unorganized, unsafe, and undesirable places to obtain medical attention in the 1960's and 70's into the Emergency Departments of today, recognized as credible and reliable providers of health care.

As the number of ED visits continues to increase and the number of ED beds continues to decrease, however, contemporary EDs confront a growing problem of crowding. In the second chapter, I described how ED crowding impairs adherence to fundamental bioethical principles of autonomy, beneficence, nonmaleficence, and justice, primarily by limiting the ability of clinicians to provide timely, safe, and effective treatment. Chapter 3 used the input-throughput-output model to identify a wide variety of potential causes of ED crowding and to assess their significance. Chapter 4 described multiple initiatives to prevent or mitigate the detrimental effects of ED crowding. In this final chapter, I will describe measures taken by working groups in the US, as well as evaluate how other countries experience and deal with ED crowding, before finally

concluding with recommendations for reforming the US health care system to decrease the prevalence of ED crowding.

### **US Collaborative Initiatives**

EDs need the most assistance at the output level, particularly with the movement of patients from ED beds to inpatient facilities. Hospitals must address the “patient flow obstacles that lead to overcrowded EDs” (Wilson and Nguyen 2004). A national initiative funded by the Robert Wood Johnson Foundation in 2002, *Urgent Matters*, sought to understand the issues surrounding ED crowding, including the complex causes of crowding, and to develop strategies to improve patient flow and the delivery of safe and effective care by reducing crowding. This initiative brought 10 hospitals together in a year-long "collaborative learning network" to research these strategies. It "implemented rigorous performance measures, assessed current processes, . . . used techniques of rapid cycle change to improve ED throughput and output [and] found that overcrowding can...be addressed...through better capacity and patient flow management" (Wilson and Nguyen 2004). From the initial Learning Network *Urgent Matters* created, a number of "critical success factors" were identified:

- ED crowding must be treated as a hospital problem and not solely as an ED problem.
- Change can only be implemented through collaborative hospital-wide initiatives. One such method suggested is the development of multi-disciplinary teams consisting of ED representation as well as from inpatient services and other related hospital departments.

- A "champion" must be determined. This individual will be responsible for overseeing the improvement initiatives and advocating for easing crowding.
- The hospital must have the full support of its management team in the changes it implements.
- Formal improvement methods greatly improve the odds of success for any strategies implemented. The report suggests use of Rapid Cycle Change (RCC) to improve patient flow. RCC takes successful results and accelerates improvement processes by building upon those results.
- Transparency throughout the hospital must be promoted. This can be done through the use of email, newsletters, and meetings.
- Collaboration must be evenly balanced among hospital departments as well as collaboration and competition with other institutions. Each entity should build upon the other in terms of what works, for the purposes of both improving patient safety and efficacy of treatment and improving performance to be more competitive in the larger health care system.

By acting upon these factors, the hospitals in the network observed a decrease in average time from bed placement to physician exam, a decrease in average ED throughput time, a decrease in boarding time of ED patients and a decrease in ambulance diversion. This collaborative also found a marked decrease in the number of patients who left without being seen, from 21% to 7% at one hospital. (Wilson and Nguyen 2004).

A second initiative, Learning Network II, was formed among six hospitals to further identify the issues exacerbating crowding and to develop strategies to reduce the problem (Wilson and Nguyen 2004). These six hospitals formed their network with three clear goals in mind:

1. to evaluate rigorously the implementation of strategies for improving patient flow and reducing ED crowding within the context of a hospital collaborative;
2. to advance the development of performance measurement in the ED; and
3. to promote the spread of promising practices to a wider audience and variety of hospitals.

These goals promote further research into ED crowding, seek to unite the ED with the rest of the hospital, and encourage education and the spread of information regarding causes of and solutions to ED crowding. The six hospitals evaluated success of their strategies based on the seven National Quality Forum-endorsed factors:

1. Length of stay for admitted patients (to an inpatient bed)
2. Length of stay for discharged patients
3. Time to pain management for admitted patients
4. Time to pain management for discharged patients
5. Median time to chest x-ray for admitted patients
6. Median time to chest x-ray for discharged patients
7. Admit decision time to ED departure time

From the initial 18-month collaborative, all six hospitals achieved success in decreasing ED crowding. (Learning Network II). Some of the strategies

implemented at each hospital partaking in the collaboration (designated A-F) ED are outlined below:

