Information Management in the Emergency Department

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KEYWORDS

• Electronic medical records • Emergency department information systems
• Communication • Informatics • Operations

KEY POINTS

- Communication in the emergency department (ED) takes many forms, and clear communication is critical to successful patient care.
- Interruptive alerts should be used sparingly and only for the most severe or high-risk alarms.
- Systems must be developed to detect and remove or correct low-yield alerts in order to minimize alert fatigue.
- Additional research is needed on ED information systems and ED-specific communication.
- The future of information management should largely focus on minimizing interruptions, improving provider wellness, and reducing provider burnout.

INTRODUCTION

The emergency department (ED) is a unique health care environment. It is complex, unpredictable, resource limited, and constantly in flux.[1] The amount of information that must be managed to adequately and safely care for patients in the ED can be overwhelming. This information must not only be identified, documented, interpreted, and retrieved but often it needs to be communicated and acted on immediately. The communication burden on ED providers is unbounded and fraught with interruptions and distractions that potentially introduce error and lead to mismanagement of information.

The percentage of hospitals with an electronic medical record (EMR) has increased over the past decade. As of 2017, 96% of acute care hospitals possessed certified

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EMRs.[2] This article refers to the interface of the EMR used by ED providers as ED information systems (EDISs). Although many health care systems use a dedicated interface for the EDIS, others use the same interface and layout as the inpatient providers.

EDISs are not perfect systems. They help manage the vast amount of information in an ED but have been shown to both benefit and harm ED patient care.[3] EDIS workflows are often time intensive and detract from other tasks, including provider-patient interactions.[4] In addition to impeding throughput, EDISs have the potential to introduce new forms of error into the system, and the burden of electronic documentation can lead to provider burnout.[4,5]

COMMUNICATION IN THE EMERGENCY DEPARTMENT

Communication is paramount to the delivery of safe, high-quality, effective, and efficient care in any ED.[1,6,7] Successful communication is a combination of active and passive communication techniques, and takes many forms.[6] Each form of communication involves both the transfer of information but also behaviors accompanying that transfer.[6]

The communication load on emergency providers has been shown to be substantial. It has been estimated that communication, in all its forms, occupies about 80% of clinicians' time.[8] Coiera and colleagues[9] found that a third of communication events were interruptions, and, 10% of the time, communications involved more than 1 simultaneous conversation. This volume of communication can be problematic in many ways. The sheer volume of communication can overwhelm short-term memory, causing more relevant pieces of information to be forgotten. Untimely or irrelevant data are distracting and interrupt workflow, including complex decision making and task performance.[8] Observational studies have shown clinicians in the ED are interrupted as frequently as every 6 to 9 minutes.[10] The enormous amount of communication that takes place in a complex, high-risk environment such as an ED has the potential to directly contribute to medical errors, adverse events, and patient harm.[6]

Modes of Communication

Fairbanks and colleagues[9] identified several modes of communication in the ED setting (**Box 1**). Face-to-face communication has been shown to be the most common form of communication in an ED, estimated to be from 82% to 90% of all communication.[8,9,11]

The advent of secure texting systems has substantially expanded transmission of patient information for consultation, admission, or other transitions of care. As a result, mobile phones have increasingly supplanted the more traditional communication modality of paging, although personal and overhead pagers are still used in many EDs. Overhead announcements are still used throughout many EDs to communicate a multitude of information, including patient arrivals, notification of needed tests (ie, electrocardiograms or radiographs), and to alert ancillary personnel of the need for their service.[7]

With the advent of the EMR, computers are growing as a fundamental communication tool, but one with new benefits and potential pitfalls. EMRs allow for a wide range of communication modalities, including messaging platforms, push notifications, and automated and asynchronous messages such as best-practice alerts (BPAs).

EMERGENCY DEPARTMENT INFORMATION SYSTEMS

As part of the Centers for Medicare and Medicaid Services meaningful use criteria, hospitals in the United States are now required to use certified EMRs and EDIS.[12]

Box 1
Common forms of communication within the emergency department

- Face to face
- Telephone
- Chart writing and reading
- Order writing and reading
- Whiteboards
- Test and laboratory results
- Item drop-off (eg, Sticky note)
- Vitals (on a monitor)
- Computer
- Other

Data from Coiera EW, Jayasuriya RA, Hardy J, et al. Communication loads on clinical staff in the emergency department. Med J Aust. 2002;176(9):415-418.

