URGENT MATTERS:

IMPROVING SAFETY IN MASSACHUSETTS EMERGENCY DEPARTMENTS

A BETSY LEHMAN CENTER EXPERT PANEL REPORT

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for Patient Safety

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AN EXPERT PANEL REPORT

Safety risks exist in all medical care settings, but emergency medicine professionals face particular challenges as they strive to deliver the safest, highest quality care to their patients.

Massachusetts emergency departments rank high in a national review of ED quality and safety. Yet many frontline staff express concerns that the environment is not as safe as it needs to be for patients or staff. In response to these concerns from their members, leaders of the Massachusetts College of Emergency Physicians (MACEP) reached out to the Betsy Lehman Center to help facilitate work to improve safety in emergency departments across the state. The Massachusetts Emergency Nurses Association (MENA) and the Massachusetts Association of Physician Assistants (MAPA) joined as partners in the effort.

Through this collaboration, the Betsy Lehman Center convened an expert panel to identify key risks to safety in emergency departments, recommend practical steps for mitigating these risks, and develop a toolkit to support implementation of the recommendations.

Recognizing the broad range of safety issues facing emergency medicine clinicians and staff, the expert panel focused on interventions that could be executed from "within the four walls" of the emergency department in three key areas: (1) **crowding**; (2) **cognitive overload**; and (3) **care coordination**.

CHALLENGES TO SAFETY IN EMERGENCY MEDICINE

Almost 20 percent of adults in the United States visit an Emergency Department (ED) at least once a year, accounting for 145 million visits in 2016. By some estimates, nearly half (47.7 percent) of all hospital-based medical care is delivered in the ED and half of inpatient admissions come through the ED.

In Massachusetts:

- There were 3,144,308 patients visits to the emergency department in the most recent year for which data are available.
- Average volume of patient visits to EDs in the state ranges from under 50 patient visits per day in small community hospitals to over 300 per day in large, urban hospitals.
- The total number of visits to the emergency department per 1,000 residents declined by 6 percent between 2012 and 2017.
- Complexity of patients being seen in the ED is on the rise. For example, visits by patients with behavioral health conditions, increased 14 percent from 2012 to 2017.
- 23 percent of all medical visits to the ED in Massachusetts in 2016 resulted in an inpatient admission, long observation stay, or transfer.

A key challenge and risk to patient safety is crowding in EDs. Over 90 percent of EDs in the United States report that they experience routinely crowded conditions, and Massachusetts EDs are no exception. The primary driver of crowding is a lack of inpatient and outpatient capacity — there are too few inpatient beds to admit patients from the ED, and too few outpatient resources to meet the needs of lower acuity patients.

Crowding, in turn, impacts quality of care and patient outcomes, sometimes in profound ways. Patients in crowded EDs wait longer to be seen and are at heightened risk of leaving without treatment or having their condition worsen. Crowding has even been tied to costly downstream effects, such as increased inpatient length of stay and risk of death. It also contributes to stress, compassion-fatigue and burnout among ED staff and raises the risk of workplace violence.

Patient volume in the ED is unpredictable, and decisions must be made under significant time pressure, frequently with limited information, limited resources, and in the context of increasing patient complexity. Emergency department caregivers must contend with frequent interruptions, electronic medical records systems that disrupt clinical workflow, a staffing mix that varies day-to-day, and a need to task-switch in order to keep pace with patients' needs.

In this context, it is not surprising that adverse events occur. Studies estimate that:

- As many as six percent of all patients seen in an emergency department experience an adverse event.
- Most common errors are related to patient management, diagnosis and medications.
- Of the adverse events that occur in the ED, between 53 and 83 percent are likely preventable, compared to 21 to 51 percent for all hospital-based events.

In addition, it is worth noting that emergency physicians rank in the top-five list of most burnt-out clinical specialists, with 48 percent reporting that they feel burned-out in a recent survey. The same is true for emergency nurses, with 82 percent in one study reporting mid-to-high levels of burnout, causing many to consider leaving the profession. Since clinician burnout may contribute to adverse events as well as be exacerbated by them, care for the wellbeing of emergency medicine clinicians is an emerging priority.

We asked **Massachusetts ED** nurses, physicians and physician assistants**:**

When you think about caring for patients in your emergency department,

WHAT KEEPS YOU UP AT NIGHT?

"DELAYS IN PATIENT CARE"

"NOT ENOUGH TIME"

"EMR INEFFICIENCIES"

"MAKING AN ERROR BECAUSE I AM NOT AWARE OF THE FULL CARE PLAN"

"DID I DIAGNOSE THE PATIENT CORRECTLY AND DID I COMPLETE A THOROUGH EXAM?"

"FEAR OF BEING HURT BY MY PATIENTS"

"NUMBER OF PATIENTS WHO BOARD IN ED FOR LONG PERIOD OF TIME"

"THE DRIVE TO SHORTEN THROUGHPUT"

EXPERT PANEL ON IMPROVING SAFETY IN EMERGENCY MEDICINE

The 14 members of the expert panel represent a wide variety of perspectives and roles in and around the emergency department, including patients, physicians, pharmacists, nurses, physician assistants, emergency medicine technicians and administrators. Guided by a small steering committee of health care leaders in Massachusetts, the panel met monthly from July 2018 through June 2019 to develop its findings and recommendations. The panel's work was informed by surveys about safety risks in the ED setting sent to members of MACEP, MENA and MAPA, ensuring the inclusion of as many voices from the frontline ED provider community as possible. In addition, many Massachusetts hospitals contributed their own proven strategies for mitigating safety risks in the ED to the toolkit.

KEY PANEL FINDINGS AND RECOMMENDATIONS

The Expert Panel identified three overarching patient safety challenges in Massachusetts EDs. All three affect the emergency department in unique ways, though they are not unique to the field of emergency medicine. Similarly, robust solutions to the problems are cross-cutting and cannot always be fully addressed within the emergency department. That said, the panel strived to identify recommendations and strategies that may be implemented by the ED without significant investment of time and resources by other hospital departments.

"The daily challenges that we face in the ED—the crowding, the time pressure, the unpredictable flow of patients—pushes us as a discipline to be flexible, creative and innovative. That's just one thing that's exciting about working in emergency medicine."

- Emergency nurse, MENA member

"The volume of older, sicker, more complicated patients is increasing and we know that the numbers of these patients will be going up significantly over the next decade."

- Emergency physician, MACEP member

I. CROWDING

Crowding is the condition that "occurs when the identified need for emergency services exceeds available resources for patient care in the emergency department, hospital, or both" and is a common and persistent experience in Massachusetts emergency departments. Crowding contributes to various patient safety risks, including delayed triage and treatment, patients leaving without being seen, medication-related errors, communication errors between units, failure to rescue or reassess, patient falls, and intentional injuries.

Opportunities to reduce crowding:

- Optimize patient flow within the ED to reduce crowding;
- Implement resource and personnel management policies to mitigate risks during times of peak crowding; and
- Explore alternatives to traditional inpatient admissions.

Over

90%

of emergency departments in the United States report that they experience routine crowding
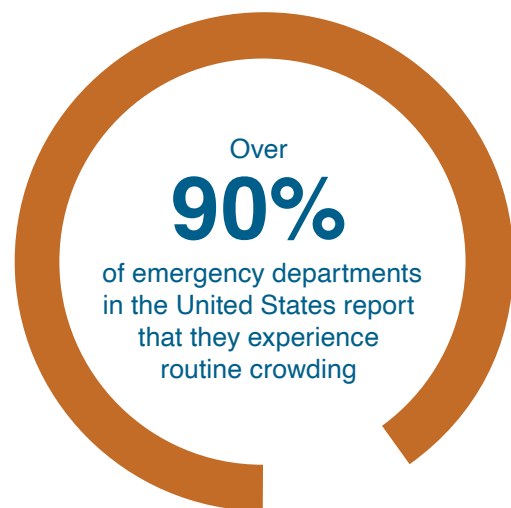
SOURCE: American College of Emergency Physicians, 2016.

"Emergency medicine is a team discipline, so the solutions must be multidisciplinary, too."

- Emergency nurse, MENA member

II. COGNITIVE OVERLOAD

Cognitive overload is a challenge that many emergency medicine professionals experience as they manage patients while sorting through an overwhelming amount of information from patients, colleagues, and the electronic health record system. Compounding the challenge is that members of the clinical team experience frequent interruptions that cause them to task-switch, increasing the risk that an error will occur. Cognitive overload contributes to numerous patient safety risks, including missed or delayed diagnosis and treatment, medication errors and inappropriate or unnecessary treatment or procedures.

