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Improving the Brooke Army Medical Center  
Department of Emergency Medicine Admissions Process

Captain John R. Fuda  
Fort Sam Houston, Texas

April 12, 2006

**20071101270**

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### Abstract

The purpose of this study was to determine, evaluate, and propose ways to mitigate factors that contribute to overcrowding and wait times experienced by patients admitted through the Brooke Army Medical Center Department of Emergency Medicine. Data were collected on 343 patients admitted to the Department of Medicine between August 8 and September 4, 2005. The mean wait time for admission was 7 hours, 16 minutes, with a standard deviation of 2 hours, 14 minutes, and a mode of 4 hours, 20 minutes. A bivariate correlation analysis revealed staffing, Emergency Department census, and day of week as significant contributors to overall wait time or steps in the admissions process. Based on these and recommendations from the literature review, the following recommendations were made: streamline sign-in and triage through consolidation of steps; restructure and/or retrain nursing teams; change staff days to days with the highest wait times; increase the availability of the Fast Track; improve automation to reduce the administrative workload and increase situational awareness; and use a direct admissions system. Based on these recommendations, a new process that allows ED providers to directly admit non-urgent chest pain patients between 2300 and 0700 was implemented.



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## Improving the Brooke Army Medical Center

### Department of Emergency Medicine Admissions Process

#### Introduction

Brooke Army Medical Center (BAMC) is a U.S. Army medical center located at Fort Sam Houston, (San Antonio) Texas. It currently operates as a 224-bed facility with the ability to expand to 450 beds. It has an average inpatient census of 142 and has over 640,000 outpatient visits per year. BAMC has the U.S. Army's only American College of Surgeons verified Level-1 trauma division and the Department of Defense's only American Burn Association verified burn center. BAMC has also treated over 2,100 casualties from the global war on terrorism (GWOT) and provides health care services to over 212,000 eligible beneficiaries (Brooke Army Medical Center, n.d.). Eligible beneficiaries include active duty and retired service personnel, their eligible family members, and survivors (TRICARE Online, n.d.). Exceptions to this are civilian emergency patients and other patients subject to requirements set forth by higher authorities, including the Great Plains Regional Medical Command, U.S. Army Medical Command, and Department of Defense.

The BAMC Department of Emergency Medicine (DEM), or emergency department (ED), provides emergency care for military health care beneficiaries and severely traumatized patients from the local civilian community. BAMC is one of three Level-1 trauma centers in San Antonio that includes The University of Texas/San Antonio Medical Center and Wilford Hall Medical Center, serving 26 Texas counties. BAMC also has one of only three emergency medicine training programs in the U.S. Army. The DEM serves as the entry, initial evaluation, and resuscitation point for all trauma patients arriving at BAMC. In addition to trauma patients, the



BAMC DEM evaluates and treats over 40,000 patients per year with a broad range of minor to life-threatening conditions (Brooke Army Medical Center, n.d.).

The BAMC DEM is partnered with Wilford Hall Medical Center (WHMC) in conducting a teaching program for physicians and physician assistants. This program is one of the oldest and largest in the U.S. The physician assistant fellowship is one of only three training programs in the U.S. that provides post-graduate specialty training in Emergency Medicine. The DEM also trains Special Forces Medics, military and civilian medical students, residents and emergency nurses (Brooke Army Medical Center, n.d.).

WHMC is currently scheduled for restructuring by 2011 due to Base Realignment and Closure (BRAC). All of WHMC's inpatient capacity, its emergency and trauma care, and some of its outpatient capacity will move to BAMC, with the combined facility being called the San Antonio Military Medical Center (SAMMC) (Cuda, 2005). Scheduled for completion in 2010, the new consolidated DEM and trauma suite will be capable of handling over 120,000 visits per year, which is up from BAMC and WHMC's current combined capacity of 76,000 emergency patients per year (S. G. Mehta, personal communication, October 10, 2005).

Throughout this study, DEM and ED are used interchangeably, with specific references to the BAMC Department of Emergency Medicine being listed as "DEM," and emergency departments as a whole and of other organizations listed as "ED," which is the more common name used in the literature.

### *Problem Statement*

The purpose of this study is to determine, evaluate, and propose ways to mitigate factors that contribute to overcrowding and wait times experienced by patients admitted through the BAMC DEM.

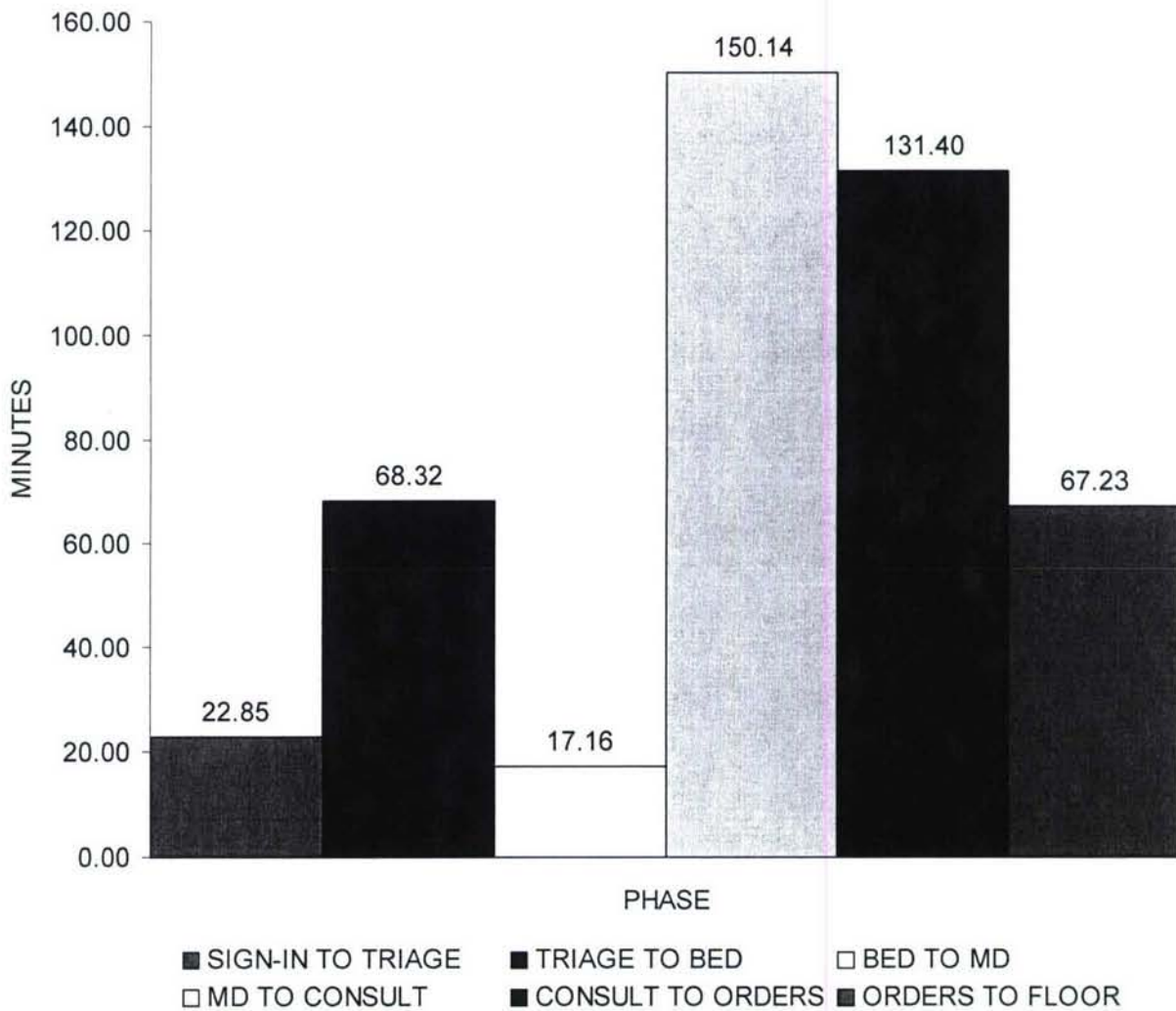
*Conditions that Prompted the Study*

Several conditions prompted the BAMC DEM to measure and evaluate patient wait times for admission. The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) requires “leaders to develop and implement plans to identify and mitigate impediments to efficient patient flow through the hospital” (Joint Commission on Accreditation of Healthcare Organizations, 2005, p. LD-11), and states “The emergency department is particularly vulnerable to experiencing negative effects of inefficiency in the management of this process” (Joint Commission on Accreditation of Healthcare Organizations, 2005, pp. LD-11 – LD-12). Lapses in patient safety and decreases in quality of care are often attributed to patient overcrowding, which are primary reasons the requirement for monitoring and managing patient flow exist (Joint Commission on Accreditation of Healthcare Organizations, 2005).

Additionally, as part of the organization’s overall performance improvement program, the DEM needed to establish standards of measurement (C. J. Hunter, personal communication, September 30, 2005). One of BAMC’s mission essential tasks, which are tasks that must be completed to achieve mission success, is “continuous improvement in health care delivery” (Brooke Army Medical Center, 2005, slide 15). Monitoring patient flow and determining ways to improve patient flow are key components in accomplishing this mission essential task. Since no real industry standard exists, and due to the unique nature of the BAMC DEM, a baseline needed to be determined against which its future performance could be measured. Data was first collected in February 2005 to establish this baseline and to identify preliminary areas for improvement. Figure 1 summarizes wait times, by phase, for the February data collection period.

The larger, redesigned SAMMC DEM may eventually help mitigate some of the factors contributing to patient length of stay in the DEM, but in the interim, processes need to be

evaluated and improved to shorten this time and improve efficiency, safety, and overall patient quality. Improvements made to the processes now can be carried on to the new facility when it opens in five years.



*Figure 1.* Average time by phase for patients admitted through the BAMC DEM, February 8 – March 5, 2005



### *Literature Review*

Current journals and previous Graduate Management Projects were reviewed for information regarding contributors to ED overcrowding, symptoms of overcrowding, variables that have a significant correlation with ED wait times, and recommendations for improving ED throughput and the admissions process. The literature also provided a wealth of information regarding the history of ED overcrowding, and provided an opportunity to compare and contrast the BAMC DEM with other EDs in the nation. Since overcrowding and wait times are often seen as both indicators and symptoms of each other, literature regarding both was thoroughly reviewed with some instances using “overcrowding” and “long wait times” interchangeably. Primarily, however, the literature review served to focus data collection on variables that are most likely to significantly contribute to ED wait times for admission.

#### *Emergency department overcrowding*

“ED overcrowding is widespread in U.S. cities and has reached crisis proportions” (Trzeciak & Rivers, 2003, p. 402). While not all variables contributing to ED overcrowding are prevalent or controllable at every institution, it is useful to review these variables because lessons learned during this study may be beneficial beyond BAMC and other military treatment facilities.

EDs are, for over 44 million Americans, the primary means for access to health care. This is largely due to the Emergency Medical Treatment and Labor Act, which is the “U.S. law mandating that DEM patients cannot be turned away, regardless of payer status” (Trzeciak & Rivers, 2003, p. 402). This law is strictly enforced by the Health Care Financing Administration, “making ED services the first and only health care in the U.S. guaranteed by law” (Trzeciak & Rivers, 2003, p. 402). In 2002, over 90% of large U.S. hospitals reported operating at or over

inpatient capacity. Between 1992 and 1999, ED utilization rose more than 14%, increasing to over 100 million annual visits. “ED overcrowding has been reported to cause delays in diagnosis, delays in treatment, decreased quality of care, and poor patient outcomes” (Trzeciak & Rivers, 2003, p. 403).

An important factor to consider when looking at ED overcrowding is that “non-urgent visits are no longer considered to be the main cause of overcrowding” (Trzeciak & Rivers, 2003, p. 403). This is because overcrowding of the triage or waiting areas is not the same as overcrowding of the patient treatment areas. A high demand for non-urgent care causes the waiting room to become overcrowded, which may lower patient satisfaction and lead to an increase of patients leaving without being seen, but does not seriously impact treatment area overcrowding because “the highest acuity patients are always brought into the treatment areas first. In fact, the total number of ED visits has been reported to poorly correlate with ED overcrowding” (Trzeciak & Rivers, 2003, p. 404).