Most EMRs are chosen by health system administrators. EMRs have increased the frequency of task switching that providers perform,[13] with physicians clicking the mouse almost 4000 times in a single shift.[14] This increase in workload and the frequency of interruptions has increased the risk of new types of medical errors, which both threaten patient safety and also contribute to provider burnout.[15] Physicians now spend 25% to 65% of their time during a shift documenting.[16,17]

Not surprisingly, providers often find EMRs difficult to use.[13] EMRs often have busy, confusing displays that attempt to cram large amounts of information in a small space. Data organization within the EMR often does not match clinical workflow, resulting in information remaining undiscovered.[18] Furthermore, different ED team members may have different screen layouts or access to different areas of the chart, increasing the potential for miscommunication.[19]

To address some of those issues, some health systems have standardized their EMR layout for all members of the health care team. Other systems give the option of direct communication between providers within the EMR.[19] Additional recommended improvements include reducing variability within the EMR, standardizing provider interaction with the EMR, formal usability assessments, and adverse events reporting systems.[14]

In spite of the problems that they have been shown to cause for providers, EDISs have proved to be valuable tools for accumulating and storing data specific to both patients and the ED. These data can be used in real time by clinical staff or administrative leaders to identify and troubleshoot problems in flow (eg, radiology or laboratory delays, overcrowding, or an influx of patients), and can also be used retrospectively for research and quality-improvement purposes.[3]

INPUT

Prehospital

Emergency medical service (EMS) arrivals, especially those for patients with time-sensitive clinical conditions, can be preceded by a prehospital notification that readies providers.[20] EMS providers are a source of valuable information, but information is frequently lost during this handoff, especially for lower-acuity patients. In particular,

the lack of a standardized handoff process from EMS to nursing can lead to failures in communicating patient needs and expectations.[21] These omissions can subsequently result in impaired ED flow, repetitive testing, or excessive work-ups. Although, in many EDs, EMS trip sheets are scanned into the EDIS, there is often a delay between the entry of these data and the patient's arrival, making them an unreliable source of information.[22]

Outpatient Referrals

An estimated 12% to 59% of patients have made contact with their outpatient providers before an ED visit or are referred to the ED.[23–26] Referrals from the outpatient team to the ED can come in many forms, including verbal handoffs to either triage nurses or ED providers, paperwork sent with the patient, a note within the hospital EMR or EDIS, or an electronic message sent directly to the ED. An electronic referral that is automatically associated with the patient in the EDIS intuitively seems like the best option for many ED providers; however, there is limited research in this area. Many hospitals also send notifications to primary care providers when patients are registered within the ED.[27]

Triage

Although standardized triage scores and criteria are common in the ED, there is considerable variability in the information documented in different hospitals' EDISs during the triage process. Universally collected information includes the patients' chief complaints and vital signs. Other information, including past medical and surgical history, social history, medication reconciliation, allergies, and screenings for abuse or public health measures, can be collected during the initial triage phase but can also be collected later in a patient's ED stay.[28] Some of the heterogeneity of information gathered in triage is caused by the triage process being presented differently in different EDISs. However, regulatory requirements for gathering information can place an undue burden on triage, resulting in poor signal/noise ratio and information being either hidden or overlooked.[29]

Increased morbidity and mortality can result from triage errors, including overtriage and undertriage.[30] In addition, care trajectories can often be altered if the information in triage is incorrect or overlooked.[29] Further complicating information management in triage is the simple fact that patients may tell triage nurses something about their presentation that they do not repeat later in their ED stays. If those particular details are not incorporated into the initial triage assessment, they may never be reclaimed. Both the variability of the information gathered in triage and the location of that information within the EDIS make managing triage information challenging for ED providers.