Opportunities to reduce cognitive overload:

- Adopt strategies to limit interruptions, especially during the execution of complex and critical tasks by differentiating between high- and low-acuity messages;

- Support all members of the care team to practice at the top of his/her license by rebalancing tasks, eliminating extraneous tasks or realigning tasks to appropriate personnel resources, including non-clinical team members;

- Adopt and actively promote the use of cognitive job aids to reduce the amount of working memory necessary for common tasks;

- Optimize use of the electronic health records (EHR) system to reduce cognitive burden posed by EHR system;

- Adopt a team-based approach that focuses on situational awareness and shared responsibility for patient safety; and

- Support clinical staff in engaging in self-care as a way to improve a provider's ability to manage their cognitive load.

III. POST-ED CARE COORDINATION

Post-ED care coordination is essential for patients, but often difficult for busy EDs to manage given the time needed to provide effective discharge instructions and establish a follow-up plan. Care coordination is especially important for vulnerable patient populations such as the frail elderly, medically or socially complex patients, and pediatric patients. Patients leaving the ED for home or another community setting with an inadequate follow-up plan are at risk of missing critical medical appointments, taking medications incorrectly, having their condition worsen, or revisiting the ED.

Opportunities to improve post-ED care coordination:

- Review new and changed medications prior to discharge to ensure that patients will be taking the appropriate medications upon discharge;

- Develop a standardized discharge process for patients who are being discharged to home or another community setting;

- Take steps to ensure that patients and their caregivers receive effective education, including education at the appropriate reading level and language, as part of the discharge process;

- Identify patients who may have social or medical needs that impede their ability to access follow-up care;

- Develop a process to reach patients who have been discharged recently to ensure that if they have any questions about their ED stay or follow-up care, a clinician at the hospital can help them get the answers;

- Develop a process to follow-up on results that are pending at discharge (e.g. follow up nurses) to ensure that results are reviewed and communicated to the patient; and

- Utilize existing digital tools to help ensure that information about the patient's ED visit is documented in a timely fashion and available for the follow-up provider.

In conjunction with this report, the Expert Panel is releasing a set of strategies that track to each of its recommendations. Illustrative case studies and tools are also included to help emergency medicine teams implement the strategies.

For more information, please visit **BetsyLehmanCenterMA.gov/EDsafety**

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INTRODUCTION

The emergency department is a "complex system, optimized to operate on the edge of chaos."[1] Each year, emergency departments across the United States are visited over 145 million times by patients of all ages and with all levels of acuity.[2] Over the course of a year, almost 20 percent of the US adult population is seen in an ED.[3] In Massachusetts, patients seek care in the emergency department at a higher rate than the national average, though the gap narrowed from 2011-2016.[4] On average, 50 to 75 percent of patients admitted to the hospital come through the emergency department.[5]

The working environment in an emergency department is unlike any other medical setting. Patient volume in the ED is unpredictable and decisions must be made under significant time pressure, frequently with limited information, limited resources, and in the context of increasing patient complexity. Emergency department caregivers must contend with frequent interruptions,[6] electronic medical records systems that disrupt clinical workflow, a staffing mix that varies day-to-day, and a need to task-switch in order to keep pace with patients' needs.[7]

In addition to the stressors inherent to the working environment in the ED, clinicians must also cope with a shift-work schedule that often calls for disruption of normal sleep patterns and offers only limited opportunities for meal and restroom breaks. Sleep deprivation not only impacts the health and well-being of the emergency department staff,[8] but may also impact the quality of care provided to patients.[9] Not surprisingly, emergency physicians rate as the most burned out (59 percent) of any clinical specialty group. Like sleep deprivation, burnout contributes to poorer outcomes for patients and a greater likelihood of attrition.[10] Nurses who work in the ED show higher rates of burnout compared to their colleagues in other areas of medicine, with 82 percent in one study reporting mid-to-high levels of burnout, causing many to consider leaving the profession altogether.[11]

In this context, it is not surprising that adverse events occur. Studies estimate that:

- As many as six percent of all patients seen in an emergency department experience an adverse event.[12]
- Most common errors are related to patient management, diagnosis and medications.[13]

- Of the adverse events that occur in the ED, between 53 and 83 percent are likely preventable, compared to 21 to 51 percent for all hospital-based events.[14]
- Of those adverse events that are preventable, a greater number were among the discharged population (71.4 percent) compared to those who are admitted (41 percent).[15]

Compared to other departments in the hospital, EDs are significantly less able to control the timing, volume, or length of patient visits. The ED must manage variability in patient flow depending on time of day, week and season and is also vulnerable to fluctuations in community outpatient capacity and the hospital's inpatient bed capacity.[16,17]

EXPERT PANEL ON IMPROVING SAFETY IN EMERGENCY MEDICINE

Massachusetts emergency departments rank high in a national review of ED quality and safety, according to the American College of Emergency Physicians. Yet many front line staff express concerns that the environment is not as safe as it needs to be for patients or staff. In response to these concerns from their members, leaders of the Massachusetts College of Emergency Physicians (MACEP) reached out to the Betsy Lehman Center to help facilitate improvement in the safety of EDs across the state. The Massachusetts Emergency Nurses Association (MENA) and the Massachusetts Association of Physician Assistants (MAPA) joined as partners in the effort.

Through this collaboration, the Betsy Lehman Center convened an expert panel to identify key risks to safety in emergency departments, recommend practical steps for mitigating these risks, and develop a toolkit to support implementation of the recommendations. The 14 members of the panel represent a wide variety of perspectives and roles in and around the ED, including patients, physicians, pharmacists, nurses, physician assistants, emergency medicine technicians and administrators. Guided by a small steering committee of health care leaders in Massachusetts, the panel met monthly from July 2018 through June 2019 to develop its findings and recommendations. The panel's work was informed by surveys about safety risks in the ED setting sent to members of MACEP, MENA and MAPA. In addition, many area hospitals contributed their own proven strategies for mitigating safety risks in the ED to the online toolkit that accompanies this report.

EMERGENCY MEDICINE SAFETY IN MASSACHUSETTS

Although emergency departments, like all clinical environments, experience patient safety risks, there are limited data to help quantify the types of harm and degree of risks that currently exist in Massachusetts. To help bridge this gap and in support of this initiative, the Expert Panel relied on a number of sources of information, including:

1. A survey of frontline emergency medicine providers in Massachusetts conducted with support of the MACEP, MAPA and MENA in 2017;

2. A summary of Serious Reportable Events (SREs) from Massachusetts emergency departments from 2011-2016; and

3. An analysis of patient safety incidents in Pennsylvania emergency departments from 2011-2016.

2017 EMERGENCY MEDICINE WORKFORCE SURVEY

The Betsy Lehman Center conducted online surveys of members of three professional organizations, MACEP, MENA, and MAPA, to solicit perspectives from frontline workers regarding adverse events and other issues related to caring for patients who enter the hospital through the emergency department.[18] The survey responses highlighted concerns related to extended "boarding" of patients in emergency departments, a practice whereby "a patient remains in the emergency department after the patient has been admitted or placed into observation status at the facility, but has not been transferred to an inpatient or observation unit."[19] Respondents cited other conditions that make for a crowded, time-pressured environment and described needs and opportunities to improve systems and processes to ensure safe and reliable care — both within and beyond emergency departments.

The following tables summarize respondents' rankings of the most prevalent adverse events and contributing factors in the ED. (See Appendix for additional details.)