- (Hospital A) Protocols for consultations with specialists: Implementation of a computerized method of requesting consultations, with frequent follow up with specialists to ensure communication. ED clerks were instructed to page the specialists every 10 minutes until contact was made. This technique did not generate any expenses, other than requiring personnel to perform tasks in a different method from the usual (McHugh et al 2012).
- (Hospital B) Standardized registration and triage for nonurgent patients where both a nurse and registrar greet patients upon arrival to the ED using “a small number of essential demographic items to create a patient record, and conduct a 3-to5-minute triage.” Expenses for this technique totaled to \$32,850, including 2 portable computers at \$16,000 and a training course for two nurses to learn the triage method at \$16,850 (McHugh et al 2012).
- (Hospital C) Implement a 5-level triage system, generating no expense to the hospital. This nationally recognized method of triage was taught to the ED nurses through free materials from the Agency for Healthcare Research and Quality (McHugh et al 2012).
- (Hospital C) Immediately bed incoming patients where triage and registration occurs simultaneous to medical workup. This technique did not require training sessions (thus did not cost the hospital anything to

implement), only communication from the ED director to staff during meetings regarding how the new process would be followed (McHugh et al 2012).

- (Hospital C) Improvements to existing fast-track, by hiring more staff and physically separating the area from the main ED. Costs generated by new hires totaled to \$340,000 for 4 nurse practitioners, and physically separating the fast track area from the ED at a cost of \$150,000 (McHugh et al 2012).
- (Hospital D) Secondary improvements to fast-track services require only redirection of staff, improving the efficiency of registration, and providing more education to nurses and medical teams staffing the area. These changes did not lead to any financial costs (McHugh et al 2012).
- (Hospital E) Improve evaluation of mid-acuity patients through the use of physician-at-triage in order to decrease the time to medical evaluation and treatment. This change required the addition of an emergency physician and a technician to the department for this express duty, renovations to the triage room to allow for mid-level treatment to be done before admission, creation of new electronic forms for this type of patient, and staff training on the new process. Renovations and new hires totaled to \$320,683 (McHugh et al 2012).
- (Hospital F) Improved communication between the ED and inpatient departments through the use of faxed reports. This strategy involved designating an employee to serve as “bed coordinator” to discuss

occupancy rates of the ED and inpatient floors as well as to facilitate transfers. The only expense generated through implementation of this method was for the purchase of a fax machine, totaling \$200 (McHugh et al 2012).

While some of the above solutions come at a relatively hefty cost, especially for smaller hospitals, many of them were very inexpensive to implement and only required minor changes to existing protocols.

Similar to Urgent Matters, other collaborations and working groups have been put together across the country to collaborate on how to eradicate the problem of ED crowding. In 2011, a group of experts in the fields of patient safety, ED crowding, and systems engineering participated in a conference to assess what knowledge was available, what knowledge was lacking, and what aspects of patient care in EDs needs particular attention. The conference participants concluded that (1) more studies are needed addressing how to evaluate and improve upon patient safety, (2) more efficient methods of recognizing when an ED begins to reach seriously crowded levels should be put into place, and (3) better communication among hospital departments and between the hospital and its patients must occur to eradicate the issue of ED crowding. (Fee et al 2011).



## **International Comparisons**

In addition to observing trends in our own health care system, viewing ED crowding from an international perspective sheds some light on the causes of crowding (both internal to EDs and in the larger health care system) as well as offering data on how well proposed interventions work. ED crowding is not a problem unique to the United States. In this section, I describe the situation in a number of other countries whose hospital-based EDs face similar issues, focusing on the health care system in place and how EDs have responded to crowding.

### **Australia**

All Australian citizens can obtain health care from public hospitals free of charge, as well as from private hospitals where insurers cover some of the fees. Australia faces hospital closures and significant increases in the use of EDs, with ED crowding recognized as an issue since 1998. Data points to boarding as the leading contributor to crowding and in response, Australian EDs have attempted to remove obstructions to flow through the use of fast-tracks for low acuity patients, improving hospital discharge practices, and increasing the number of available beds and resources in the ED. One recent analysis of ED crowding in this country reports that no one method has yielded substantial improvements (Pines et al 2011).