Patient identification

The handling of unidentified patients in the ED is a frequent occurrence. Numerous schemes have been developed for how to represent these individuals.[23,31,32] This requirement is especially important when there are large numbers of unknown patients in the department (eg, mass casualty incidents). Recommended strategies include visually distinct representation with names that are unique and easy for providers to remember.[32]

Transgender patients deserve special attention. As an already marginalized group, the most basic single-step registration system, containing only a single binary field to represent gender, can cause problems for both patients and providers.[24] Although 2-step processes identifying a patient's gender identity and their birth-assigned sex improve on this process,[25] newer techniques have been suggested to collect a

patient's gender identity (ie, how a patient wishes to be addressed), the birth sex, and the legal sex.[26] Whatever system is used, it is important that providers be able to easily identify transgender patients in order to provide the best care possible.

Notification of New Patients

Notification of new patient arrivals to the ED and of their subsequent placement in treatment spaces can happen through verbal and nonverbal means. Nonverbal communication typically takes the form of a change in the EDIS, such as a color change that reflects a patient's status or the appearance of the patient's name on a track board or map. Verbal communication could be face to face, if the charge nurse or triage nurse directly notifies a bedside nurse or provider of a new patient being bedded in their treatment area, or it could take the form of overhead pages or announcements.[7]

THROUGHPUT

Emergency Department Information System Chart Matching

Before electronic records, patients were often physically accompanied by their paper charts. In the current era of electronic records, it is common to have multiple patient charts open at once, and often patient names are not fully displayed between charts.[27] A simple misclick can lead a provider to the wrong patient's chart and, in turn, can lead to documentation and ordering errors.

Matching the correct chart is especially important in computerized physician order entry (CPOE) systems, where there is potential for harm by ordering inappropriate tests or interventions on the wrong patient. It has been suggested that the prominent display of the patient's room[12] as well as patient photographs[16] have the potential to prevent wrong-patient orders.

Emergency Department Information System Chart Review

It has been shown that providers spend about 12% of their time reviewing results and old records.[17] One of the manifest benefits of EDISs is that they have made old records more accessible for review and more comprehensive. Information can now be shared between hospitals and health systems, through improved interoperability and health information exchanges, although there remains a substantial disparity.[14,19] However, the amount of information now available can make finding relevant information more challenging and time consuming.

Computerized Physician Order Entry Systems

Development of CPOE was one of the earliest uses of EMRs and is well adopted. Its use has been shown to affect the communication pattern between providers and nurses.[13] CPOE has been shown to reduce the rate of medication errors,[33] and with reported high user satisfaction.[34]

Integrated allergy alerts and drug-drug interaction alerts are important features of CPOE, which have been shown to reduce adverse medication reactions in the ED.[33] As shown by providers overriding up to 90% of these alerts, most are clinically insignificant.[15] Having such a high false-positive rate of alerts creates a classic example of alert fatigue, where users become accustomed to ignoring these alerts and are more likely to overlook those with clinical significance that could negatively affect patient care.[35] It has thus been recommended that many of these interaction alerts should be noninterruptive.[36]

Order sets have been proposed as a method of both making it easier for providers to quickly place orders on their patients and standardizing care between providers, but

there are variable rates of adherence with order sets.[13,37,38] ED-specific order sets and dashboards have been created to match key pieces of information with patient care flow.[13,33]

Best-Practice Alerts

BPAs are alerts within the EDIS to prompt intervention or inform the user. BPAs are clinical support tools designed to help improve safety, but they can also be used to reduce cost by reducing duplicate testing,[39,40] help remind providers to start antibiotics early in sepsis,[41] and decrease opioid prescribing.[42]

However, BPAs are often seen as a panacea for improving compliance metrics and other problems, leading to their overuse. This overuse has led to a marked increase in the number of alerts providers are faced with on a given shift, which in turn increases the burden of communication interruptions and changes in task they face. As the number of BPA alerts increases, providers become less likely to respond and more likely to ignore them, which is another example of alert fatigue. The rarer an event, the less useful BPAs become, which merits evaluation of other solutions and interventions.[39,43]

There have been various attempts to automatically detect when BPAs are incorrectly configured or are less useful. Aaron and colleagues[40] noted that users often responded with "cranky" free-text comments when overriding misconfigured alerts, and suggested that an automated detection system could be created to search for such cranky words.