MOST COMMON ADVERSE EVENTS

RANKING	MACEP	MAPA	MENA
1	Delayed or missed care in the ED	Delayed or missed care in the ED	Violence or abuse against staff
2	Patient left without being seen	Diagnostic error (missed/delayed/incorrect diagnoses)	Delayed or missed care in the ED
3	Violence or abuse against staff	Patient left without being seen	Patient left without being seen
4	Diagnostic error (missed/delayed/incorrect diagnoses)	Discharge of patient without adequate instructions or plan for follow-up treatment	Inadequate pain management
5	Medication errors	Healthcare-associated infections	Falls with injury

MOST COMMON CONTRIBUTING FACTORS TO ADVERSE EVENTS

RANKING	MACEP	MAPA	MENA
1	Boarding of behavioral health patients	Overcrowding	Boarding of behavioral health patients
2	Boarding of medical/surgical patients	Boarding of behavioral health patients	Overcrowding
3	Overcrowding	Patient left without being seen	Boarding of medical/surgical patients
4	Time-pressured environment	Boarding of medical/surgical patients	Understaffing
5	Understaffing	High productivity expectations	Time-pressured environment

SERIOUS REPORTABLE EVENTS IN MASSACHUSETTS EMERGENCY DEPARTMENTS

In addition to the workforce survey, the Betsy Lehman Center reviewed Serious Reportable Events (SREs) that occurred in emergency departments from January 2011-October 2016 as reported to the Department of Public Health by Massachusetts hospitals. Serious reportable events are defined by the National Quality Forum as events belonging to one of 28 categories events and by state regulation must be reported by hospitals and ambulatory surgery centers to the Massachusetts Department of Public Health.[20] While SREs are likely under-reported, they are useful as "signal" data for understanding system-wide risks.

The incidence and contributors to ED-associated SREs, as summarized in the table below, reveal both consistencies and gaps between clinicians' perceptions of risk and the types of adverse events that hospitals actually report.

For instance, while falls with serious injury are by far the most frequently-reported SRE in the ED, emergency physicians, nurses and physicians assistants perceive the incidence of falls to be outside of the five most common adverse events. Similarly, patient self-harm events represent 11 percent of ED-associated SRE reports, but do not even appear among the top 10 most common adverse events in the ED physician survey results. The role of boarding and a time-pressured environment are reflected in both the survey results and SRE analysis.

The state of Pennsylvania collects significantly more data about adverse events and other patient safety incidents from health care providers than does Massachusetts. The Pennsylvania Patient Safety Authority generously shared its analysis of recent ED-related incidents, which also informed the panel's understanding of key contributors to safety risks. (See Appendix.)

MOST COMMON SERIOUS REPORTABLE EVENTS AND CONTRIBUTING FACTORS IN MASSACHUSETTS EMERGENCY DEPARTMENTS
January 2011 - October 2016

Types of SREs in the ED	Hospital-identified contributors to SREs in the ED
• Falls (n=155, 53%)	• SREs involving boarded patients (n=27)
• Medication errors (n=34, 12%)	• Patient harm partially or fully attributable to poor communication during transitions or handoff (n=18)
• Self-injuries (n=33, 11%)	• Patient self-harm due to unsafe environments within the ED (n=10)
• Physical assaults (n=26, 9%)	• Medication error partially or fully attributable to electronic dispensing or ordering practices (n=7)
	• Equipment failures (n=5)

KEY CHALLENGES IN EMERGENCY MEDICINE

Taking into account the workforce survey, data from ED-related SREs, published literature regarding patient safety in the ED and their own experience working in Massachusetts EDs, the Expert Panel members identified three overarching patient safety challenges that emergency medicine professionals face in Massachusetts.

I. CROWDING

Crowding "occurs when the identified need for emergency services exceeds available resources for patient care in the emergency department, hospital, or both"[21] and is a common and persistent experience in Massachusetts emergency departments.[22] Crowding contributes to various patient safety risks, including delayed triage and treatment, patients leaving without being seen, medication-related errors, communication errors between units, failure to rescue or reassess, patient falls, and intentional injuries.

II. COGNITIVE OVERLOAD

Many emergency medicine professionals experience cognitive overload as they manage a large number of patients while sorting through the vast amount of information they receive from patients, colleagues, family members, bystanders, and the electronic health record system. Compounding the challenge of processing all the information is that members of the clinical team experience frequent interruptions that cause them to task-switch, increasing the risk that an error will occur. Cognitive overload contributes to numerous patient safety risks, including missed or delayed diagnosis and treatment, medication errors and inappropriate or unnecessary treatment or procedures.

III. POST-ED CARE COORDINATION

Though often essential, busy EDs can't always find the time to provide effective discharge instructions and establish a follow-up plan for patients. Care coordination is especially important for vulnerable patient populations such as frail older adults, medically or socially complex patients, and pediatric patients. Patients leaving the ED for home or another community setting with an inadequate follow-up plan are at risk of missing critical medical appointments, taking medications incorrectly, having their condition worsen, revisiting the ED, or even death.

I. CROWDING

Emergency department crowding was identified as a problem in Massachusetts hospitals more than 20 years ago and remains a persistent challenge despite numerous statewide policy and hospital-based practice improvement initiatives.[23] ED crowding is associated with a variety of negative outcomes[24] including increased morbidity and mortality among patients,[25] increased inpatient length of stay,[26] increased rates of preventable medical errors[27] and decreased satisfaction among emergency department patients and staff.

Crowding increases stress among staff and patients, raising the risk of intentional and unintentional injuries to staff and patients. Crowding also contributes to negative downstream outcomes such as increased mortality and longer inpatient length of stay.

Acknowledging that ED crowding is largely caused by forces outside the control of those working in emergency departments today – such as hospital capacity constraints, allocation of hospital resources, and admissions processes that lead to boarding of admitted patients in the ED – this section will focus on strategies that care teams may implement within the ED to mitigate the patient safety risks posed by crowding.[28]

SAFETY RISKS

Safety risks associated with crowding include:

- Patients leave without being seen[29]
- Delayed triage and treatment[30]
- Orders and medication related errors[31]
- Communication errors between units
- Failure to rescue or reassess
- Intentional injuries[32]
- Patient falls

RECOMMENDATIONS

While recognizing that crowding is an issue that ultimately will require systems- and policy-level changes to eliminate, the harmful effects of crowding in emergency departments can be mitigated using some of the following methods:

1. Optimize patient flow within the ED to reduce crowding.

   ### Strategies:

   - **Point of care testing:** Establish a point-of-care testing lab in the ED to process a limited set of routine tests to speed results and diagnosis.[33]

   - **Split flow structure (also called "streaming"):** Split patients into groups based on their condition and treatment needs, which allows separate teams to tend to patients based on acuity, reducing length of stay for low-acuity patients.[34]

   - **Fast track:** Establish a "fast-track" area for patients with the lowest acuity scores,[35] enabling them to be treated and released faster while also allowing the ED team to focus more time on higher-acuity patients.[36]

   - **Vertical patient flow model:** Create more capacity during peak times using vertical flow, a split flow model that replaces traditional ED beds with recliners for patients with lower acuity scores (ESI-3 or lower). The use of recliners increases capacity and reduces length of stay for these patients.[37]

   - **Designate an ED flow coordinator:** Use a coordinator who is empowered to expedite and facilitate the movement of patients through the ED to reduce length of stay and percent of patients who leave without being seen.[38]

2. Activate resource and personnel management policies to mitigate risks during times of peak crowding.

Strategies:

- **Operationalize the ED's Code Help policy:** Use the hospital's Code Help policy to temporarily reduce strain caused by crowding by bringing other hospital resources to the aid of the ED.

- **Pursue an aggressive bed management strategy within the entire institution:** Utilize a "bed czar" or other mechanism that facilitates the use of inpatient beds to alleviate ED crowding during peak times.

- **Explore implementation of hallway boarding:** Board stable ED patients in hallways on inpatient floors during times of crowding to reduce congestion in the emergency department.[39]

3. Explore alternatives to traditional inpatient admissions.

Strategies:

- **Hospital at Home:** Discharge patients with certain conditions from the ED to their homes with inpatient level care rather than admitting to the hospital.[40]

- **Mobile integrated health or community paramedicine:** Utilize mobile integrated health or community paramedicine to provide urgent treatment and, if appropriate, avoid an ED visit.[41]

II. COGNITIVE OVERLOAD

The working environment in an emergency department is unlike any other medical setting. Patient volume in the ED is unpredictable and often overwhelming, and decisions must be made under significant time pressure, frequently with limited information, limited resources, and in the context of increasing patient complexity. In addition, like other medical professionals, emergency department clinicians must contend with frequent interruptions,[42] electronic medical records systems that disrupt clinical workflow, a staffing mix that varies day-to-day, and a need to task-switch in order to keep pace with patients' needs.[43]

Under these conditions, ED clinicians are challenged to maintain their focus, increasing the risk that an error will occur. The challenges associated with processing and acting on information in a busy emergency department can be better understood through the principles of cognitive load theory, which proposes that human memory is divided into three parts: sensory memory, long term memory and working memory.[44] While sensory and long term memory perform important functions, working memory is used to complete current tasks. This aspect of working memory is limited in that it can only hold a small amount of information at any given time and that information is easily forgotten.[45] Working memory is burdened by both intrinsic load - the weight or complexity of a particular task – and extraneous load – the way that the information is presented to the clinician making the decision or completing the task.[46] When working memory gets overloaded, performance suffers, and in the context of medical care, patient outcomes may suffer as well.[47] The proposed recommendations below seek to reduce the burden on working memory, freeing clinicians to execute tasks and make complex diagnostic and treatment decisions.