### **Canada**

Canada offers a universal health care system funded by federal legislation, with physicians most commonly paid on a fee-for-service basis. However, emergency

physicians, along many other specialists, have begun to receive payments on salary or at an hourly rate as of late. Use of EDs in Canada closely resembles that of the United States: the number of individuals seeking medical care in the ED increases yearly as the available resources (number of EDs, ED beds, ED staff) face reductions. Two main Canadian initiatives to reduce ED crowding are the ER Wait Times Strategy and the Emergency Services and System Capacity (ESSC) initiative. The ER Wait Times Strategy attempted “to reduce total LOS and increase patient satisfaction” through the use of financial incentives to reward exceptional performance of EDs in terms of reduced LOS, increased accountability, and increased transparency to the public. The ESSC initiative sought to reduce bottlenecks to flow by increasing beds and improving bed management practices. The former saw improvement in LOS and wait times by around 18%, but the latter did not yield significant results (Pines et al 2011).

## Denmark

Health care services in Denmark are publically financed through government programs, and citizens have the ability to choose their general practitioner, who will provide all primary care and serve as a gatekeeper to specialty services. Denmark does not experience ED crowding to the extent the US does due to the ease of contacting a GP for most medical issues (pre-hospital systems, on-call GP's making house calls, call center for medical emergencies). However, hospital crowding is common, with 80% of hospital ICU's operating at 100% capacity much of the time (Pines et al 2011).

## Hong Kong

There are a total of 17 EDs in Hong Kong, with 16 of them being public. The public EDs in Hong Kong are part of government hospitals and funded by taxes. When citizens elect to obtain health care from a public ED, they are charged a fee of \$100 Hong Kong (approximately \$12.80 US), but anyone presenting is seen regardless of ability to pay. Even during periods of peak ED use (such as influenza pandemics) 16 of the 17 EDs experience little to no crowding, most likely because boarding does not occur. Simple and straightforward assessments and treatments take precedence over more in-depth and comprehensive protocols because they offer quick turnaround. In addition, more complicated cases “are simply admitted... [and] hospital management...has decided that patients will not board for more than a few hours after the decision to admit” (Pines et al 2011). Since boarding correlates poorly with good outcomes and offers a negative public image, admissions face little delay. These hospitals have the ability to expedite admissions because of the excess bed space they have created in observation and emergency wards “constructed with a bed number equal to one bed for every 10 new patient visits per day” and extra beds available in all wards in the hospitals (Pines et al 2011). EDs also have a team of specialists to monitor higher acuity patients as they await admission when boarding cannot be avoided (Pines et al 2011).

## The United Kingdom

In the United Kingdom (UK), the National Health Service (NHS) provides free health care to all citizens, including an assigned or chosen general practitioner (GP) who can refer patients to specialists. In addition to the public health care system, a private

sector is also available, usually funded through insurance or out-of-pocket payment. Similar to the US, the UK has seen an increase in ED utilization and an increase in crowding along with it. Crowding has become such a problem that the government instituted a “four-hour rule” in 2000, where any patient presenting to the ED must be either admitted to the hospital or discharged within four hours of arrival. This new mandate was gradually put into place, with yearly increases on the required percentage of ED visits meeting the criteria, with 98% of ED visits being required to fall under the 4 hour time frame by 2005. When hospitals were successful at meeting the criteria, they were awarded financial bonuses. In addition to the 4-hour rule, hospitals were encouraged to implement other strategies to improve flow including: streaming (separating major and minor cases), “see and treat” (immediate treatment for minor cases requiring simple treatment processes), elimination of formal triage procedures, creation of CDUs for patients unable to meet the 4-hour rule, and increasing staff to better accommodate the increase in patients. No single initiative yielded significant results, and the 4-hour rule was discarded in 2011 after many hospitals failed to meet the requirements, along with findings that even in hospitals that did meet requirements, patient experience and outcomes were not necessarily improved. (Pines et al 2011).

### **Concluding Comments**

The experience of these countries suggests that solving the issue of ED crowding cannot be done by implementing new initiatives in the EDs alone. Crowding does not result from inadequate insurance coverage in a private market, as data shows that

countries such as Canada and the UK encounter crowding similar to the US. In fact, ED crowding seems to only be less of an issue in countries with “very robust systems to care for patients outside of EDs” such as highly developed general practice medicine and easily accessible telephone service, as seen in Scandinavian countries such as Denmark (outlined above), as well as Sweden and Finland. All of these countries have extensive telephone networks with nurses and physicians available to give medical advice when GPs are not available for clinic visits (Pines et al 2011).