Three major factors contribute to ED overcrowding: (a) insufficient inpatient capacity; (b) hospital system restructuring; and (c) higher severity of illness (Trzeciak & Rivers, 2003).

Nationwide, inpatient hospital beds decreased by 39% between 1981 and 1999 due to cost-containment initiatives. These initiatives result in hospitals maintaining a consistently higher census (as a percentage of total beds), which limits waste, but also hampers hospitals’ ability to respond to fluctuations in demand (Trzeciak & Rivers, 2003). Haraden and Resar (2004) state:

The ... ‘ED problem’... is actually a system-wide problem. EDs do not exist in isolation, but are part of a system of care through which patients flow. Increasing capacity in the

ED... is like broadening the large end of a funnel without increasing capacity at the neck or constriction point (6).

Haraden and Resar also note a 2003 study by the U.S. General Accounting Office that found the most common factor associated with a delay, and therefore largest contributor to crowding, was delayed transferring of ED patients to inpatient beds due to non-availability. Forster, Steil, Wells, & Van Walraven (2002) found that length of stay in the ED increases significantly when hospital inpatient census exceeds 90%.

“Hospital system restructuring further contributes to ED overcrowding. The abrupt elimination of EDs by hospital mergers and/or closures increases the burden on neighboring EDs” (Trzeciak & Rivers, 2003, p. 404). Nationwide, the number of EDs fell by 9% between 1988 and 1996, while the number of visits increased by as much as 45%.

The demographic shift associated with an aging population poses another challenge for EDs. The increase in the aging population brings with it an increase in the prevalence of complex and severe illnesses. In California, between 1990 and 1999, the number of critically ill patients presenting to EDs increased by 59%. This results in lower availability of critical care beds in EDs and increases the chances that critically ill ambulance patients will be diverted to other EDs. “Projections are that by the year 2030, 150 million Americans will have one or more chronic conditions” (Clark & Normile, 2002, ¶ 5).

#### *Indicators of overcrowded emergency departments*

There are several indicators and possible outcomes arising from overcrowded EDs, including: (a) boarding patients in the ED; (b) increased risk of errors; (c) ambulance diversion; (d) threat to disaster preparedness; and (e) diminishing reliability of emergency services (Trzeciak & Rivers, 2003).



Often, patients are “boarded” in the ED as they wait for inpatient beds to become available. Nationwide, the average wait time for an acute or critical care bed (from when the decision to admit is made) is slightly over three hours, but in hospitals that report ED overcrowding, the average wait is 5.8 hours (Trzeciak & Rivers, 2003). Clark and Normile (2002) measured a positive correlation between increased length of stay in the ED and tests missed or delayed upon arrival to a critical care unit, often resulting increased inpatient length of stay.

Overcrowding in the ED leads to an environment where quality of care may be compromised as pressure to meet the needs of patients in the treatment areas and pressure to see patients waiting to be seen conflict. This creates a high-risk environment for medical errors that threaten patient safety (Trzeciak & Rivers, 2003). As demand for ED services increases, this issue becomes more and more relevant for BAMC. JCAHOs’ review of sentinel events attributes many patient deaths to delays in care. Delayed treatment is the most common sentinel event for EDs. Staffing (34%), crowding (31%), and specialist availability (21%) were the most common causes of delay in the ED that contributes to these sentinel events (Bradley, 2005).

Many EDs have to turn away inbound ambulances due to overcrowding. In many urban areas, EDs are on bypass status 20% - 50% of the time. This has a two-fold effect. First, care for the patient in the ambulance is delayed by the increased time in transport, and second, care for the next patient needing that ambulance is delayed by the time spent transporting the first. Furthermore, the hospitals routinely on the receiving-end of diversions often surpass capacity and assume bypass status as well. In some regions overcrowding is so severe, that all facilities request to be on bypass status simultaneously, resulting in all diversions being overridden and this tool becoming ineffectual (Trzeciak & Rivers, 2003).

An ED that is overwhelmed with day-to-day care of patients will likely be ill-equipped to handle the response required for a disaster. This compromises the entire health care system's readiness with regards to disaster preparedness (Trzeciak & Rivers, 2003).

Finally, "in many regions, leaders in emergency medicine have 'lost confidence in the emergency health care infrastructure' because 'the current resources supporting emergency care are inadequate to meet the needs of all patients at all times' (Taylor, 2000)" (Trzeciak & Rivers, 2003, p. 403). Many health care leaders feel that the entire U.S. emergency care system is no longer reliable (Trzeciak & Rivers, 2003).

#### *Variables studied in previous research*

Several variables were measured by previous researchers in attempts to identify and isolate factors that contribute to ED wait times. A common theme among many of these studies was the identification of "bottlenecks," which are points in the process that take more time than they should. King, Shaw and Adams (2004) suggested that all EDs should monitor patient flow to identify bottlenecks. This monitoring should be proactive, as required by JCAHO, not in reaction to an increase in wait times and/or decreases in patient or staff satisfaction. Studies by Castro (1993), and Schloss (1992) measured patient wait times at each step in the process and conducted statistical analysis to determine if these variables were dependent on several independent variables to identify what created the "bottleneck." Swiderski (1990) conducted a sensitivity analysis using a computer model based on data gathered in a time and motion study to determine if subtle staffing or physical changes to the ED would improve throughput.

Castro (1993) found significant correlations between wait times for admission and ordering laboratory or radiology procedures; consulting service; and with the nursing shift during



which the patient presented. Schloss (1992) found significant correlations between wait times for admission and the patient's triage category; the ED census; and consulting service.

*Recommendations of previous research*

Studies by Frew and Wright (1999), and Honeycutt (2004) determined that the use of an admission nurse or other person to control the admission process, "who could come to the emergency department, take the patient to the floor, admit the patient, and begin treatments" (Frew & Wright, 1999, p. 123) would decrease ED length of stay, increase patient satisfaction, and improve quality of care. The admissions nurse would ideally work during the ED's peak admissions period, eight hours a day, seven days a week, for a total requirement of 1.4 full time equivalents. Although their study concluded the use of an admissions nurse would improve the admissions process, Frew and Wright never implemented their recommendations due to budgetary constraints at their organization. Honeycutt's organization employed two full-time nurses to handle admissions during peak hours, but have not yet reported the results of this action.

Trzeciak and Rivers (2003) make several recommendations that may assist in alleviating the strain on EDs. These recommendations are largely policy-based and applicable at higher levels of government and within health care systems. Their first recommendation is to identify threats to the emergency care system and implement measures to safeguard against these threats. Next, as a temporary measure, they recommend creating observation units, separate from the DEM, to hold patients that are waiting admission. This would help reduce the number of patients in the patient care area. "An ED managed observation unit has been shown to markedly decrease waiting times and cut the mean monthly hours of ambulance diversion by 40%" (Trzeciak & Rivers, 2003, p. 404). This recommendation, however, will be difficult to implement because it

does not mitigate space and staffing concerns. Another recommendation from Trzeciak and Rivers is to implement early warning systems using regional ED and hospital capacity data that authorities could use to detect overcrowding in its early stages. They could then attempt to alleviate overcrowding by triggering the expansion of acute care capacity. Additionally, this plan could lay the groundwork or be an integral part of a disaster preparedness plan. Trzeciak and Rivers also underscore JCAHOs' emphasis on strategic planning and the importance of the ED being thoroughly integrated into the plan. Finally, Trzeciak and Rivers state that fixing the problem of DEM overcrowding requires a multidisciplinary approach. It requires system-wide integration to identify and mitigate the causes of overcrowding.

King et al. (2004) suggested that the value of a bottleneck step should be assessed, and if possible, bypassed. This may be possible for some steps, such as registration at point of entry, which could be either performed bedside or expedited for frequent users, whose information would already be recorded, but not for steps that involve actual assessing and treating of patients. Other approaches for dealing with a bottleneck suggested by King et al. were to apply more resources such as staffing or beds, to increase the throughput of that step. This approach, however, is limited by space and budgetary constraints.

Howell, Bessman, and Haya (2004) found that shifting to a system where admission is based on a telephone consultation with an admitting service physician reduced time of consult to floor from 150 minutes to 18 minutes. This is a significant improvement in reduction of ED length of stay.

Hoffenberg, Hill, and Houry (2001) found that clearly assigning responsibility for tasks, creating performance expectations, and conducting continuous monitoring reduces ED length of



stay. These findings again emphasize the JCAHO requirement for continuous monitoring of patient flow.

Fottler and Ford (2002), while mentioning some ways to potentially mitigate wait times, focused more on ways to improve the experience of waiting, which could result in a perception of a shortened wait by patients. Some of the techniques mentioned by them include diverting patients with activities, improving the accommodations of the waiting area, streamlining the registration process, and improving communication between the staff and patients regarding delays.

Haraden and Resar's (2004) recommendations focused primarily on freeing inpatient beds to allow for speedy transfers from the ED. They recommend scheduling discharges to ensure rooms are freed and prepared for new patients in a timely manner, whether the decision to discharge is made days in advance, the day prior, or the same day. They also recommend better monitoring of patients in non-critical care areas to ensure they do not become critical care patients, thereby reducing the number of critical care beds used.

Doxzon and Howard-Ducay (2004) instituted a status reporting and response program at their hospital. They established four levels of ED status ranging from level one, where patient flow is easily manageable, to level four, where the ED is overwhelmed by a mass casualty or similar situation. Each reported status level has a response associated with it. The response comes from multiple departments throughout the hospital, which assist in alleviating the burden on the ED by providing manpower, preparing inpatient areas, prioritizing tests, etc. Many facilities have response plans that only engage during a circumstances equivalent to status level 4, however, this layered approach is more proactive in that it prevents the situation from getting

out of hand and uses a scaled response, rather than an all or nothing response used by many facilities.

### *Purpose and Hypothesis*

The results of this study should assist the DEM and DOM leadership in making performance improvement decisions regarding the processes of admitting patients through the DEM. Given the correlations uncovered in previous research, there will likely be correlations between wait time for admission and staff days, day of the week, nursing team, time of day, and emergency department census.

## Methods and Procedures

### *Patient Movement*

There are five major modes of patient entry to BAMC's ED: (a) ambulance, (b) drop-off (or honk and holler), (c) walk-in, (d) clinic referral, and (e) in-house codes. Each of these methods of receiving patients results in a slightly different stream of patient movement.

Figure 2 outlines the movement of patients from arrival via walk-in and clinic referral through when they are placed in an ED bed. Patients arrive into this movement pathway by either self-referral or clinic-referral. Self-referral is simply a patient believing they have a need to see a provider and cannot wait to make an appointment to fulfill this need. Clinic referrals occur when a patient at an appointment in a BAMC clinic has needs that are beyond the capabilities of the clinic in which they are being seen. Both of these patients present to the ED, with the clinic-referrals being preceded by a phone call from the referring clinic and usually an escort to the ED. Once either type of patient arrives in the ED, their movement pathway converges at check-in. These steps comprise the sign-in to triage phase as described in this study.

Shortly after checking-in patients are triaged and assigned a category number of 1 through 5. Category 1 patients have a life-threatening condition and are sent or taken to an ED bed immediately. Category 2 and 3 patients are less severe than category 1, but still require immediate attention and are differentiated from each other by the number of resources required to treat the patient, with category 2 patients requiring a greater resource expenditure than a category 3 patient. Category 4 and 5 patients are routine patients, with 5 being a lower priority than 4.

Patients in categories 4 and 5 are candidates for the ED's Fast Track, which provides care for routine patients with a minimal consumption of resources. The Fast Track's hours are normally 1200 – 2200, but may sometimes be open until 2400 if the two providers that work in the Fast Track have staggered shifts. If the Fast Track is open, category 5 patients are automatically sent to the Fast Track. Category 4 patients are also sent to the Fast Track if space is available. After being evaluated and treated in the Fast Track, patients are usually released.

Patients in categories 2 and 3 enter the queue to wait for an available bed in the ED. Category 4 patients that cannot be seen in the Fast Track also enter this queue. During the hours when the Fast Track is not operational, all patients category 2 through 5 are placed in the queue. Patients wait in the ED waiting area until space is available and are reevaluated every hour until they are moved into a bed. Any change in their triage category upon reevaluation influences their place in the queue. Any patient that is reevaluated to category 1 is immediately placed in an ED bed.