SAFETY RISKS

Safety risks associated with crowding include:

- Missed or delayed diagnosis and treatment
- Medication errors[48]
- Inappropriate or unnecessary treatment or procedures

RECOMMENDATIONS

In order to reduce the safety risks associated with cognitive overload among emergency department clinicians in Massachusetts, hospitals can:

1. Adopt strategies to limit interruptions, especially during the execution of complex and critical tasks by differentiating between high- and low-priority information.

   Strategies:

   - **Develop interruption guidelines** to address preventable interruptions and educate staff about the harms of unnecessary interruptions.[49]

   - **Assign tasks that cause frequent interruptions** (e.g., transfers/lab follow-up) to one team member per shift and realign other tasks so that the assigned team member can focus on only those tasks.

   - **Set certain off-limit times/zones** for clinicians during critical times, such as medication prescribing[50] and administration,[51] sign-off[52] and discharge to enable more reliable execution of these critical tasks.

   - **Use tools for communication of non-urgent messages** (e.g., an electronic whiteboard[53] or secure text applications[54]) that clinicians may check when they have the opportunity rather than breaking their task.

2. Support all members of the care team to practice at the top of his/her license by rebalancing tasks, or realigning tasks to appropriate personnel resources, including non-clinical team members.

   Strategies:

   - **Implement a scribe program:** Medical scribes assist with documentation, reducing the amount of time physicians must spend at the electronic health record and increasing time for direct patient care.[55] Emergency departments may use scribes to document, perform order entry, admit/discharge, request consults, pull-up prior patient data, and alert providers to new/important information.

- **Use the pharmacy team** to assist with medication selection and safety, care of critically ill patients, antimicrobial stewardship, and calculation of weight-based dosing.[56] Studies show that having a pharmacist on staff in the ED may reduce medication errors by two-thirds.[57]

- **Use pharmacy technicians** to complete medication histories and medication reconciliation. This has been shown to both increase accuracy of medication histories and reduce medication errors by as much as half.[58,59]

- **Use paramedics within the ED** to complete tasks such as triage, starting IVs, and offloading patients from arriving Emergency Medical Services units.[60]

3. Adopt and actively promote the use of cognitive job aids to reduce the amount of working memory necessary for routine tasks.

   Strategies:

   - **Identify and implement key clinical pathways** that are up-to-date and readily accessible to clinicians to help guide triage and treatment of patients.[61,62]

   - **Use kits or carts** for select procedures to reduce the need for hunting and fetching of materials and equipment, enabling providers to stay focused on performing the procedure.

   - **Implement checklists** for use during procedures that are high-risk but infrequently performed to reduce the risk of complications.[63,64]

4. Optimize use of the electronic health records (EHR) system to reduce cognitive burden posed by the EHR system itself. Emergency medicine physicians report spending approximately 23 to 65 percent of their clinical time completing electronic documentation in the EHR.[65,66]

   Strategies:

   - **Adopt only clinically validated EHR reminders** to prevent interruptions that are clinically meaningless and poorly targeted.[67]

   - **Establish an EHR governance structure** to consult with clinical end-users, monitor use of alerts and complete a periodic reassessment to ensure that they are clinically appropriate and relevant.

5. Adopt a team-based approach that focuses on situational awareness and shared responsibility for patient safety.[68]

Strategies:

- Use **huddles at key times** to ensure communication of important information.[69]

- **Implement hard-stops** at discharge/prior to admission.

- Promote **awareness among team members** of each other, in particular their identified roles/responsibilities and experience level.

6. Support clinical staff in engaging in self-care to improve their ability to manage their cognitive load.

Strategies:

- Implement a **peer-support program**.

- Use **hospital wellness resources** to provide specific support to ED clinical teams.

- Adopt scheduling strategies that allow ED clinical teams **time to meet basic needs**, including meals, restroom breaks and lactation.

III. POST-ED CARE COORDINATION

Care coordination is essential for patients, but often difficult for busy EDs to manage given the time needed to provide effective discharge instructions and establish a follow-up plan.[70] This is especially true for patients who are being discharged from the ED to their home or to another community setting. According to the Agency for Health Care Research and Quality, the ED discharge process should achieve three basic functions: (1) communicate with and educate patients; (2) support post-ED discharge care and (3) coordinate care with other providers.[71] Care coordination can help ease this transition and ensure that critical information and resources are available so patients are able to obtain the follow-up care they need.

SAFETY RISKS

Specific risks accrue for patients who are discharged home after an emergency department visit. These risks include:

- Lack of necessary follow-up to ensure treatment of identified medical condition;

- Lack of follow-up on test results obtained after a patient has been discharged;[72]

- Medication-related errors[73]

These risks lead to poorer outcomes for patients, including worsening of medical conditions and the need to return to the ED for additional care and possible admission to the hospital.

WHAT IS CARE COORDINATION?

Care coordination is the deliberate organization of patient care activities between two or more participants (including the patient) involved in a patient's care to facilitate the appropriate delivery of health care services. Organizing care involves the marshalling of personnel and other resources needed to carry out all required patient care activities, and is often managed by the exchange of information among participants responsible for different aspects of care. (Agency for Healthcare Research and Quality, 2014)

RECOMMENDATIONS

To help ensure that patients who are discharged to the community have a successful transition, all hospitals in Massachusetts can:

1. Review new and changed medications prior to discharge.

2. Develop a standardized discharge process for patients going home or to another community setting.

   Strategies:

   - Use a **checklist** to ensure each step of the discharge process is completed.

   - Use a **standardized discharge form** for patients who are headed home.

3. Ensure that patients and their caregivers receive effective education at the appropriate reading level and language as part of the discharge process.[74]

   Strategies:

   - Use the **teach-back method** to help ensure patient and family comprehension of the most important elements of their discharge instructions.[75]

   - Implement a **time-out at discharge** to allow for protected time for the care team and patient/family members during discussion of discharge instructions.

4. Identify patients who may have social or medical needs that impede their ability to access follow-up care.[76]

   Strategies:

   - Utilize **screening tools** that help to identify high-need patients and coordinate with care managers to address needs prior to discharge.[77,78]

   - Use **digital platforms** (e.g., Collective Medical, Patient Ping) to help gather information about patients who have been previously screened as having special medical or social needs.

   - Use **specialized team members** (e.g., community health workers, care coordinators, community paramedics, navigators) or systems (e.g. mobile integrated healthcare) to help with screening and discharge planning for high-need patients.

   - Develop and periodically update **special discharge strategies** for high-need patients.

5. Conduct outreach to patients who have been discharged recently to ensure that if they have any questions about their ED stay or follow-up care, a clinician at the hospital can provide answers.

   Strategies:

   - Call or text message all recently discharged patients to screen for concerns.[79,80]

   - Use **post-discharge home visits** or mobile integrated healthcare to provide follow-up to special populations.[81]

6. Develop a process to follow-up on test results that are pending at discharge (e.g. follow up nurses) to ensure they are reviewed and communicated to the patient.

   Strategies:

   - Utilize **electronic tools** to prompt follow-up on pending test results.[82]

   - Include list of **pending test results in discharge notes** to prompt follow-up.

7. Utilize existing digital tools to help ensure that information about the patient's ED visit is documented in a timely fashion and available for the follow-up provider.

In addition to these recommendations and suggested strategies, the Expert Panel reviewed a series of illustrative case studies and tools that can be found online at **BetsyLehmanCenterMA.gov/EDsafety**. The case studies were collected from emergency departments across the state and serve as examples of innovative strategies that may help improve ED safety.