Judging from these international comparisons, it appears that ED crowding cannot be eradicated without modifications to the entire health care system. The only health care systems that did not consider ED crowding a public health concern were those with well-established and easily accessible pre-hospital medical care, usually including a general practitioner and multiple mechanisms that advise and direct patients to the appropriate level of health care. In addition, it is important that EDs, and hospitals in general, have enough beds to serve the surrounding population, and that there are enough facilities at which to provide treatment. This of course is limited by the financial and personnel resources the hospital has, and the feasibility of expansion of beds and other ED resources is uncertain, especially when the very opposite has been occurring (ie closure of hospital-based EDs due to inability to financially support them). Under the recently passed Patient Protection and Affordable Care Act, over 30 million additional US citizens will have health insurance, allowing them access to the health care system (Marco et al 2012). However, whether this will increase the percentage of individuals with a primary care physician who regularly oversees their health care, and result in a decrease in ED utilization, remains unclear. When Massachusetts implemented its health care reform,

mandating that all citizens have health insurance, ED utilization increased rather than decreased, due to the limited availability of primary care physicians (Marco et al 2012).

If the accessibility of primary care increased, how could that help to alleviate ED crowding? One expert maintains that nonurgent visits to the ED fall into two categories: “primary care preventable” and “primary care treatable” (Kellerman and Weinick 2012). Many visits to the ED are “primary care treatable” (such as seeking medical attention for flu symptoms), but that does not mean that those patients should refrain from seeking care in the ED; chances are those patients do not have other options for obtaining medical treatment (Kellerman and Weinick 2012). Many of the chief complaints reported by patients presenting the ED can be representative of both emergency and nonurgent conditions. One study found that “although only 6.3% of ED visits had primary-care treatable discharge diagnoses the chief complaints reported for these visits encompassed 88.7% of all visits” (Raven et al 2013). In other words, the majority of symptoms patients experience can be indicative of either a minor or a serious ailment; which acuity level the symptoms correlated to was only apparent after medical workup. Therefore, the expectation that a layperson can discern whether chest pain relates to something as innocuous as heartburn or to something more serious such as acute coronary syndrome is unrealistic and unsafe. Patients with these symptoms should present to the ED for treatment, even if their condition is eventually determined to be “primary care treatable.”

Some visits to the ED are the result of dangerous health behavior, but individuals who have access to, and take advantage of, good primary care are less likely to engage in unhealthy behavior. If a primary care physician manages a patient with a complex medical condition over time, the likelihood of that patient presenting to the ED with an

acute exacerbation of that condition should decrease (Kellerman and Weinick 2012). In the case of manageable chronic conditions, such as diabetes, when the patient receives routine medical care, the chances of a primary care preventable ED visit for reasons related to the diabetes decrease. When the health care system offers the patient the opportunity to manage a chronic condition effectively, that patient will theoretically need emergency health care services less frequently, and in turn the ED will be less crowded.

Unless health care reform in the United States is able to increase both access and affordability, health care issues, like ED crowding, which threaten the moral foundations of medicine, will persist. This change cannot occur in a fragmented system; in order to maintain quality while at the same time increasing the availability of services and keeping costs controlled the health care system must provide better coordinated care as well as maintain transparency to keep the public informed. As the U.S. population continues to age, chronic illness becomes more common, and primary care remains unavailable for many, the ED will continue to serve as a safety net for medical care. Whether this use is “appropriate” or not, the point remains that EDs are being pushed to their limits, resulting in a compromised quality of care and decreased positive health outcomes in the long term.

Many issues surrounding ED crowding have not been covered extensively, as they are simply beyond the scope of this thesis. They are however worth mentioning as possible avenues to extend the arguments I have made. A huge factor playing into both the causes and frequency of ED crowding is that of the attitude the US population has toward health care. Without a societal adjustment in the idea that EDs can and should provide comprehensive medical care, and an increase in health education for the public,

EDs will likely continue to experience the level of crowding they currently do. Just as important, hospitals should also make adjustments in terms of how to better manage and coordinate their departments so that hospital units might work together more efficiently. So also should providers across the health care system as a whole strive for better coordination of their various services in order to provide the most ethical and effective medical care. The first step to doing so is to increase access to primary care physicians and to increase the affordability of medical care.