As beds in the ED become available, patients are chosen from the queue to fill the bed. The method by which they are chosen is not solely based on the patient's priority, but also on the number of resources they will consume. For example, a category 3 patient may be seen before a



category 2 patient because the resources to see the category 2 patient are not available but the resources to see the category 3 patient are. These steps comprise the triage to bed phase as described in this study.

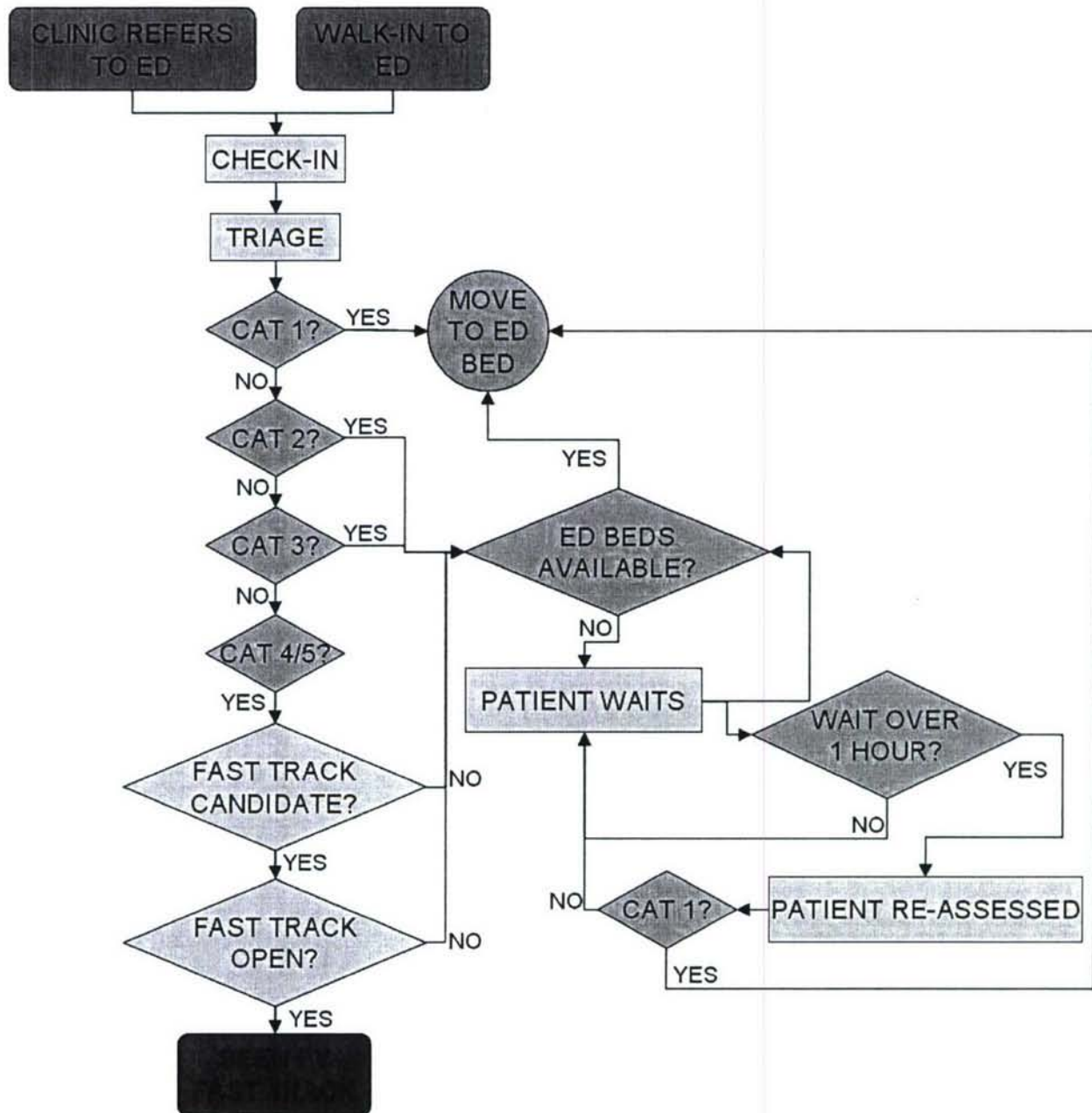


Figure 2. Movement of walk-in and referred patients from arrival through bed assignment



Figure 3 outlines the movement of patients from arrival via ambulance, drop-off, and in-house codes through when they are placed in an ED bed. Patients arrive in this movement pathway via ambulance, by being dropped-off in the ambulance bay, or as a result of a cardiac arrest in the ED's response area. Ambulance patients arrive via an ambulance responding to a trauma or other life-threatening situation and transporting the patient to BAMC. Drop-off, or honk and holler patients are usually the results of violent acts where a patient is dropped off anonymously at the ambulance bay doors with a car horn, door bang, or holler used to alert the ED staff of the patient's presence before the vehicle that transported the patient to the hospital speeds away. The BAMC ED is also responsible for responding to all cardiac arrest codes in the first floor of the hospital and the entire Institute for Surgical Research Building. In these cases, the ED dispatches a team to the location of the code, provides immediate resuscitation on site, and then brings the patient back to the ED.

Ambulance crews alert the ED that they are inbound to BAMC with a patient and provide details of the patient's condition. The responding ED clerk uses this information to begin checking-in the patient and assigns the patient to a provider based on availability and nature of the illness or injury. Once the ambulance arrives, the ambulance crew and ED staff move the patient into the ED.

When patients are dropped-off in the ambulance bay, the ED staff retrieves them from the bay and moves them to a bed. Similarly, the ED staff, after responding to a code in their area of responsibility, bring a patient who has suffered cardiac arrest into the ED.

Once in the ED, patients that arrived via ambulance are immediately moved to a bed. Patients that were dropped off or result from a code are checked-in and assigned to a provider as they are being moved to a bed. Patients that arrive via ambulance, drop-off, and in-house code

bypass the sign-in to triage and triage to bed phases as described in this study. The time for bed to MD for these patients is often zero because they are usually placed in a bed and seen by a provider nearly simultaneously.

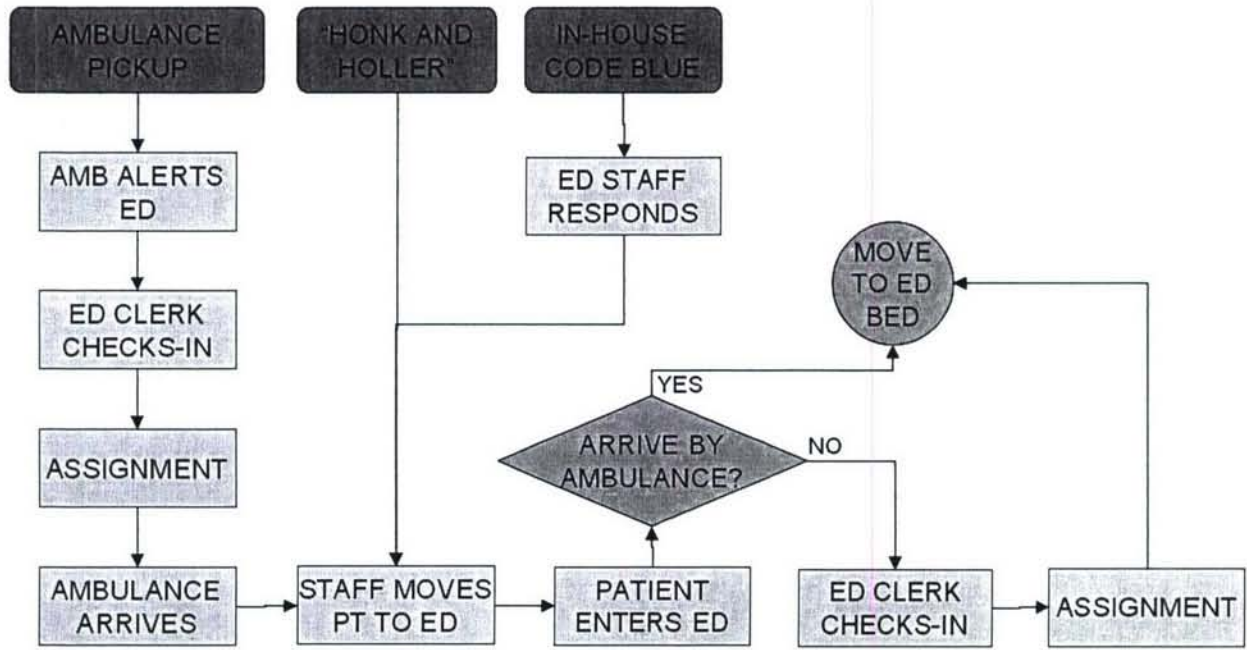


Figure 3. Movement of ambulance, drop-off, and in-house code patients from arrival through bed assignment.

Figure 4 outlines the movement of patients from the point they are placed in an ED bed until they are admitted to a ward or released from the ED. Once in a bed, the movement pathway for all types of patients converge. Soon after being placed in a bed, patients are evaluated by a nurse. These steps comprise the bed to MD phase as described in this study.

Next, a provider begins to evaluate the patient and orders any laboratory or x-ray procedures required to complete the assessment. Upon receipt of laboratory and x-ray results, if any, the provider finalizes their evaluation and determines if a specialty consultant is needed to further evaluate the patient. If no consult is needed, and the patient does not require further

observation, the patient's treatment is finalized and they are released. If the patient requires further observation, they are kept in an ED bed and reevaluated until they are either able to be released, or the need for a consultation is determined. These steps comprise the MD to consult phase as described in this study.

If a patient requires further evaluation by a specialty service, a request is made to that service to come and evaluate the patient. When a provider from the consulted service arrives, they review the evaluation conducted by the original provider and begin their own evaluation. The consulted provider also orders laboratory and x-ray procedures as needed. Upon receipt of laboratory and x-ray results, the consulted provider finalizes their evaluation and determines if the patient needs to be admitted as an inpatient, observed for later reevaluation, or released. If the patient requires further observation, they are kept in an ED bed and reevaluated until they are either able to be released, or the need to admit is determined. These steps comprise the consult to orders phase as described in this study.

Once a need to admit is determined, the consulted provider drafts the admission order and sends it to the receiving ward. Once the receiving ward notifies the ED staff they are ready to receive the patient, the ED staff transports the patient to the ward. These steps comprise the orders to floor phase as measured in this study.



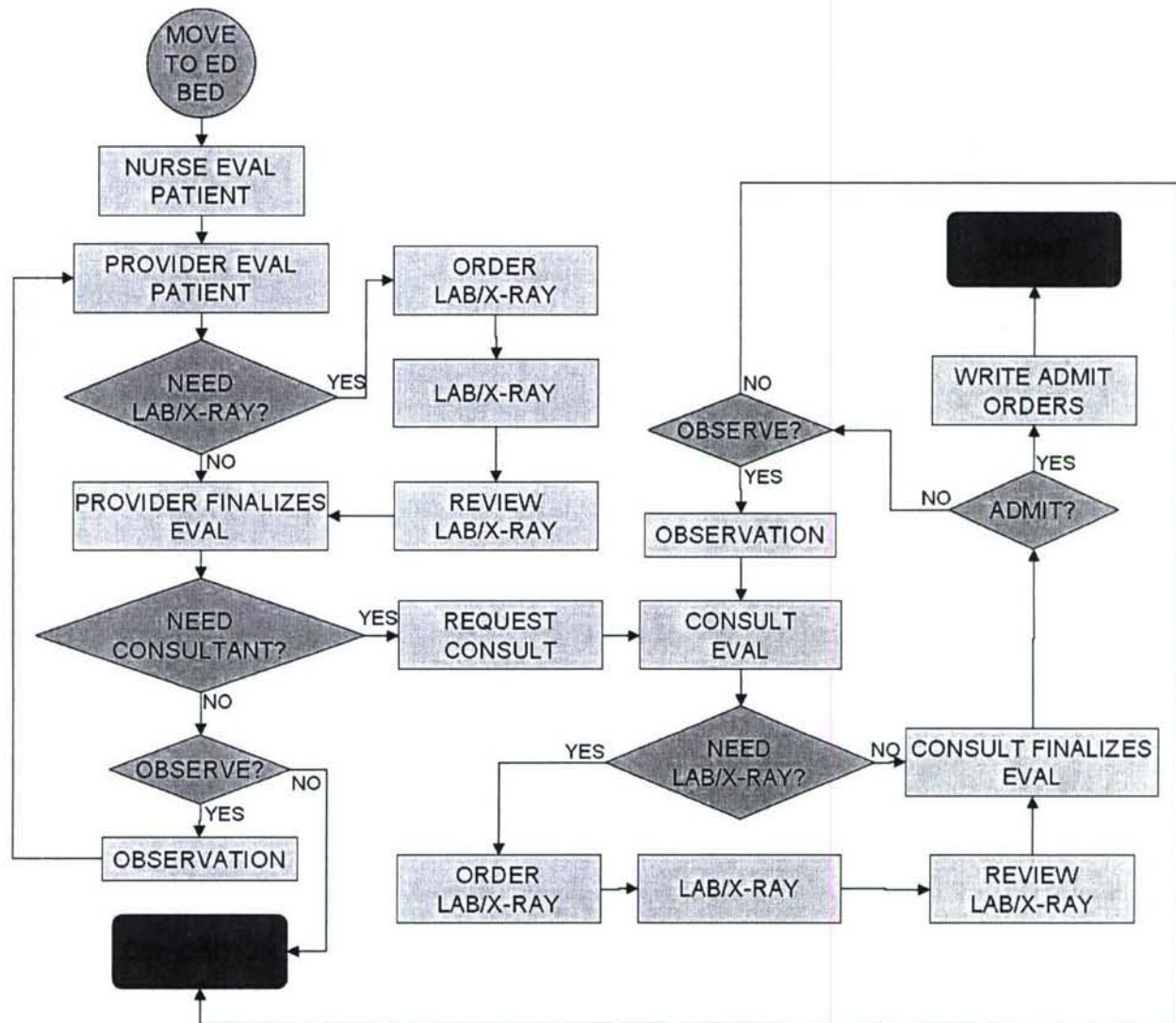


Figure 4. Movement of patients from bed assignment through admission or release.