APPENDIX: ADDITIONAL DATA

A. 2017 EMERGENCY MEDICINE WORKFORCE SURVEY

TABLE 1: TOP RANKED PATIENT SAFETY RISKS IN THE EMERGENCY DEPARTMENT

RANKING	MACEP	MAPA	MENA
1	Delayed or missed care in the ED	Delayed or missed care in the ED	Violence or abuse against staff
2	Patient left without being seen	Diagnostic error (missed/delayed/incorrect diagnoses)	Delayed or missed care in the ED
3	Violence or abuse against staff	Patient left without being seen	Patient left without being seen
4	Diagnostic error (missed/delayed/incorrect diagnoses)	Discharge of patient without adequate instructions or plan for follow-up treatment	Falls with injury
5	Medication errors	Healthcare-associated infections	Inadequate pain management
6	Discharge of patient without adequate instructions or plan for follow-up treatment	Violence or abuse against staff	Medication errors
7	Falls with injury	Medication errors	Discharge of patient without adequate instructions or plan for follow-up treatment
8	Inadequate pain management	Inadequate pain management	Diagnostic error (missed/delayed/incorrect diagnoses)
9	Healthcare-associated infections	Falls with injury	Patient self-harm events
10	Patient self-harm events	Patient not notified of critical lab results post-discharge	Healthcare-associated infections

TABLE 2: TOP 10 CONTRIBUTORS TO ADVERSE EVENTS IN THE EMERGENCY DEPARTMENT

RANKING	MACEP	MAPA	MENA
1	Inefficient ED processes and workflows	Inefficient ED processes and workflows	Inefficient ED processes and workflows
2	Difficulties related to electronic health records	Lack of available medical history, including current medications	Staff turnover
3	Inadequate communication/hands-off btw. ED staff and other depts./external providers	Staff turnover	Inadequate communication/hands-off btw. ED staff and other depts./external providers
4	Staff turnover	Under-triage	Inadequate communication or hands-off among staff
5	Lack of available in-house or on-call specialists	Inadequate communication or hands-off among staff	Insufficient orientation of new clinical staff
6	Lack of available medical history, including current medications	Inadequate communication/hands-off btw. ED staff and other depts./external providers	Staff reluctance to speak up about safety observations or concerns
7	Inadequate communication or hands-off among staff	Inadequate teamwork among staff	Lack of available medical history, including current medications
8	Inadequate teamwork among staff	Insufficient overnight staff by attending physicians	Sign off processes that delay discharge
9	Under-triage	Lack of available in-house or on-call specialists	Inadquate teamwork among staff
10	Lack of available diagnostic support (ultrasound, MRI, other imaging)	Sign off processes that delay discharge	Under-triage

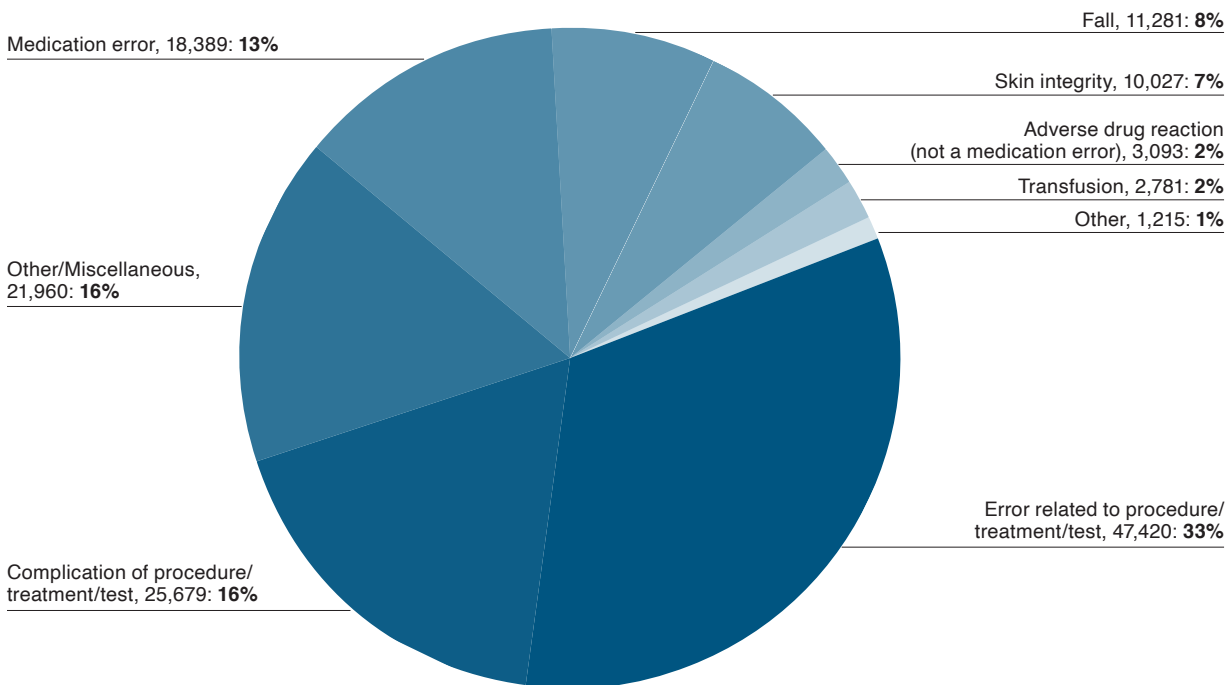### B. PENNSYLVANIA PATIENT SAFETY AUTHORITY DATA

The Betsy Lehman Center often turns to its counterpart in Pennsylvania to access more robust patient safety incident datasets. The Pennsylvania Safety Authority (PSA) receives close to 300,000 reports of safety incidents and near misses in Pennsylvania hospitals and ambulatory surgery centers each year. We believe that Pennsylvania's health care system is similar enough to Massachusetts to make its data useful to our understanding of likely systemic patient safety risks here.

LONGITUDINAL ANALYSIS

The PSA agreed, at the Center's request, to review their ED-related event reports for a 5-year period, from 2011 to 2016. The following is not broken down by component, but by adverse event type. Errors related to a procedure, treatment, or a test make up the majority of the over 140,000 events submitted to the PSA. This type includes errors like wrong side procedures, tests being ordered and not performed, or a delay in service.

FREQUENCY OF EVENT TYPES IN THE EMERGENCY DEPARTMENTS

Submitted to the Pennsylvania Safety Authority, 2011-2016 (N=141,890)

Fall, 11,281: **8%**

Skin integrity, 10,027: **7%**

Adverse drug reaction (not a medication error), 3,093: **2%**

Transfusion, 2,781: **2%**

Other, 1,215: **1%**

Medication error, 18,389: **13%**

Other/Miscellaneous, 21,960: **16%**

Complication of procedure/ treatment/test, 25,679: **16%**

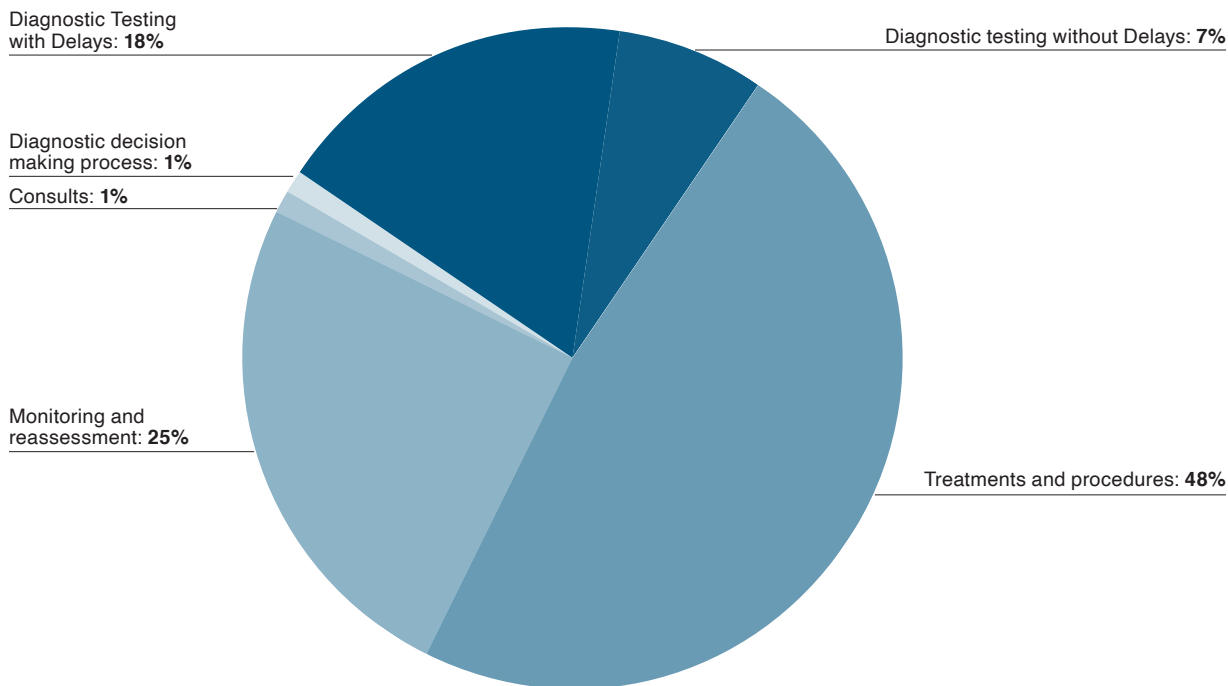Error related to procedure/ treatment/test, 47,420: **33%**