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## CURRICULUM VITAE

**Education**

Master of Arts, Bioethics <i>Wake Forest University</i>	2011-Present
Expected Date of Graduation	2013 May
Current GPA: 3.56	
Bachelor of Science, Biology and Chemistry <i>The University of North Carolina at Pembroke</i>	2006-2011
Date of Graduation	2011 May
GPA: 3.54	
Honors and Awards	
UNCP Honors College, 2006 - present	
Honors List and Chancellor's List Honoree, 2006 – present	
National Service Trust education award recipient, 2009	

**Work Experience**

Science Writing Tutor, UNCP Writing Center, Pembroke NC	2010-2011
Research Intern, UNC Chapel Hill, Cystic Fibrosis Center, 2010	May 2010-July
Molecular Biology Core, Chapel Hill, NC	
UNCP RISE (Research Initiative for Scientific Enrichment) fellow, Pembroke, NC	2009-2011
Chemistry/Biology Tutor, Center for Academic Excellence, UNCP	2008

**Research Experience****Biology:**

*Effect of High Carbon Dioxide Levels on Colony Formation Efficiency and Diversity of UTI-Causing Microorganisms*, Kimberly Brassard and Marilu Santos, PhD

This study provides empirical evidence that growth of UTI-causing bacteria is enhanced by high CO<sub>2</sub> level and that there are bacteria in human urine that can only form microcolonies and hence remain undetected on standard agar plates.

*Impaired airway mucus clearance and susceptibility to bacterial infection/colonization: characterization of the lung microflora in  $\beta$ ENaC-overexpressing mice*, Kimberly Brassard and Alessandra Livraghi, PhD

The project focused on identifying the types of bacteria present in fluid collected from the lungs (bronchoalveolar lavage, BAL) of mice that exhibit Cystic Fibrosis (CF)-like lung disease due to overexpression of the  $\beta$  subunit of the epithelial sodium channel ( $\beta$ ENaC), which causes airway surface dehydration and impaired mucus clearance. The data suggests the bacterial population changes over time and the environment plays a role in colonization in addition to impaired mucus clearance.

**Chemistry Education:** *Catalyzing the Reaction: High school seniors  $\rightarrow$  college chemists*, Kimberly Brassard and Brian Postek, PhD

The purpose of this initial investigation was to determine if college chemistry professors feel their students are prepared for the work expected of them, and to determine if introductory students feel they have been adequately prepared by their high schools to complete college-level chemistry work. After reviewing the data, it can be postulated that the general chemistry I students are not prepared for the work expected of them. All three sources have expressed that more preparation could have occurred, which is consistent with the hypothesis that incoming general chemistry students are not adequately prepared for college-level work by high school science classes.

### **Leadership and Community Service**

North Carolina Region IV Science Fair Judge	2010
Senior Class Representative, UNCP Ester G Maynor Honors Council	2010
Vice President, Student Government Association, UNCP	2009-2011
Southeastern Regional Medical Center Volunteer	2009- 2011
Alternative Spring Break 2009: Second Harvest Food Bank New Orleans, LA	2009
North Carolina Activating Citizenship through Service! (NC-ACTS!) AmeriCorps Member	2008-2009
Advantage Hospice and Home Care Volunteer	2008 - 2009
Toys for Tots of Salisbury NC Volunteer	2008

### **Conference Presentations**

Catalyzing the Reaction: high school seniors → college chemists (2010) K. Brassard, B. Postek, 21<sup>st</sup> Biennial Conference on Chemical Education (BCCE).

Effect of High Carbon Dioxide Levels on Colony Formation Efficiency and Diversity of UTI-Causing Microorganisms (2010) K. Brassard, M. Santos, Pembroke Undergraduate Research and Creativity Center (PURC) Symposium at University of North Carolina at Pembroke (UNCP).

Catalyzing the Reaction: high school seniors → college chemists (2010) K. Brassard, B. Postek, North Carolina Academy of Sciences (NCAS) Guilford College, Greensboro NC.

Catalyzing the Reaction: high school seniors → college chemists (2010) K. Brassard, B. Postek, Pembroke Undergraduate Research and Creativity Center (PURC) Symposium at University of North Carolina at Pembroke (UNCP).