### Subjects and Events Measured

Three criteria were used to determine which variables to measure: (a) it showed significance in previous studies; (b) it measured something that can be controlled; and (c) it was specifically requested by the command or DEM management. The first criterion (a) was used to limit the number of variables and make a more efficient use of time available to collect data. The second criterion (b) was used to eliminate variables that cannot be controlled, such as patient



demographics or triage category. The final criterion (c) overrode the first two, in that any measurement specifically requested by the command or DEM leadership was included in the study. Other variables, such as hospital census, were eliminated because they do not apply to this particular setting. Also, since admissions by the Department of Medicine (DOM) account for over 77% of all admissions, the study was limited to only cases that ended in an admission to DOM. This simplified data collection and analysis but still yielded recommendations beneficial to multiple services.

The first group of dependant variables measured the times between each step of the process of admission through the DEM, and the total length of stay in the DEM. These variables are (a) sign-in to triage; (b) triage to bed; (c) bed to MD; (d) MD to consult; (e) consult to orders; (f) orders to floor; (g) total minutes; (h) total hours; (i) total < 2 hrs; (j) total 2 – 3 hrs; (k) total 3 – 6 hrs; and (l) total > 6 hrs. Variables “a” through “g” are measured in minutes. “Sign-in to triage” measured the amount of the time between when the patient registered in the waiting room until they began triage. “Triage to bed” measured the time between the start of triage and when a patient was given a bed in the treatment area. This time includes time spent in the waiting room following triage while waiting for a bed. “Bed to MD” measured from when the patient was placed in a bed in the treatment area until they were seen by a physician. “MD to consult” measured the time from when the physician began assessing the patient and a physician from the DOM arrived to assess the patient. “Consult to orders” measured the time from when the DOM physician arrived to when they issued orders to admit the patient. “Orders to floor” measured the time between the issuing of admission orders and the patient physically arriving to their room on the ward they are admitted to. “Total minutes” measured the total time that elapsed between sign-in and physical arrival on the ward. “Total hours” is “total minutes” expressed as hours.

“Total < 2 hrs”, “total 2 – 3 hrs”, “total 3 – 6 hrs”, and “total > 6 hrs” were each mutually exclusive categorically exhaustive variables coded “1” if the case fell into the time range, and “0” if not. This allows for grouping of cases by blocks of time.

The next group of independent variables focus on when the case presented with regards to week, day of week, and whether the day was a weekday, weekend, or holiday. These variables are: (m) week 1; (n) week 2; (o) week 3; and (p) week 4. These were mutually exclusive categorically exhaustive variables coded “1” if the case occurred during that week, and “0” if not. Variables (q) Monday; (r) Tuesday; (s) Wednesday; (t) Thursday; (u) Friday; (v) Saturday; and (w) Sunday were mutually exclusive categorically exhaustive variables coded “1” if the case occurred during that day, and “0” if not. Variables (x) Weekday; (y) Weekend; and (z) Holiday are mutually exclusive categorically exhaustive variables coded “1” if the case occurred during that type of day, and “0” if not. Holidays were exclusively coded, so a day could not be coded as both a holiday and a weekday or weekend.

The next group of variables are independent variables and look at staffing of the DEM. Variables (aa) nurse team 1; (bb) nurse team 2; (cc) nurse team 3; and (dd) nurse team 4 were mutually exclusive categorically exhaustive variables coded “1” if the case was seen by that team, and “0” if not. These teams worked rotating shifts, so a case tied to a particular team was not tied to a particular shift. Variables (ee) number registered nurses; (ff) number licensed vocational nurses; and (gg) total nurses were continuous variables representing the number of each type of nurse on duty at the time the patient presented to the DEM. The variable (hh) absent nurse is coded “1” if there was an unscheduled absence of one or more nurses while the patient was being seen and “0” if not. The variable (ii) staff is coded “1” if the physicians on duty in the DEM were primarily staff physicians and coded “0” if they were primarily residents.



The independent variable (jj) ambulance, was coded “1” if the patient arrived by ambulance and coded “0” if they were a walk-in patient. This allows for accounting of “total time” differences due to ambulance patients skipping the sign-in through bed steps of the process.

The final group of independent variables measured when the consult to DOM occurred. Two of the variables represented 4-hour blocks of time between 00:01 and 08:00, while eight of the variables represented 2-hour blocks of time between 08:01 and 00:00. Variables (kk) consult 00:01 – 04:00; (ll) consult 04:01 – 08:00; (mm) consult 08:01 – 10:00; (nn) consult 10:01 – 12:00; (oo) consult 12:01 – 14:00; (pp) consult 14:01 – 16:00; (qq) consult 16:01 – 18:00; (rr) consult 18:01 – 20:00; (ss) consult 20:01 – 22:00; and (tt) consult 22:01 – 00:00 were mutually exclusive categorically exhaustive variables coded “1” if the consult began during that time block, and “0” if not.

#### *Method of Data Collection and Schedule of Procedures*

The BAMC DEM used Department of the Army (DA) Form 4700 “Medical Record-Supplemental Medical Data” (see appendix A) that is overlaid with a template that directed the transcription of treatment times, demographic data, and vital signs to record patient information from sign-in through triage. Once the patient entered the treatment room, data collection moved to the Standard Form (SF) 558 “Emergency Care and Treatment” (see appendices B & C ) These forms served as a continuous form of data collection that facilitated treatment of patients in the DEM as well as providing an available source of patient flow data for analysis. Date and time data from these forms was placed into a Microsoft Excel Spreadsheet by the DEM Director of Performance Improvement for analysis.

In August of 2005, a new Director of Performance Improvement, Captain Sumeru Mehta, MD, began to compile data for the 4-week period of August 8, 2005, through September 4, 2005. As each week of data was collected, it was entered into an Excel spreadsheet. In September 2005 this data was consolidated into a single spreadsheet and analyzed. The August data set yielded a population size of 343, representing all patients that were admitted through the DEM to the DOM during the data collection period. Personnel information was removed from both the February and August data sets so no information could be traced back to patients admitted through the DEM to ensure compliance with the Health Insurance Portability and Accountability Act of 1996.

Major Cynthia Campbell, the Head Nurse for the DEM provided the nursing schedule for the department. The BAMC DEM used four nursing teams of eight personnel each on rotating shifts. The times and days when the teams worked varied from week-to-week, making it possible to measure performance of the teams without the time the team is working acting as a confounder. The schedule was also annotated with unscheduled absences and when personnel worked alternative shifts. This data was associated with each of the 343 cases.

Using additional scheduling data from the DEM, the times when the DEM was primarily staffed by staff physicians, rather than residents, was annotated. The entire data set was arrayed against a calendar to determine which cases were seen by day of week, week of the month, and type of day (weekday, weekend, or holiday). Consult times were reviewed to determine during which of ten time blocks the consult portion of each case occurred. Initial analysis of the completed data set began on September 14, 2005 to provide the DEM with data to present to the Performance Improvement Committee.



*Type of Analysis Performed*

Bivariate correlation analysis was used to determine the magnitude and direction of relationships between all variable pairs. Bivariate correlation analysis does not distinguish between independent and dependant variables, however, results of the analysis will be simplified to focus on dependant-independent variable relationships. A level of significance ( $\alpha$ ) of .05 was used to test each correlation for significance. To automate the task of performing correlations among 34 variables, resulting in 1122 correlation analyses, SPSS statistical software was used. Once the analysis was complete, it was reviewed, focusing on the relationships between pairs of dependant and independent variables. This served to identify significant correlations between the duration of each step (each a dependant variable) and the independent variables.

*Validity and Reliability of the Study*

Validity and reliability were considered during data collection. The use of the modified DA 4700 and the SF 558 gave the data collected content validity, as both forms have been approved as acceptable data collection instruments. Content validity was reinforced by the data collection representing the entire population studied, and not just a sample of the population. Reliability of the data was achieved by using personnel well trained in the use of the modified DA 4700 and SF 558 to record the data on the forms, and was assured through close supervision of the personnel. Furthermore, reliability of the data collection method was demonstrated by the similarities between the February 2005 and August 2005 data sets. Using DEM personnel trained in the use of the data collection forms and conditioned to record the times of each step also added to the practicality of the data collection effort.

## Results

A summary of mean times in minutes by staffing and patient arrival method is provided in table 1 and figure 5. A summary of statistically significant results, in the form of a correlation matrix, is contained in table 2. Due to the large number of variables on which the bivariate correlation analysis was performed, it was not practical to summarize the entire data set, therefore statistically insignificant correlations and trivial correlations (such as Tuesday correlating to Friday) were omitted.

Originally, ED census was not evaluated as a contributor to wait time, but after seeing several correlations between days of the week, and steps of the process or total time, data was obtained from the Department of Health Care Operations (DHCO) regarding ED patient census. This data was inserted into the existing data and bivariate correlation analysis was recalculated. Table 3 summarizes the average number of patients seen in the ED by day of week during the time period of this study.

Additionally, total admissions per day were added to the bivariate correlation analysis to see if it was a contributor to total time spent in the ED for admission. Table 4 provides a summary of the average number of admitted patients by day of week for the time period of this study.