PSA EMERGENCY DEPARTMENT (ED) REPORTS

In 2013, the PSA issued a series of reports analyzing that year's incident data from Pennsylvania hospital EDs, applying a three-phase framework that they had previously established in 2010. Each phase covers a time period of the ED visit:

PHASE I	PHASE II	PHASE III
Patient Arrival in the emergency department (ED) to Diagnostic Evaluation	Diagnostic Evaluation through Disposition Decision	Disposition Decision to Departure from the ED
Includes: • Patient arrival in the ED • Patient triage • Placement in the treatment area • Practitioner arrival/initial assessment • Practitioner arrival/initial assessment	**Includes:** • Treatments and procedures • Diagnostic testing • Monitoring and reassessment (including continued physician and nursing assessments) • Consults • Diagnosing (including medical decision making) • Disposition decision	**Includes:** • Monitoring patient until bed or unit is available or until the patient is discharged • Communication or handoff to next facility, unit, or care setting • Patient teaching and discharge • Transportation or transfer
Patient safety hazards: • Patients who leave without triage • Unmonitored patients in the waiting area • Rushed or inaccurate triage process • Patients who leave without being seen • Unmonitored patients in rooms • Rushed, incomplete, or inaccurate patient assessments	**Patient safety hazards:** • Patients who leave without being seen, leave without treatment, or leave against medical advice • Unmonitored patients in the treatment room • Errors in ordering, executing, and resulting • Rushed, incomplete, or inaccurate patient assessment • Diagnostic decision errors of failure to diagnose	**Patient safety hazards:** • Gaps in treatment responsibilities and oversight • Unmonitored patients • Unmonitored boarders in the ED • Rushed, incomplete, or inaccurate patient assessment • Poor communication and handoffs • Incomplete patient and family education • Transportation or transfer difficulties

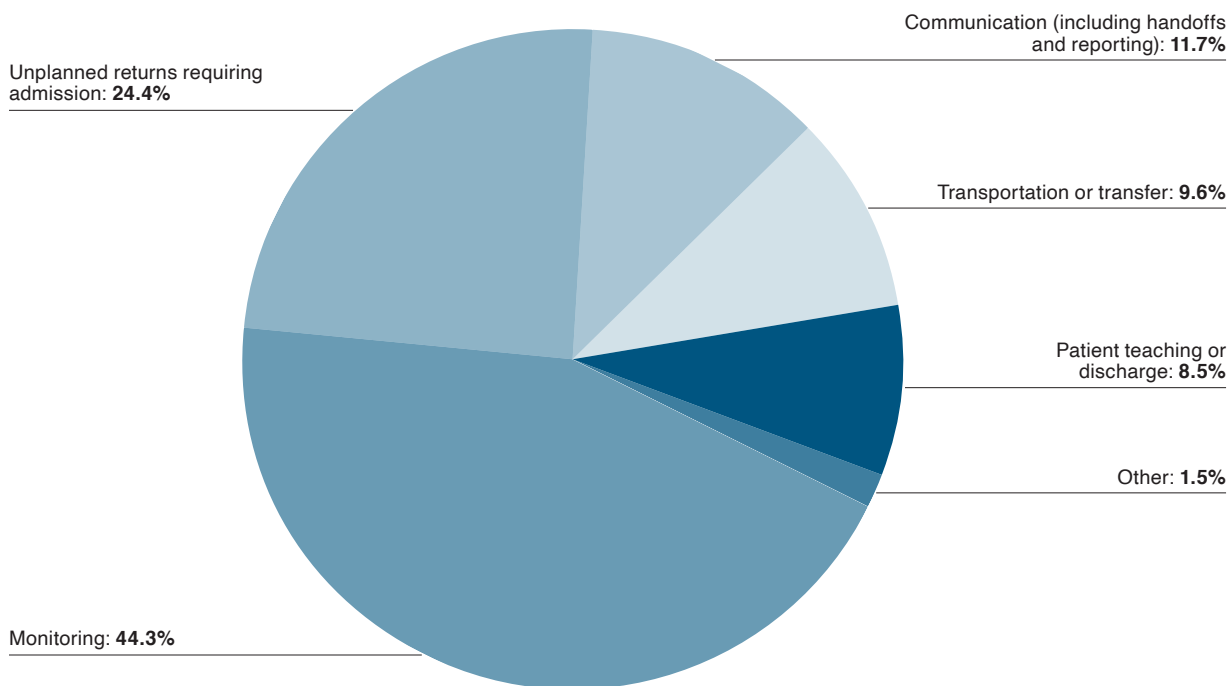## PERCENTAGE OF EMERGENCY DEPARTMENT FLOW PHASE II EVENT REPORTS, BY COMPONENT

Submitted to the Pennsylvania Safety Authority in calendar year 2013 (N=2,495)

Diagnostic Testing with Delays: **18%**

Diagnostic decision making process: **1%**

Consults: **1%**

Monitoring and reassessment: **25%**

Diagnostic testing without Delays: **7%**

Treatments and procedures: **48%**

ED Phase II Incident Component	Example
Treatments and procedures	The tech reported that the patient weighed 22 kg, which was [used to administer a weight-based medication]. Before giving the next medication, [staff] realized the patient weighed 22 pounds not kg. The [electronic medical record] was corrected, and there were no adverse reactions.
Diagnostic testing with delays	A patient had an EKG [electrocardiogram] performed, which was read by the resident. The EKG was misplaced. It was not until the final reading of the EKG, which was available electronically [about two days] later, that it was discovered that the EKG was [abnormal].
Diagnostic testing without delays	Respiratory therapist drew an ABG [arterial blood gas], which resulted in a large hematoma formation.
Consults	A [cardiac arrest alert] was called. Calls were placed to two different cardiologists who stated they were not on call. This resulted in a 12-minute delay in getting the patient to the catheter lab.
Diagnostic decision making process	A patient was diagnosed with hypertension and Bell palsy. Patient returned with no control of right arm, and CT scan [showed] an infarct in left frontal parietal region.

PERCENTAGE OF EMERGENCY DEPARTMENT FLOW PHASE III EVENT REPORTS, BY COMPONENT

Submitted to the Pennsylvania Safety Authority in calendar year 2013 (N=540)

Communication (including handoffs and reporting): **11.7%**

Unplanned returns requiring admission: **24.4%**

Transportation or transfer: **9.6%**

Patient teaching or discharge: **8.5%**

Other: **1.5%**

Monitoring: **44.3%**

ED Phase III Incident Component	Example
Monitoring	Patient was sitting up in the chair awaiting transport back to nursing home. RN [registered nurse] near the room heard a thump and found the patient lying against the wall complaining of left arm pain.
Unplanned returns requiring admission	A [pediatric] patient was seen in the ED for nausea and vomiting and decreased urine output. The patient was discharged with a [gastrointestinal infection] diagnosis and given a prescription. The parents brought the patient back with worsening symptoms, and [the patient] was admitted.
Communication (including handoffs and reporting)	There was a delay in transferring the patient to the inpatient unit. There was confusion about the admission orders, and poor communication led to a delay in medication administration. The medication was administered once the error was discovered.
Transportation or transfer	The patient was admitted with a [respiratory diagnosis] and was transported to CAT scan and ultrasound prior to being transported to the unit. The patient was to be on oxygen continuously but was transported without it. On arrival to the floor, [the patient's] oxygen saturation was in the 70s, [his] heart rate was tachycardic, and [he] was complaining of chest [tightness]. Oxygen was immediately applied and [he] received an EKG [electrocardiogram], lab work, and breathing treatment. [He] responded to treatment within a half hour.
Patient teaching or discharge	The patient was instructed [on the use of] crutches prior to disposition. The patient attempted to walk with crutches and fell and is [now] unable to bear weight on foot.
Other	Events that did not meet the criteria of the above classifications.