Table 1. Mean time in minutes for each phase by staffing and patient arrival method

	Sign-in to triage	Triage to bed	Bed to MD	MD to consult	Consult to orders	Orders to floor	Total
Nursing Team							
Team 1	15.9	42.6	18.5	176.9	112.4	65.5	431.9
Team 2	11.5	46.5	13.6	169.1	119.8	58.6	420.3
Team 3	19.8	62.2	15.3	172.3	131.8	59.4	460.8
Team 4	19.2	55.4	16.9	161.7	133.3	62.0	448.6
Nurse Attendance							
Planned nurses	18.6	52.9	14.9	165.2	132.2	58.8	434.5
Absent nurse(s)	10.7	38.7	16.7	172.6	118.6	62.5	442.7
Nurses on duty							
4 Nurses	13.4	42.8	12.1	167.0	118.9	69.0	423.2
5 Nurses	14.8	48.5	15.8	170.0	122.6	72.4	446.2
6 Nurses	12.4	43.5	15.8	179.2	118.3	59.0	428.3
7 Nurses	19.0	54.2	15.6	162.6	115.6	58.6	425.5
8 Nurses	18.4	57.1	19.8	172.8	147.3	59.0	474.4
9 Nurses	29.8	89.6	23.8	130.2	132.4	43.9	449.7
Patient Arrival							
Ambulance			15.6	177.8	120.3	63.5	378.5
Walk-in	20.7	66.2	16.4	168.0	123.2	60.8	457.2
Physicians on Duty							
Staff	10.7	38.7	13.5	160.3	88.7	71.6	388.0
Residents	16.3	50.8	16.4	171.4	125.3	60.6	441.0

Notes: n=343



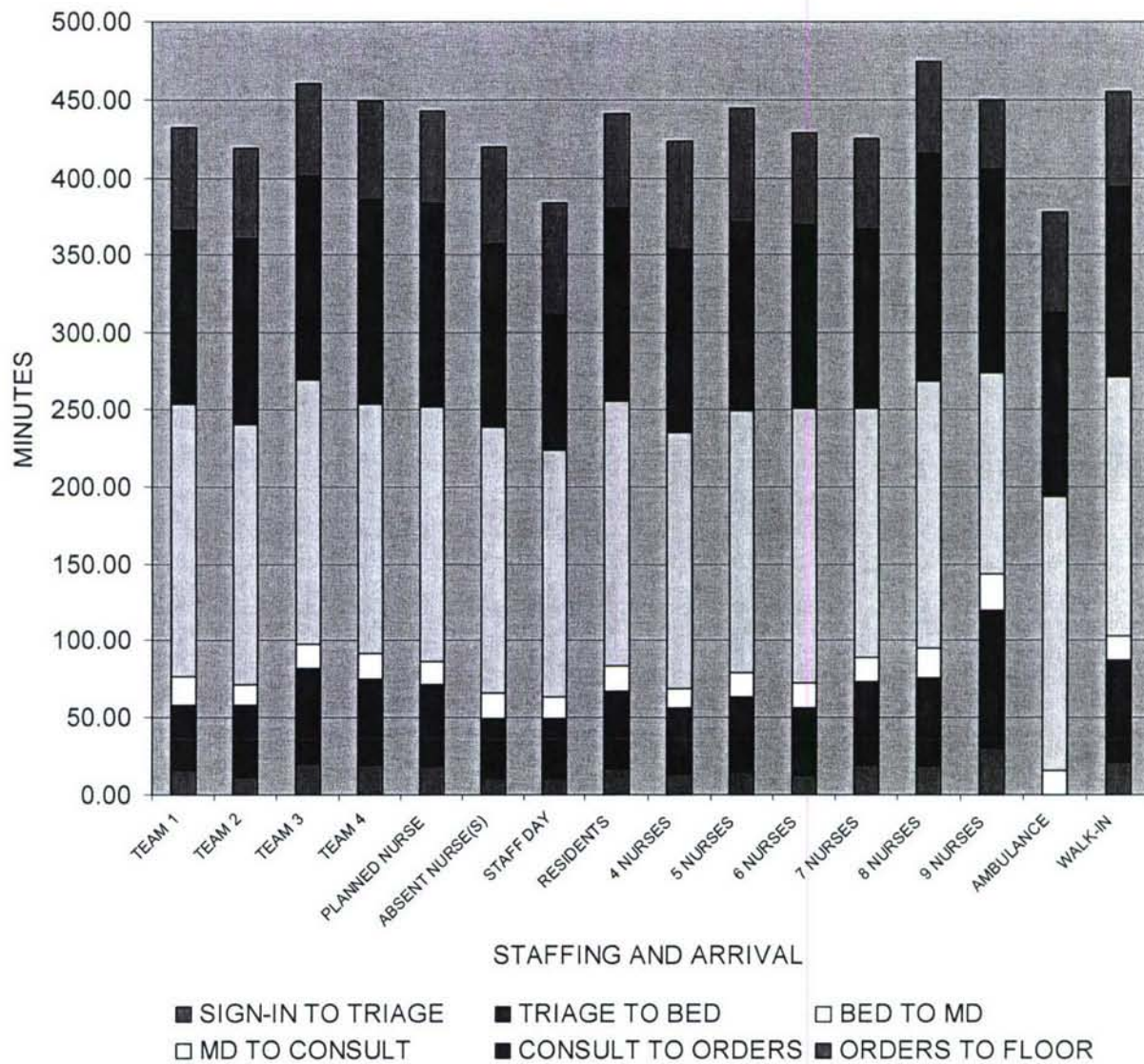


Figure 5. Mean time in minutes for each phase by staffing and patient arrival

The following variables demonstrated significant positive correlations: (a) sign-in to triage was significantly correlated with total time with a correlation coefficient of 0.314, with Saturday with a correlation coefficient of 0.166, with 1800-2000 with a correlation coefficient of 0.133 and with daily census with a correlation coefficient of 0.278; (b) triage to bed was significantly correlated with total time with a correlation coefficient of 0.542; (c) bed to MD was

significantly correlated with total time with a correlation coefficient of 0.127, and with team 1 with a correlation coefficient of 0.126; (d) MD to consult was significantly correlated with total time with a correlation coefficient of 0.536, with Saturday with a correlation coefficient of 0.112, with 1401-1600 with a correlation coefficient of 0.150, and with daily census with a correlation coefficient of 0.159; (e) consult to orders was significantly positively correlated with total time with a correlation coefficient of 0.512, with Tuesday with a correlation coefficient of 0.143, and with Thursday with a correlation coefficient of 0.115; (f) orders to floor was significantly correlated with total time with correlation coefficient of 0.285; and (g) in addition to the previously mentioned correlation total time was also significantly correlated with Tuesday with a correlation coefficient of 0.133.

The following variables demonstrated significant negative correlations: (a) sign-in to triage was significantly correlated with Friday with a correlation coefficient of -0.171, with team 2 with a correlation coefficient of -0.179, with staff with a correlation coefficient of -0.131, and with 1201-1400 with a correlation coefficient of -0.162; (b) triage to bed was significantly correlated with 1401-1600 with a correlation coefficient of -0.179; (c) bed to MD was significantly correlated with team 2 with a correlation coefficient of -0.123; (d) consult to orders was significantly correlated with staff with a correlation coefficient of -0.140, and with 1201-1400 with a correlation coefficient of -0.142; (e) orders to floor was significantly correlated with Monday with a correlation coefficient of -0.113, and with 2001-2200 with a correlation coefficient of -0.152; and (f) total time was significantly correlated with Friday with a correlation coefficient of -0.135, with staff with a correlation coefficient of -0.107, and with ambulance with a correlation coefficient of -0.258.

Table 2. Significant Correlations

Variable		Sign-in to triage	Triage to bed	Bed to MD	MD to consult	Consult to orders	Orders to floor	Total time
Total time	Pearson Correlation	0.314	0.542	0.127	0.536	0.512	0.285	
	n	254	254	332	343	343	343	
Monday	Pearson Correlation						-0.113	
	N						343	
Tuesday	Pearson Correlation					0.143		0.133
	n					343		343
Thursday	Pearson Correlation					0.115		
	n					343		
Friday	Pearson Correlation	-0.171						-0.135
	n	254						343
Saturday	Pearson Correlation	0.166			0.112			
	n	254			343			
Team 1	Pearson Correlation			0.126				
	n			332				
Team 2	Pearson Correlation	-0.179		-0.123				
	n	254		332				
Staff	Pearson Correlation	-0.131				-0.140		-0.107
	n	254				343		343



Ambulance	Pearson Correlation						-0.258
	n						343
1201-1400	Pearson Correlation	-0.162	-0.121			-0.142	
	n	221	288	299		299	
1401-1600	Pearson Correlation		-0.179		0.150		
	n		221		299		
1801-2000	Pearson Correlation	0.133					
	n	221					
2001-2200	Pearson Correlation						-0.152
	n						299
Daily census	Pearson Correlation	0.278			0.159		
	n	254			343		

Notes: sample size (n) varied from the population size (N) of 343 due to incomplete data for some variables. Only significant correlations were listed in this table, so the actual significance values were excluded in the interest of space.

*Table 3. Average total patients seen in the ED by day of week for time period*

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Number of Patients	139	128	112	123	112	157	135

Notes: n=343

*Table 4. Average admitted patients by day of week for time period*

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Number of Patients	64	52	58	48	45	32	44

Notes: n=343

### Discussion

The results of the analysis were used to develop and support recommendations. First, the results were looked at independently to determine root causes of correlations uncovered in the analysis. Next, both the results and associated processes were reviewed against the literature to determine how BAMC compares with other institutions and to help determine which external solutions were applicable to BAMC's ED.

#### *Interpretation of the Results*

The results of the statistical analysis revealed several correlations among variables. Sign-in to triage was significantly longer on Saturdays, between 1800 and 2000, and when ED patient census was high. Sign-in to triage was significantly shorter on Fridays, when nursing team 2 was on duty, when the ED was staffed primarily by staff physicians, and between 1201 and 1400. Saturdays were also the day with the highest inpatient census, as shown in table 4. Triage to bed was significantly shorter between 1401 and 1600. Bed to MD was significantly longer when team 1 was on duty. It was significantly shorter when team 2 was on duty and between 1201 and 1400. MD to consult was significantly longer on Saturdays, between 1401 and 1600, and when daily census was high. Consult to orders was significantly longer on Tuesdays and Thursdays. It was significantly shorter when the ED was staffed primarily by staff physicians and between 1201 and 1400. Orders to floor was significantly shorter on Mondays and between 2001 and

2200. Total time was significantly longer on Tuesdays and significantly shorter when the ED was staffed primarily by staff physicians, on Fridays, and when patients arrived by ambulance.

Saturdays mirrored daily census in that both of these variables significantly correlated with both Sign-in to triage and MD to consult. Since there were no other significant correlations to Saturday, it was concluded that Saturdays are only significantly correlated to longer patient sign-in to triage and MD to consult times because of the high patient census on Saturdays. A similar situation existed for Fridays. All non-holiday Fridays were also staff days, but not all staff days were Fridays. This led to the conclusion that the shorter patient wait times seen on Fridays were due to the high number of staff physicians on duty and not necessarily to any other unique characteristic of Fridays. Although MD to consult, or evaluation time by ED physicians, did not show a significant improvement on days when staff providers were working, consult to orders time did. This is likely due to a more thorough evaluation performed by the ED staff, resulting in less work being required of the consulted service.

The time patients spend between arrival in a bed and evaluation by a provider was spent with members of the nursing team on duty. Nursing team 2 was significantly faster than the other teams, and team 1 was significantly slower than the other teams during this nursing evaluation time.

Patients that arrived by ambulance, drop-off, or code had overall shorter wait times for admission solely due to the fact that they skipped the sign-in to triage, triage to bed, and bed to MD phases. However, once in a bed, they did not complete the subsequent steps in the process any faster than patients that presented to the ED as a walk-in or referral.

Explanations for correlations that occurred during time periods 1201-1400, 1401-1600, 1801-200, and 2001-2200, and days of week Monday, Tuesday, and Thursday could not be



found. There were no unique staffing, patient census, or patient mix combinations that significantly correlated to any of these variables.

#### *BAMC versus Other Institutions*

The literature review indicated a high inpatient census contributed to overcrowding and wait times in the ED. BAMC maintained a 224-bed capacity and an average daily census of 142 (64%). That appeared to put BAMC in a position to easily respond to fluctuations for inpatient beds. However, although the overall census was low, the census for specific types of beds, in particular ICU beds requiring telemetry, were sometimes filled to capacity and closed to DOM admissions. Furthermore, while overall physical bed availability remained high, the ability to staff all available beds was occasionally limited. Staffing constraints may make some recommendations from the literature, such as direct admissions from the ED, impractical due to inadequate staff on the receiving ward causing the admitted patient to wait several hours to be seen by a provider following admission. However, considering that BAMC DEM physicians and the admitting service agree on the decision to admit a patient over 95% of the time, direct admissions for the ED could help to mitigate some of the BAMC DEM length of stay, as long as there are adequate beds available (S. G. Mehta, personal communication, September 14, 2005).

The average wait time for an inpatient bed at BAMC was 67 minutes in February 2005 and 61 minutes in August 2005, which was well below the national average, and emphasizes again that inpatient census is likely not a contributor to wait time for admission through the BAMC DEM.

Trzeciak & Rivers (2003) stated that the total number of ED visits has been reported to poorly correlate with ED overcrowding, however, this does not seem to be true at BAMC. Wait times for admission positively correlated to high ED census in this study, but did not correlate

with the number of admissions. This demonstrates that non-urgent patients do impact the BAMC ED's ability to evaluate and admit patients requiring urgent care.