REFERENCES

1. Smith M and Feied C. The Emergency Department as a Complex System. New Engl Complex Syst Inst (2006). Available at: https://necsi.edu/the-emergency-department-as-a-complex-system. Accessed July 30, 2019.

2. Rui P, Kang K, Ashman JJ. National Hospital Ambulatory Medical Care Survey: 2016 emergency department summary tables. 2016. Available: https://www.cdc.gov/nchs/data/ahcd/nhamcs_emergency/2016_ed_web_tables.pdf. Accessed July 30, 2019.

3. Table 74; Emergency department visits within the past 12 months among adults aged 18 and over, by selected characteristics: United States, selected years 1997–2014. In: National Center for Health Statistics, Health United States, 2015. Hyattsville, MD, 2016. Available: https://www.cdc.gov/nchs/data/hus/hus15.pdf#074. Accessed July 30, 2019.

4. Health Policy Commission, 2017 Cost Trends Report Chart Pack. Available: https://www.mass.gov/files/documents/2018/03/28/2017%20CTR%20Chartpack.pdf. Accessed July 29, 2019.

5. Dawson H, Weerasooriya J, Webster G. Hospital admissions via the emergency department: Implications for planning and patient flow. *Healthc Q.* 2008;11:20–2.

6. While all medical professionals experience interruptions, it has been demonstrated that ED physicians are more likely to experience interruption. According to an observational study by Chisolm, et al, ED physicians were interrupted an average of 9.7 times per hour compared to 3.9 times per hour among primary care physicians. See, Chisolm CD, Dornfeld, AM, Nelson DR, Cordell WH. Work interrupted: A comparison of workplace interruptions in emergency departments and primary care offices. *Ann Emerg Med* August 2001;38:146-151.

7. The 2016 Model of the Clinical Practice of Emergency Medicine calls for emergency physicians to "prioritize and implement the evaluation and management of multiple patients in the emergency department, including handling interruptions and task switching, in order to provide optimal care." See Counselman FL, et al. *Journ. Of Emer. Med.* June 2017; 52(6): 846-849.

8. Smith-Coggins R, Broderick KB, Marco CA. Night shifts in emergency medicine: the American board of emergency medicine longitudinal study of emergency physicians. *J Emerg Med.* 2014 Sep; 47(3):372-8.

9. Lockley, SW, Barger LK, Ayas NT, et al. Effects of health care provider work hours and sleep deprivation on safety and performance. *Jt Comm J Qual Patient Saf.* 2007 Nov; 33(11) Supp.

10. Peckham C. Medscape Lifestyle Report of 2017: Race and Ethnicity, Bias and Burnout, January 11, 2017.

11. Hooper C, Craig J, Janvrin DR, et al. Compassion satisfaction, burnout, and compassion fatigue among emergency nurses compared with nurses in other selected inpatient specialties. *J Emerg Nurs* 2010 Sep; 36(5): 420-7.

12. Stang AS, Wingert AS, Hartling L, and Plint AC. Adverse events related to emergency department care: a systematic review. *PLoS One* 8(9): e74214.

13. Id at 4.

14. Id.

15. Id.

16. Bobrovitz N, Lasserson DS, Briggs AD. Who breaches the four-hour emergency department wait time target? A retrospective analysis of 374,000 emergency department attendances between 2008 and 2013 at a type 1 emergency department in England. *BMC Emerg Med* 2017 Dec;17(1):32.

17. Wargon M, Casalino E, Guidet B. From model to forecasting: a multicenter study in emergency departments. *Acad Emerg Med* 2010 Sep 1;17(9):970-978.

18. The workforce survey was sent via electronic mail to 885 MACEP members, 337 MAPA members and 898 MENA members. The response rates for each, respectively, were 10 percent, 14 percent and 10 percent.

19. American College of Emergency Physicians. Definition of Boarded Patient, Revised September 2018. Available at: https://www.acep.org/patient-care/policy-statements/definition-of-boarded-patient. Accessed July 11, 2019.

20. Massachusetts Department of Public Health. Serious Reportable Events (SREs) website. Available at: https://www.mass.gov/lists/serious-reportable-event-sres. Accessed July 22, 2019.

21. American College of Emergency Physicians, Crowding Policy Statement, Approved April 2019. Available: https://www.acep.org/globalassets/new-pdfs/policy-statements/crowding.pdf. Accessed July 11, 2019.

22. Litvak E, McManus ML, Cooper A. Root cause analysis of emergency department crowding and ambulance diversion in Massachusetts. A report submitted by the Boston University Program for the management of Variability in Health Care Delivery under a grant from the Massachusetts Department of Public Health, 2002.

23. Id.

24. Hoot NR, Aronsky D. Systematic review of emergency department crowding: causes, effects, and solutions. *Ann Emerg Med* 2008; 52:126-136.

25. Singer AJ, Thode HC Jr, Viccellio P, et al. The association between length of emergency department boarding and mortality, *Acad Emerg Med* 2011; 18(12): 1324-9.

26. Liew D, Liew D, Kennedy MP. Emergency department length of stay independently predicts excess inpatient length of stay. *Med J Aust* 2003; 177(9): 492-5.

27. Epstein SK, Huckins DS, Liu SW, et al. Emergency department crowding and risk of preventable medical errors. *Intern Emerg Med* 2012 Apr; 7(2): 173-80.

28. Bauchwitz B, Lynn S, Weyhrauch P, et al. Thematic issues in analysis and visualization of emergency department patient flow. Proceedings of the 2018 International Symposium on Human Factors and Ergonomics in Health Care. 132-139.

29. Baker DW, Stevens CD, Brook RH. Patients who leave a public hospital emergency department without being seen by a physician. Causes and consequences. *JAMA*. 1991;266:1085-1090.

30. Forero R, Hillman K. Access Block and Overcrowding: A Literature Review. The Simpson Centre-UNSW (prepared for ACEM) 2008:79.

31. Pham JC, Story JL, Hicks RW, et al. National study on the frequency, types, causes, and consequences of voluntarily reported emergency department medication errors. *Journ Emerg Med* 2011 May;40(5):485-492.

32. American College of Emergency Physicians. Fact Sheet on Emergency Department Violence. http://newsroom.acep.org/2009-01-04-emergency-department-violence-fact-sheet. Accessed July 20, 2019.

33. Asha SE, Chan ACF, Walter E, et al. Impact from point-of-care devices on emergency department patient processing times compared with central laboratory testing of blood samples: a randomised controlled trial and cost-effectiveness analysis *Emerg Med J* 2014;31:714-719.

34. Bish PA, McCormick MA, Otegbeye M. Ready-JET-go: split flow accelerates ED throughput. *J Emerg Nurs*. 2016;42(2):114-119.

35. Arya R, Wei G, McCoy JV, et al. Decreasing length of stay in the emergency department with a split emergency severity index 3 patient flow model. *Acad Emerg Med*. 2013;20(11):1171-1179.

36. Oredsson S, Jonsson H, Rognes J, et al. A systematic review of triage-related interventions to improve patient flow in emergency departments. *Scand J Trauma J Resusc Emerg Med*. 2011;19:43.

37. Wallingford G, Joshi N, Callagy P, et al. Introduction of a horizontal and vertical split flow model of emergency department patients as a response to overcrowding. *J Emerg Nurs* 2018 Jul; 44(4):345-352.

38. Murphy SO, Barth BE, Carlton EF, et al. Does an ED flow coordinator improve patient throughput? *J Emerg Nurs*, 2014.

39. Viccellio A, Santora C, Singer AJ, Thode HC, Henry MC. The association between transfer of emergency department boarders to inpatient hallways and mortality: a 4-year experience. *Ann Emerg Med* 2009; 54: 487-91.

40. Shepperd S, Doll H, Angus, RM, et al. Avoiding hospital admission through provision of hospital care at home: a systematic review and meta-analysis of individual patient data. *CMAJ* 2009 Jan 20; 180(2): 175-182.

41. Tadros AS, Castillo EM, Chan TC, et al. Effects of an emergency medical services-based resource access program on frequent users of health services. *Prehosp Emerg Care*. 2012;16(4):541–7.