With the coming restructuring of WHMC and increasing population, BAMC and the region it serves will be following the nationwide trend of reduction in ED services and increase in ED visits (Trzeciak & Rivers, 2003).

During this study, BAMC was not diverting any ambulances that were destined for it; however, it was occasionally on the receiving end of ambulances carrying trauma patients diverted from civilian institutions, and for ambulances carrying all types of patients from WHMC (S. G. Mehta, personal communication, October 10, 2005).

Since BAMC's primary mission was to provide health care to its eligible beneficiary population, and it is currently engaged in treating casualties from the GWOT, its requirement to respond to local or regional disasters is limited and only considered in cases where civilian facilities are overwhelmed, or where BAMC has a unique capability not available from the other facilities. BAMC also has a limited mission to provide decontamination in response to a chemical, biological, radioactive, nuclear, or explosive (CBRNE) incident. The biggest threat to BAMC's disaster preparedness is overcrowding at other local facilities, which may become overwhelmed early in a disaster, requiring BAMC to react (Brooke Army Medical Center, 2005, June).

### Recommendations and Conclusion

Analysis of the data collected and review of the literature point toward several recommendations that may reduce wait time for admission through the BAMC ED. A total of six recommendations were made to the DEM and DOM chiefs, with one being implemented and two others with potential implementation in the future. The recommendations were: streamline sign-

in and triage through consolidation; restructure and retrain nursing teams based on the most efficient team; change staff days to days with the highest wait times; increase the availability of the Fast Track to relieve some of the burden on the ED treatment room; use automation to reduce the administrative workload of providers and increase situational awareness; and use a direct admissions system where ED providers can admit patients directly or via telephone consultation.

### *Recommendations*

#### *Streamline sign-in to triage*

Sign-in to triage time increased significantly as ED census increased. Converting this two-step process into a single step and automating data collection for this step may improve the speed and utility of this process. During this study, patients were checked-in at the front desk and then waited in chairs until a triage room was available. By increasing the triage capacity, the sign-in and triage processes can be consolidated. In this new process, a greeter would immediately greet arriving patients and take them to a triage room, where they would be simultaneously checked-in and triaged. Once triaged, patients can more expeditiously be sent to the ED queue or the Fast Track. To facilitate this process, an automated replacement for the existing DA 4700 needs to be created. This will be discussed in greater detail in the improve automation section.

#### *Restructure or retrain nursing teams*

This study revealed that there were significant differences among the times the four nursing teams required to prepare patients for evaluation by a provider. Team 1 took significantly longer than all other teams and team 2 was significantly faster. The total number of nurses and mix of RN and LVN did not significantly impact the speed with which the process was completed. Variables that were not measured, such as leadership and teamwork, may be



what enabled team 2 to perform significantly faster than the other teams. Team 2 was lead by a Major, and had two additional active duty military members. Teams 1, 3, and 5 were lead by Captains and had only one additional active duty member. I recommend that team 2 be observed to determine what techniques, clinical and administrative, they use to perform their functions more efficiently, and these observations be used to retrain or restructure the remaining teams.

#### *Change staff days*

Days when the ED was primarily staffed by staff providers had significantly shorter consult times and wait times for admissions than other days. Fridays, which make up the bulk of staff days, were also one of two days, along with Wednesdays, that had the lowest average census, as shown in table 4. To improve ED throughput, these staff days should be changed to Tuesday, which had significantly longer consult times and overall wait times or shared with Thursdays, which had significantly longer consult times. Doing this may reduce overall wait times both due to the efficiency by which these providers can evaluate patients, and by the reduction in consult time required due to the thorough evaluations performed by these providers.

#### *Increase fast-track availability*

Daily census significantly correlated with sign-in to triage and MD to consult. The Fast Track's hours were usually 1200 – 2200, but was sometimes be open until 2400 if the two providers that work in the Fast Track have staggered shifts. Previous analysis by the DEM have determined that these are the hours of peak demand for non-urgent care in the ED, however, the capacity of the Fast Track could be increased to reduce the burden in the ED. Increasing staffing of the Fast Track will give providers in the ED more time to focus on urgent patients, resulting in reduced evaluation times for these patients and greater overall throughput. This, combined with enhancements made to the sign-in to triage process, may help ensure that routine patients are

seen in a timely manner by the Fast Track, thereby freeing resources to focus on more urgent patients.

#### *Improve automation*

Patient tracking was performed on paper using DA 4700 and SF 558 forms. The only automation in the ED consisted of an electronic status board. By moving to an entirely electronic method of registering and documenting patients, participants in all parts of the process from sign-in through admission or disposition will maintain better situational awareness and duplication of effort and errors should be reduced.

Currently there is an effort underway to move all DoD MTFs to a single software solution, the Armed Forces Health Longitudinal Technology Application (AHLTA), for tracking patients. This application is the next generation of the DoD's previous system, the Composite Health Care System (CHCS) and will go beyond CHCS's role of tracking only outpatient visits, by ultimately tracking all types of patient care provided at all DoD locations and documenting all patient encounters in an electronic health record. Currently, AHLTA, like CHCS before it, is being used only for outpatient visits, but modules for emergency medicine and inpatient care are being developed.

The chief of the BAMC DEM, LTC Curtis Hunter, is part of a multidisciplinary, multi-service team that is developing the ED module for AHLTA. Some of the proposed functionality of this module are: (a) an ED status board that facilitates patient tracking and orders status flagging; (b) facilitation of documentation of patient encounters by all members of the health care team including templated notes, multiple notes by multiple health care team members that become one ED encounter, and flowsheets; (c) management of medication and treatment orders with both provider and non-provider order entry, orders status documentation, and the ability to



enter orders to be carried out in the ED only; (d) and the ability to create, edit, and print discharge instructions.

The use of this software and appropriate hardware, such as wireless tablet computers for the provider staff, should help streamline the entire process. A patient will be checked-in and simultaneously triaged, with all information entered into AHLTA. As this information is entered, both the ED and Fast Track become aware of the patient. Fast Track providers can then immediately call Fast Track designated patients to be seen, or see higher triage category patients if workload and resources permit. In the current scenario, the Fast Track providers have no awareness of patients not specifically sent to them. This method would allow the Fast track to see additional patients during periods of low Fast track use, thereby relieving some of the ED's burden. At the same time, providers in the ED treatment room can dynamically make decisions on when to bring a patient to the treatment room based on priorities, workload, and resources. Once a provider takes a patient, they can monitor and document their patient from their tablet PC and switch the view on their tablet among the patients they are currently seeing. The tablet would also alert the provider as procedure results become available. Finally, the provider can hand-off all collected data to a consulted service, if called, or use the data to admit the patient without having to reenter the data. AHLTA has the potential to reduce the administrative requirements of ED providers and allow them to focus on patient care.

The use of an automated patient tracking and order entry system will also facilitate process evaluation in real time, greatly reducing the time required for data collection. During this project, times were taken from DA 4700's and DA 558's and transferred to a spreadsheet. This was both a time consuming process and was prone to errors, requiring multiple crosschecks to ensure the data from the forms was correctly annotated in the spreadsheet. In the future, this data



will be instantly available from the Clinical Data Repository (CDR) for analysis at multiple levels.

*Institute ED direct admissions*

Howell, Bessman, & Haya (2004) found direct admission by ED providers reduced time of consult to floor from 150 minutes to 18 minutes. During this study, the ED provider staff was not privileged to admit patients to BAMC. However, considering that BAMC DEM physicians and the admitting service agree on the decision to admit a patient over 95% of the time, direct admissions should help to shorten the BAMC ED length of stay (S. G. Mehta, personal communication, September 14, 2005).

Direct admissions could be accomplished multiple ways: (a) the ED staff can be fully privileged to admit patients to all services directly; (b) the ED staff can be privileged to admit patients to all services after a telephone consultation with a provider from the service where the patient is to be admitted; (c) the ED staff can admit directly to some services without a telephone consultation, and to others with a telephone consultation; (d) the ED staff can admit directly to some services, while other services still perform onsite consultation and admission; or (e) the ED staff can admit directly to some services, require a telephone consultation for others, with other services still sending providers to the ED to perform the actual consultation and admission. Any of these techniques should assist in reducing wait times for admission.

LTC Curtis Hunter, Chief DEM and LTC Lisa Zacher, Chief DOM, presented option (d) to the BAMC Executive Committee on February 27, 2006, and received approval to begin implementation on March 6, 2006. Prior to implementation, several prerequisites had to be met and changes implemented: (a) ED providers had to be trained on and authorized to use Essentris, the current inpatient software, to admit patients; (b) ED providers had to qualify for and be given

admitting privileges; and (c) The DOM created a non-teaching service to ensure greater availability of hospitalists to see admitted patients quickly.

Figure 6 shows the new flow chart outlining which service admits patients by type and time of day. The new process will allow ED providers to admit non-urgent chest pain patients between 2300 and 0700, with all other admissions still being performed by the service the patient will be admitted to. The DEM and DOM will use this new process with continuous monitoring and may expand it to additional services, patient types, and hours if it proves safe and effective. The DOM is also pursuing a business case analysis on hiring more hospitalists to staff the non-teaching service to accommodate more direct admissions, while still maintaining the existing teaching service. Appendices D and E further detail the proposal and implementation of this process.

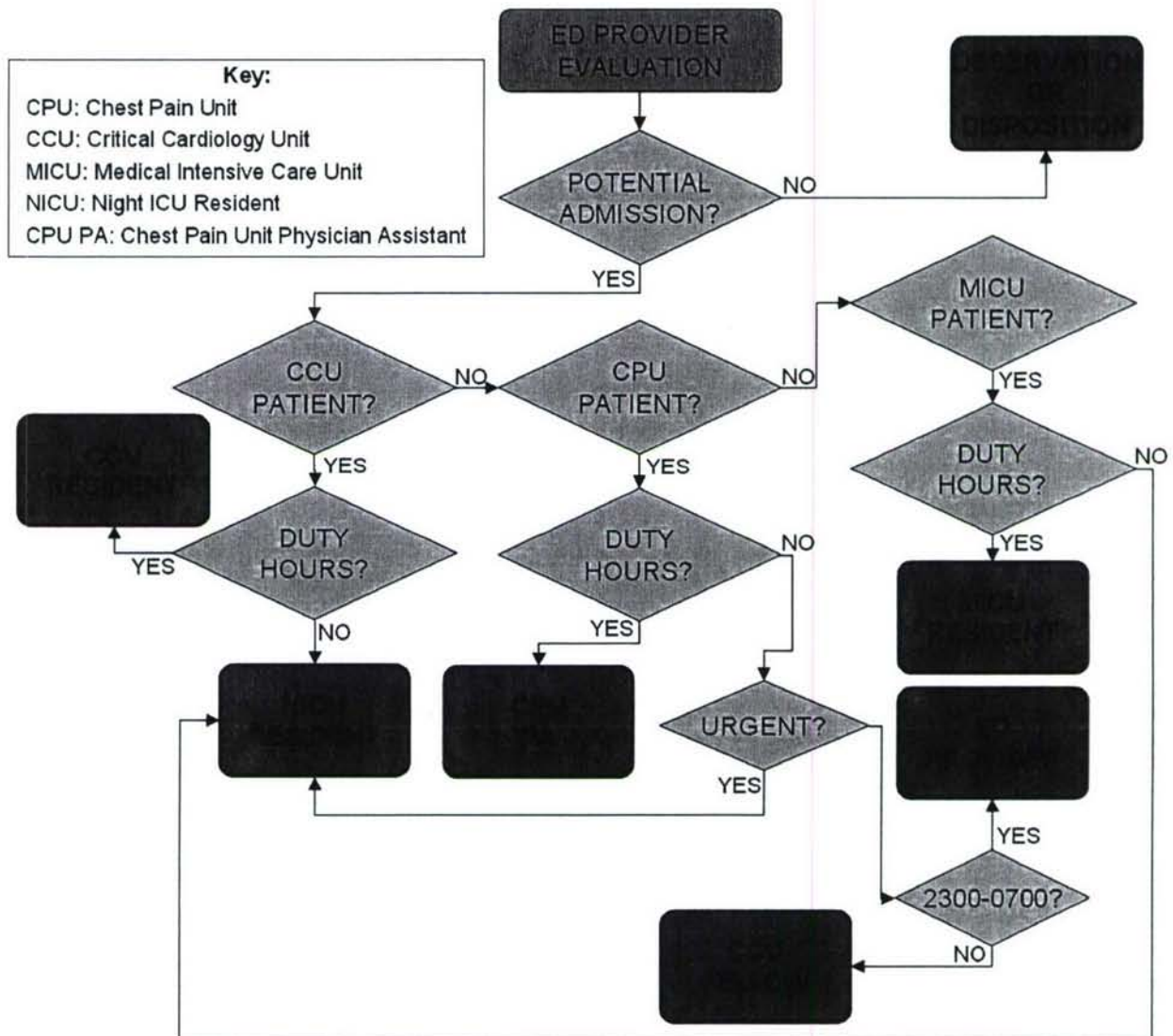


Figure 6. New ED admission flow chart

### Conclusion

The purpose of this study was to determine, evaluate, and propose ways to mitigate factors that contribute to overcrowding and wait times experienced by patients admitted through the BAMC DEM. Overcrowding and long wait times are common in EDs throughout the U.S. and are a problem that is not going away.



Through data collection and statistical analysis it was determined that factors related to staffing, ED census, and day of the week were significantly correlated to overall wait time for admission and/or steps in the admissions process. Based on these contributors and recommendations derived from the literature review, the following recommendations were made: (a) streamline sign-in and triage through consolidation; (b) restructure and/or retrain nursing teams based on the most efficient team; (c) change staff days to days with the highest wait times; (d) increase the availability of the Fast Track to relieve some of the burden on the ED treatment room; (e) use automation to reduce the administrative workload of providers and increase situational awareness; and (f) use a direct admissions system where ED providers can admit patients directly and/or via telephone consultation.

This problem could also benefit from further study. A longer data collection period may help to eliminate any seasonal variation in ED census, staff availability, and resident experience. Staffing data for the admitting service, which was not used in this study, may also assist in explaining why length of consult times varied by the time of day. Additionally, the impact of trauma patients on the ED's throughput was not evaluated; data relating to the trauma load of the ED may assist in explaining fluctuations in ED wait times for admission.

The BAMC DEM and DOM are testing a new process that allows ED providers to directly admit non-urgent chest pain patients between 2300 and 0700. This process will be continuously monitored. If effective, the types of patients ED providers directly admit may be expanded. The BAMC DEM is also heavily involved in the development and implementation of the AHTLA emergency medicine module, which should enhance the efficiency and effectiveness of the department once implemented.

## Appendix A. DA Form 4700 with ED overlay


<b>MEDICAL RECORD-SUPPLEMENTAL MEDICAL DATA</b> <small>For use of this form, see AR 40-66; the proponent agency is the Office of The Surgeon General.</small>	
<b>REPORT TITLE</b> BROOKE ARMY MEDICAL CENTER.....EMERGENCY DEPT TRIAGE ASSESSMENT	<b>OTSG APPROVED (Date)</b> <small>(YYYYMMDD)</small>
<b>TIME IN:</b> _____	<b>Vital Signs:</b> Temp: _____ B/P: _____ SaO2 _____ %
<b>AGE:</b> _____ <b>SEX:</b> _____	<b>Pulse:</b> _____ <b>RR:</b> _____ <b>WT:</b> _____ kg <b>Medic Initials</b> _____
<b>CHIEF COMPLAINT:</b> _____ <b>PAIN:</b> _____ (0-10) <b>FLACC:</b> _____	
<b>Female's LMP:</b> _____ <b>Normal/Abnormal</b> <b>Pregnant: Yes/No</b> <b>Number of Weeks:</b> _____	
<b>Allergies:</b> _____	
<b>Medications:</b> _____	
<b>PMH/PSH:</b> _____	
<b>Breathing:</b> <input type="checkbox"/> Labored <input type="checkbox"/> Unlabored <input type="checkbox"/> Retractions <input type="checkbox"/> Wheezing <input type="checkbox"/> Clear <input type="checkbox"/> Congestion	<b>Pulse:</b> <input type="checkbox"/> Regular <input type="checkbox"/> Irregular
<b>Mental Status:</b> <input type="checkbox"/> Baseline <input type="checkbox"/> Person <input type="checkbox"/> Place	<b>Visual Acuity:</b> w/correction: Yes/No Right: _____/_____ Left: _____/_____ Both: _____/_____ <b>Learning Assessment</b> Speak/Read English: Yes/No Other: _____ Hearing/Vision Impaired: Yes/No Cognitive Impairment: Yes/No
<b>Extremity Trauma Location:</b> _____	
_____ Deformity _____ Contusion _____ Abrasion _____ Puncture _____ Burn _____ Laceration _____ Swelling Color _____	
<b>Cap Refill:</b> _____ <b>Distal Neurovascular Status:</b> _____ <b>Intact:</b> _____ <b>Compromised:</b> _____	
<b>Triage Assessment</b> _____ <b>Hrs:</b> _____	
_____	
_____	
_____	
<b>Previous visit within last 48 hours:</b> Yes _____ No _____	
_____ I _____ II _____ III _____ IV _____ V _____	
<b>Verify Patient Phone # and Home Address:</b> _____	
<b>PHONE:</b> _____	
<b>LABS/XRAYS ORDERED</b> _____	
<b>PREPARED BY (Signature &amp; Title)</b> _____	<b>DEPARTMENT/SERVICE CLINIC</b> _____
<b>EMERGENCY DEPARTMENT</b>	
<b>PATIENT'S IDENTIFICATION (For typed or written entries give: Name - last, first, middle, grade, date, hospital or medical facility)</b>	
<input type="checkbox"/> HISTORY/PHYSICAL <input type="checkbox"/> FLOW CHART	
<input type="checkbox"/> OTHER EXAMINATION OR EVALUATION <input type="checkbox"/> OTHER _____	
<input type="checkbox"/> DIAGNOSTIC STUDIES	
<input type="checkbox"/> TREATMENT	

## Appendix B. DA Form 558, Emergency Care and Treatment, Front

MEDICAL RECORD		EMERGENCY CARE AND TREATMENT (Patient)				NSN 7540-01-075-3788	
				LOG NUMBER		TREATMENT FACILITY	
				RECORDS MAINTAINED AT			
PATIENT'S HOME ADDRESS OR DUTY STATION						ARRIVAL	
STREET ADDRESS						DATE (Day, Month, Year)	
						TIME	
CITY				STATE	ZIP CODE	TRANSPORTATION TO FACILITY	
SEX	DUTY/LOCAL PHONE		MILITARY STATUS			THIRD PARTY INSURANCE	
	AREA CODE	NUMBER	ITEM	YES	NO	N/A	ITEM
			PRP				ADDITIONAL INSURANCE
AGE	HOME PHONE		FLYING STATUS			DD 2568 IN CHART	
	AREA CODE	NUMBER	MEDICAL HISTORY OBTAINED FROM			NAME OF INSURANCE COMPANY	
CURRENT MEDICATIONS			INJURY OR OCCUPATIONAL ILLNESS			EMERGENCY ROOM VISIT	
			ITEM	YES	NO	DATE LAST VISIT	24 HOUR RETURN
							<input type="checkbox"/> YES <input type="checkbox"/> NO
			IS THIS AN INJURY?			TETANUS	
			WHERE				
ALLERGIES			INJURY/SAFETY FORMS			DATE LAST SHOT	COMPLETED INITIAL SERIES
			HOW				<input type="checkbox"/> YES <input type="checkbox"/> NO
CHIEF COMPLAINT							
CATEGORY OF TREATMENT				VITAL SIGNS			
<input type="checkbox"/> EMERGENT				TIME			
<input type="checkbox"/> URGENT				BP			
<input type="checkbox"/> NON-URGENT				PULSE			
				RESP			
				TEMP			
				WT			
LAB ORDERS	CBC/DIFF	ABG	PT/PTT	BHCG/URINE/BLOOD/QUANT		CXR PA & LAT/PORTABLE	
	URINE C&S	UA MSCC/CATH		CHEM:		ACUTE ABDOMEN	
	BLOOD C&S X					LS SPINE	
						HEAD CT	
X-RAY ORDERS						ANKLE R/L	
ORDERS							
<input type="checkbox"/> PULSE OX				<input type="checkbox"/> MONITOR			
<input type="checkbox"/> ECG							
TIME	ORDERS	BY	COMPLETED BY	TIME	PATIENT'S RESPONSE		
DISPOSITION		DISPOSITION QUARTERS /OFF DUTY		PATIENT/DISCHARGE INSTRUCTIONS			
<input type="checkbox"/> HOME <input type="checkbox"/> FULL DUTY		<input type="checkbox"/> 24 HRS. <input type="checkbox"/> 48 HRS. <input type="checkbox"/> 78 HRS					
MODIFIED DUTY UNTIL		RETURN TO DUTY					
CONDITION UPON RELEASE		ADMIT TO UNIT/SERVICE		REFERRED		TO	WHEN
<input type="checkbox"/> IMPROVED <input type="checkbox"/> UNCHANGED							
<input type="checkbox"/> DETERIORATED		TIME OF RELEASE		I have received and understand these instructions.			
PATIENT'S IDENTIFICATION				PATIENT'S SIGNATURE			
EMERGENCY CARE AND TREATMENT (Patient)							
Medical Record							
STANDARD FORM 558 (REV. 9-96)							
Prescribed by GSA/CMR							
FPMR (41 CFR) 101-11.203(b)(10)							



## Appendix C. DA Form 558, Emergency Care and Treatment, Back

MEDICAL RECORD		<b>EMERGENCY CARE AND TREATMENT (Doctor)</b>				NSN 7540-01-075-3786 TIME SEEN BY PROVIDER	
<b>TEST RESULTS</b>							
CBC	WBC	SMAC	ABG/PULSE OX			RADIOLOGY	Check if read by radiologist <input type="checkbox"/>
	H/H		SUP O2	PH	PO2	RESULTS	
	PLT		PCO2	SAT	OTHER		
PT				DIP	EKG INTERPRETATION		
APTT				JIA			
BHC		ETOH	GLU				
PROVIDER HISTORY/PHYSICAL							
CONSULT WITH		TIME	ACTION		RESIDENT/MEDICAL STUDENT SIGNATURE AND STAMP		
DIAGNOSIS				PROVIDER SIGNATURE AND STAMP			
				CODES			
PATIENT'S IDENTIFICATION (For typed or written entries, give: Name -- last, first, middle; ID no. (SSN or other); hospital or medical facility)							
<b>EMERGENCY CARE AND TREATMENT (Doctor)</b> Medical Record <b>STANDARD FORM 558</b> (REV. 9-96) <small>Prescribed by GSA/ICMR FPMR (41 CFR) 101-11.203(b)(10)</small>							

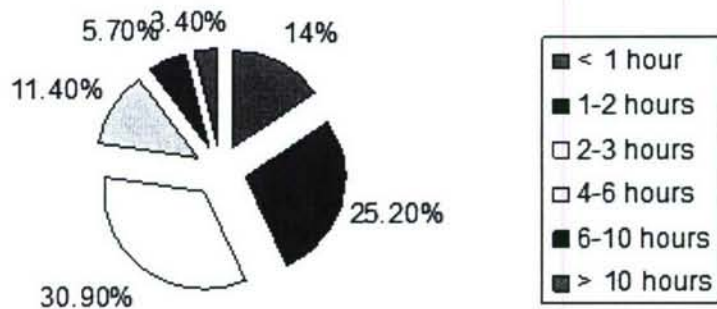
## Appendix D. Emergency Department Direct Admissions Briefing to the Executive Committee

## Emergency Department Direct Admissions

LTC (P) Hunter  
LTC (P) Zacher  
13 Feb 2006

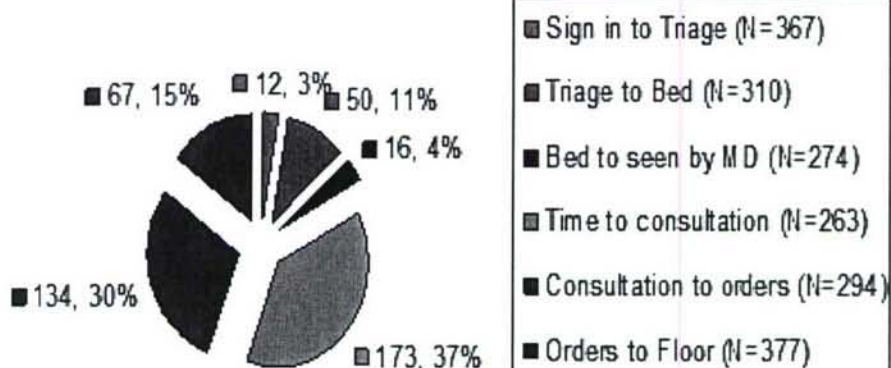
### National Hospital Ambulatory Medical Care Survey: 2003 Emergency Department Survey