42. While all medical professionals experience interruptions, it has been demonstrated that ED physicians are more likely to experience interruption. According to an observational study by Chisolm, et al, ED physicians were interrupted an average of 9.7 times per hour compared to 3.9 times per hour among primary care physicians. See, Chisolm CD, Dornfeld, AM, Nelson DR, Cordell WH. Work interrupted: A comparison of workplace interruptions in emergency departments and primary care offices. *Ann Emerg Med* August 2001;38:146-151.

43. The 2016 Model of the Clinical Practice of Emergency Medicine calls for emergency physicians to "prioritize and implement the evaluation and management of multiple patients in the emergency department, including handling interruptions and task switching, in order to provide optimal care." See Counselman FL, et al. *Journ. Emer. Med*. June 2017; 52(6): 846-849.

44. Van Merrienboer, Joroen JG, Sweller J. Cognitive load theory in health professional education: design principles and strategies. *Med Educ*. 2009 Dec; 44:85-93.

45. Miller D. My brain hurts: applying cognitive load theory to emergency medicine handoffs. NUEM Blog, 2017 Oct. Available: http://www.nuemblog.com/blog/cognitive-load. Accessed May 29, 2019.

46. Id.

47. Weigl M, Muller A, Holland S, et al. Work conditions, mental workload and patient care quality: a multisource study in the emergency department. *BMJ Qual Saf* 2015; 0:1-10.

48. Westbrook JI, Raban MZ, Walter SR, et al. Task errors by emergency physicians are associated with interruptions, multitasking, fatigue and working memory capacity: a prospective, direct observation study. *BMJ Qual Saf* 2018;27:655–663.

49. Coreia E. When conversation is better than computation. *J Am Med Inform Assoc* 2000; 7:277-86.

50. Westbrook JI, Raban MZ, Walter SR, et al. Task errors by emergency physicians are associated with interruptions, multitasking, fatigue and working memory capacity: a prospective, direct observation study. *BMJ Qual Saf* 2018;27:655–663.

51. Flynn, F, Evanish JQ, Fernald JM, et al. Progressive care nurses improving patient safety by limiting interruptions during medication administration. *Crit Care Nurs* (2016): 36(4).

52. Singer JI, Dean J. Emergency physician intershift handovers: an analysis of our transitional care. *Pediatr Emerg Care*. 2006;22: 751-754.

53. Yoo J, Jung KY, Kim T, et al. A Real-Time Autonomous Dashboard for the Emergency Department: 5-Year Case Study. *JMIR mHealth uHealth* 2018;6(11).

54. Przybylo JA, Wang A, Loftus P, Evans KH, Chu I, Shieh L. Smarter hospital communication: secure smartphone text messaging improves provider satisfaction and perception of efficacy, workflow. *J Hosp Med* 2014; 9 (09) 573-578.

55. Heaton HA, Nestler DM, Barry WJ, et al. A time-driven activity-based costing analysis of emergency department scribes. *Mayo Clin Proc Inn Qual Out* 2019:3(1): 30-34.

56. Roman C, Edwards G, Dooley M, et al. Roles of the emergency medicine pharmacist: a systematic review. *Am J Health-Syst Pharm* 2018 Jun:75(11): 796-806.

57. Brown JN, Barnes CL, Beasley B. Effect of pharmacists on medication errors in an emergency department. *Am J Health-Syst Pharm* 2008:65: 330-333.

58. Patel S, Mathis AS, Costello J, et al. Satisfaction with medication reconciliation completed by pharmacy technicians in an emergency department. *P&T* 2018; 43(7):423-428.

59. Markovic M, Mathis AS, Ghin HL, et al. A comparison of medication histories obtained by a pharmacy technician versus nurses in the emergency department. *P&T* 2017; 41(1): 41-46.

60. Silvestri S, Sun J, Ralls G and Papa L. An emergency department paramedic staffing model significantly improves EMS transport unit offload time – a novel approach to an ED crowding challenge. *Emerg Med* 2014; 4(6):1-6.

61. Panella M, Marchisio S, Di Stanislao F. Reducing clinical variations with clinical pathways: do pathways work? *Int J Qual Health Care* 2003; 15(6): 509-521.

62. Bekmezian A, Fee C, Weber E. Clinical pathway improves pediatrics asthma management in the emergency department and reduces admissions. *J Asthma* 2015: 52(8): 806-814.

63. Redfern E, Hoskins R, Gray J, et al. Emergency department checklist: an innovation to improve safety in emergency care. *BMJ Open Quality* 2018: 7(3).

64. Smith KA, High K, Collins SP, et al. A preprocedural checklist improves the safety of emergency department intubation of trauma patients. *Society of Academic Emergency Medicine* 2015. Available: https://onlinelibrary.wiley.com/doi/pdf/10.1111/acem.12717. Accessed July 30, 2019.

65. Hill, R. G., L. M. Sears, and S. W. Melanson. 4000 Clicks: A Productivity Analysis of Electronic Medical Records in a Community Hospital ED. *Am J Emerg Med* 31, no. 11 (2013): 1591–94.

66. Neri, P., L. Redden, S. Poole, et al. "Emergency Medicine Resident Physicians' Perceptions of Electronic Documentation and Workflow." *Appl Clin Inform* 6, no. 1 (2015): 27–41.

67. Green LA, Nease D Jr., Klinkman MS. Clinical reminders designed and implemented using cognitive and organizational science principles decrease reminder fatigue. *J Am Board Fam Med*. 2015 May-Jun: 28(3):351-9.

68. Morey JC, Simon R, Jay GD, et al. Error reduction and performance improvement in the emergency department through formal teamwork training: Evaluation results of the MedTeams project. *Health Serv Res*. 2002 Dec; 37(6): 1553-1581.

69. Martin HA, Ciurzynski SM. Situation, background, assessment, and recommendation – guided huddles improve communication and teamwork in the emergency department. *Journ Emerg Nurs* 2015 Nov: 41(6): 484-8.

70. Vashi A, Rhodes KV. "Sign Right Here and You're Good to Go": a content analysis of audiotaped emergency department discharge instructions. *Ann Emerg Med*. 2011;57:315–322.

71. Boonyasai RT, Ijagbemi OM, Pham JC, et al. Improving the emergency department discharge process: environmental scan report. Agency for Healthcare Research and Quality (2014).

72. Darragh PJ, Bodley T, Orchanian-Cheff A, et al. A systematic review of interventions to follow-up test results. *Journ Gen Int Med* 2018 May33(5): 750-758.

73. Murray KA, Belanger A, Devine LT, et al. Emergency department discharge prescription errors in an academic medical center. Proc (Bayl Univ Med Cent). 2017 Apr; 30(2): 143-146.

74. Horwitz LI, Moriarty JP, Chen C, et al. Quality of discharge practices and patient understanding at an academic medical center. *JAMA Intern Med* 2013;173(18):1715-22. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3836871. Accessed June 16, 2019.

75. Samuels-Kalow ME, Stack AM, Porter SC. Effective discharge communication in the emergency department. *Ann Emerg Med* 2012 Aug; 60(2): 152-159.

76. Marcoux V, et al. Screening tools to identify patients with complex health needs at risk of high use of health care services: A scoping review. 2017 *PLoS ONE* 12(11): e0188663.

77. See, for example, Salvi F., et al. Risk stratification of older patients in the emergency department: comparison between the identification of seniors at risk and triage risk screening tool. *Rejuv Res*. 2012 Jun; 15(3):288-94, for a comparison of tools that may be used to risk-stratify elderly patients in the emergency department.

78. Karam G, Radden Z, Berall LE, et al. Efficacy of emergency department-based interventions designed to reduce repeat visits and other adverse outcomes for older patients after discharge: a systematic review. *Geriatr Gerontol Int* 2015; 15: 1107-1117.

79. Jones J, Clark W, Bradford J, et al. Efficacy of a telephone follow-up system in the emergency department. *J Emerg Med* 1988;6(3):249-54.

80. Poncia HD, Ryan J, Carver M. Next day telephone follow up of the elderly: a needs assessment and critical incident monitoring tool for the accident and emergency department. *J Accid Emerg Med* 2000;17(5):337-40.

81. Nejtek VA, Aryal S, Talari D, et al. A pilot mobile integrated healthcare program for frequent utilizers of emergency department services. *Am Jour Emerg Med*. 2017 35:1702-1705.

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