#### Time Spent in the Emergency Department



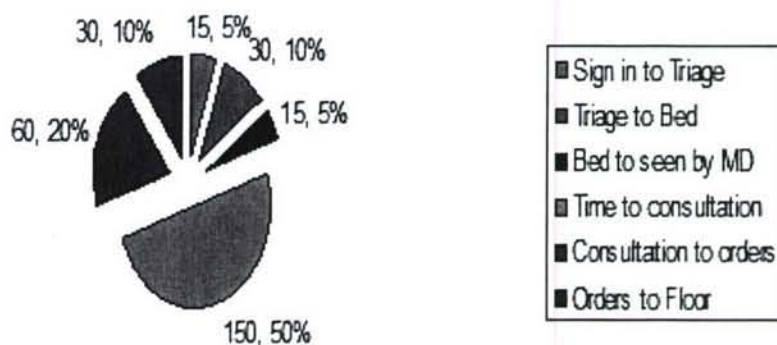
## Reality: Door to Floor 452 minutes

Patient Flow Through The Emergency Department in Minutes



## Goal: Door to Floor 300 minutes

Patient Flow Through The Emergency Department in Minutes





## Review of Data

- No difference: Feb vs Aug 05 (456 min; 457 min)
- 75th percentile (383) vs 90th (404)
- Weekday (434) vs Weekend (448)
- Ambulance (378) vs Walk In (457)
- ED Residents (441) vs ED staff only (388)
- No correlation with number of nurses  
(4 nurses 423; 6 nurses 428; 8 nurses 474)
- More consults after 1400 and at shift changes
- MICU/CCU/CPU admit time?

## ED Direct Admissions

### MICU, CCU, CPU

- Redundancy of MOD evaluation; could offload 30% of MOD consults
- MICU/CCU: Greatest safety net  
(monitored, experienced nurses, fellows)
- CPU: Civilian model; Standardized orders; monitored beds

## ED Direct Admissions

### MICU Admission

- Initial ED eval and resuscitation
- Call MICU resident
  - MICU resident prioritizes ED eval
  - Quick assessment
  - Stable for transport? Can safely care for patient in MICU?
  - Stabilize further in ED and/or calls fellow

## ED Direct Admissions

### CCU Admissions

- Similar to MICU but with acute MIs more likely that Cardiology fellow already in the loop

## ED Direct Admissions

### CPU (Low Acuity Chest Pain Admissions)

- ED calls Cardiology Fellow
- CPU bed available

ED writes hold note and order set

Duty hours: CPU PA – H&P, assumes care

After duty hours: Urgent Cross Cover – ICU resident

Non-Urgent Cross Cover – Calls Cardiology fellow

- CPU bed not available –  
admit to Medicine team or CCU team

## ED Direct Admissions Benefits

### Decrease Admission Times

- Via ED Direct Admits
- Via MOD Consult to Orders Time
- Via Triage to Bed (more bed turnover)

### Improve Resuscitation/Outcomes?

### Patient Satisfaction



## System Issues

### ED Physicians/Residents

- Essentris training (order set, hold note)
- Admission card (activate orders)
- Complete paperwork
- Contact Bed Supervisor
- Stabilize for transfer
- Assume liability for CPU patients
- GME

## System Issues

### IM Physicians/Residents

- No 24/7 in-house staff
- Safety issues (call fellow early)
- Monitor fellow hours
- Created non-teaching service
- Increased CPU LOS? (PAs must write H&Ps – then initiate risk stratification)
- Potential for inappropriate initial triage
- GME

## Other Key Players

- PAD/Admission Clerk
  - Admission Orders, Admission Card
- Radiology
  - Prioritize rads studies done in initial eval period
  - Staffing: 1 resident, 1 CT tech after 2300
- Case Management: NA after hours
- Nursing Staff

## Key Players

### Nursing Staff

- Suitable Bed Availability
- Orders activated
- Change of shift (need to take report)
- Nursing report called (PASS THE BATON)
- Packaged for transport
- Adequate ICU nursing staff to handle ongoing resuscitation

## Key Players

### Nursing staff (cont)

- Increased ICU to Radiology transports (very resource intensive)
- Some CPU pts with no H&P (up to 16 hrs)
- No 24/7 in house non-urgent CPU cross-coverage
- Communication/Detailed order sets

## What Next?

### Goal: Decrease overall admission process by 1 hr

- Implement 21 Feb 06 → now delayed 6 March
- Due out: Who to call algorithm?  
Refine CPU order sets/hold notes
- Troubleshoot daily – LTC Hunter/Zacher; LTC Osborne/Smith
- Meet weekly – multiD team (staff, residents, nursing)
- Measure impact after weekly with report to CG
- Subgroups: All, MICU, CCU, CPU – before and after
- Consider other populations for direct admissions
- Optimize telemetry utilization
- Pursue BCA – staffing non-teaching service



- CPU Cross-coverage Guidance for Nursing:
- If chest pain, arrhythmia, shortness of breath, – or any acute condition that warrants immediate evaluation – contact the ICU Night Float resident.
- For non-urgent issues (e.g. fever < 103, clarification of an order, change in diet, PRN medications) – call the Cardiology fellow.
- **IMPORTANT:** Out of courtesy, please limit the calls to the Cardiology fellow after hours to only issues that really cannot wait until the following duty day. We will continue to work with the ED to refine the order sets to be inclusive of most events. The IM residents, while convenient, should only be involved in emergent or urgent care.

## Appendix E. Direct Admissions from Emergency Department to Department of Medicine

## Working Draft

Goal: Improve “Door to Floor” time for patients requiring admission without compromising patient safety.

JCAHO: The leaders develop and implement plans to identify and mitigate impediments to efficient patient flow throughout the hospital (effective Jan 2005).

Contributors to delay from national norms: Level 1 Trauma. GME programs. No Medicine non-teaching Service. ED without direct admitting privileges. No Urgent Care Clinic. Limited availability of after hours care. No disincentive to use ED.

Analysis: Data gathered looking at all areas related to patient flow through ED, staffing, shifts, GME. (See Attachments)

Initial Solution: Avoid redundancy in ED and DOM evaluations by MOD. Maximize utility of MOD.

Plan: Direct Admit pathways for obvious MICU, CCU, and CPU (low acuity chest pain patients) admitted via the ED.

#### A. MICU/CCU Admissions

**What does this mean for the CCU/MICU?** Admits will be coming to the MICU/CCU that typically will only have had an initial ED evaluation and initial stages of resuscitation. They may not have lines in place, may not have received large volumes of fluid, and may not have all the labs and rads studies that we are used to having or would like in a particular patient. These may need to be obtained once the patient is stabilized in the unit.

*ED will still do initial evaluation and initiate resuscitation* □ therefore, these patients should all have basic labs, CXR, EKG, NG lavage, head CT (if acutely indicated), etc. In other words, the ED will conduct business as usual to the point of calling the MOD, at which time they will instead contact the MICU or CCU team.

#### How it works:

Weekdays during the day: ER will call the MICU or CCU resident (or fellow if resident off) to let them know that there is a MICU “direct admit” patient. These patients will be transferred to the appropriate ICU as soon as their clinical condition allows (i.e. they won’t be sent with ACLS/CPR in progress, etc. but won’t necessarily have the in depth work up completed.

Weekends/nights (assuming no staff/fellow in house): ER will call the on-call MICU resident to let them know that there is a MICU “direct admit” patient. The MICU resident **MUST** go to the ED and see these patients before they are transported to the ICU. Obviously, if the resident is actively resuscitating someone or in the middle of a procedure, then the ED will hold these



patients until the resident has a chance to see them. Having H&Ps to do, starting an elective line change, or spending 2 hours trying to get an a-line in a patient are **NOT** valid reasons for a resident to delay going to see the patient.

Once the resident goes to the ED he/she is to do a quick (5 minutes) assessment of the patient to ensure the patient is stable enough for transport and that the resident feels **CONFIDENT** that they can care for that patient in the ICU. The resident should also call the MICU or CCU Fellow at the earliest opportunity to provide a quick (3 minute) blurb to the fellow that they are taking a “direct admit” to the unit and that they do feel comfortable caring for that patient.

**If** the resident has concerns about their ability to care for that patient without backup, the resident will call the MICU or CCU Fellow from the ED, quickly describe the case, and ask the fellow to come in and assist with caring for the patient. The patient **WILL** remain in the ED and under the care of the ED staff until such time that the fellow arrives OR the patient’s condition has stabilized to the point the resident now feels comfortable taking them to the ICU.

*The MICU or CCU resident will write the admission orders. Ideally, the ED should notify the bed coordinator early in the process and relay that an ICU bed is needed. In no situation should the patient be moved from the ED without an admission order.*

## **B. Chest Pain Unit Admission (or Low Acuity Chest Pain Admissions).**

***What does this mean for the CPU, Stepdown, or Telemetry beds?** Low acuity chest pain admits will be coming to the CPU that typically will only have an initial ED evaluation, hold note, and standardized order set. The ED will track the availability of CPU beds and contact the Cardiology fellow if a CPU bed is available. In rare cases, the Cardiology fellow can re-direct CPU patients to either the CCU or IM team. The ED physician should then contact the CCU resident or the MOD (since the ED knows more about the patient). When the CPU reaches capacity, the ED should call the MOD for admission. The MOD will staff the patient with the Cardiology fellow and the patient will be admitted to either the CCU or IM team (business as usual – no ED hold note; no ED order set; MOD writes orders). These latter variations should be exceptions, and will be closely monitored since they subvert the intent of the pathway.*

### **How it works:**

**CPU admission:** *ER will call the Cardiology Fellow for all low acuity chest pain admissions when CPU beds are available. All patients must be chest pain free before being moved from the ER. If a CPU bed is available and during duty hours, patient will be admitted as usual to the CPU with a brief hold note and initial order set. H&P will be completed by the CPU Service along with additional order sets as required.*

*After duty hours, ER will call the Cardiology Fellow for all low acuity chest pain admissions when the CPU beds are available, and the patient will be admitted to the CPU with a brief hold note and initial order set. The H&P will be completed the following duty day by the CPU Service. Order set will state that if patient has chest pain, the ICU resident should be contacted; if troponins come back positive, Cardiology fellow should be contacted. Of note, Internal Medicine residents cannot be contacted for routine orders or evaluations since the CPU is now a*



“non-teaching service” and cross-coverage is not allowed by the Resident Review Committee. *If there is a requirement not in the order set that cannot wait until the arrival of the CPU Service at 0700, then the ER physician (or designate) should be contacted for order clarification on newly admitted patients or the Cardiology fellow for non-urgent issues.*

*If a CPU bed is not available, then the ED should call the MOD who will disposition the patient to either the CCU or Medicine Ward team after consultation with the Cardiology fellow. In this situation, the CCU resident or Medicine resident writes orders and assumes primary responsibility for the patient upon arrival to the Ward or CCU. The CCU resident or Medicine resident will complete the H&P and be available for all patient care issues.*

### **Goal: Efficient, Safe Throughput of ED Patients**

Target Population: CPU, MICU, CCU

#### Rules of Engagement

##### Order writing:

- For true direct admissions (CPU) – ED writes orders.
- If Medicine is given opportunity to evaluate patient in ED, Medicine writes orders (MICU, CCU, low acuity chest pain patients when CPU not available).

##### Contacts:

- ED must contact the Cardiology Fellow for every low acuity chest pain when CPU beds are available.
- ED contacts MOD for low acuity chest pain patients when CPU beds are unavailable.
- ED contacts bed coordinator and secures a bed on all pathway admissions. (since this is often a rate limiting step).
- No patient leaves the ED without an admission order.

##### Responsibility:

- Responsibility for patient shifts to Medicine once patient leaves ED (ED writes admitting order but to CPU Service/Attending).
- ED will always maintain some level of responsibility for adverse outcomes related to inappropriate triage or missed diagnosis.
- Cross-coverage after duty hours (see algorithm).

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