Results

New results

Providers need to be made aware of new results in a timely manner. Most importantly, they need to be aware that all of the expected results have returned and the work-up is complete. Some systems have mechanisms by which the system can indicate that a patient has new results; however, in many implementations, this indicator can be reset the first time anyone reviews the results. These systems sometimes only indicate new results but do not indicate that all results are finalized. Other systems can indicate when all results are returned but can be confused by tests not anticipated to result during an ED visit (eg, cultures). Active notification of key results affecting disposition have been shown to decrease length of stay and improve patient flow.[41,44]

Interpreting results

Even though abnormal results are often displayed bolded or underlined, they can still be difficult to find and accidently overlooked.[45–49] Many EDISs list results in text or tabular format, rather than graphically. This format then requires providers to scroll through long lists of mostly normal results to identify and act on the abnormal results.[33] Failure to recognize these abnormal tests can negatively affect patient care.[48,49]

Critical results

Laboratory results are typically classified as within the normal, abnormal, or critical ranges. Critical results typically require confirmation that the information has been passed on.[50] Although most systems require verbal acknowledgment, critical results could alternatively be acknowledged through the EDIS. Only if the provider has failed to acknowledge the result in a certain time period would a follow-up verbal communication then be required. It has been proposed that critical results be further subdivided based on the timeliness of the clinical decision required.[51]

Patient portals

The increasing presence of patient-facing portals allows patients in the ED to view their records, including laboratory results and imaging data, on smartphones in real time. In many cases, patients are aware of their own results before the providing team, making for awkward interactions that providers should be prepared to address.[50]

Future work

In the future, it may be possible for the EMR to apply knowledge of the patient's condition to help determine what distinguishes a normal from an abnormal or critical result. For example, at a basic level, the normal range for a complete blood cell count could be appropriately adjusted for a patient in her third trimester. A more advanced system might recognize that a markedly increased lactate level in a patient presenting after a seizure is probably expected, and therefore should be flagged as merely abnormal as opposed to being communicated as a critical result.

OUTPUT

Admissions and Inpatient Handoff

Information management is particularly important during transitions of care. Handoffs between the ED and inpatient teams are a major source of medical error[52] and are complicated by the lack of a universal handoff process.[53] Transmission of inaccurate information was most commonly related to the physical examination, followed by the results of ancillary tests, the history of present illness, and the patients' clinical course while in the ED.[52]

Electronic asynchronous transitions of care have been used as an alternative to the traditional verbal handoff.[54] These models, which still allow for additional verbal communication when needed, are standardized and can help to minimize interruptions.[55] However, technology has also complicated ED-to-inpatient handoffs. Fragmented CPOE systems between the ED and inpatient units can make it difficult for inpatient providers to locate pending orders, resulting in duplication of work. When the EMR does not clearly delineate the current care team after a handoff, critical results can be communicated to the incorrect team.[52]

Discharge Communication

Clear discharge instructions are necessary to communicate to patients their diagnosis, treatment, follow-up plan, as well as return instructions.[56] It is recommended that these instructions be given both verbally as well as in written form. Multiple studies have shown that there are significant deficiencies in patient comprehension of their discharge instructions despite these efforts.[56–59] There are additional barriers for patients who speak different languages, as well as those with poor reading comprehension skills.[57,58,60] The use of interpreters to deliver verbal discharge instructions has been shown to be somewhat effective, although the amount of time spent with the patient is also important.[57]

Elderly patients being discharged back to a skilled nursing facility represent a particularly vulnerable population, especially when being discharged with a change in status, need for follow-up, or with new care instructions (eg, change in medication, new weight-bearing status, or new wound care instructions).[61]

In addition to individualized discharge instructions, it is important to have standardized instructions available in multiple languages.[57,62] The provider should be able to select the appropriate discharge instructions in the EMR, and the correct version should be automatically printed in the patient's preferred language.

SUMMARY AND RECOMMENDATIONS

Information management in the ED is complex and creates a large burden on providers, which hinders patient care. The future of information management should largely focus on minimizing interruptions, optimizing patient safety, and improving provider wellness. Based on our comprehensive review, we put forth the following recommendations:

1. A dedicated EDIS from the main EMR optimized for ED workflow
2. Standardization within the EDIS for the entire care team
3. Standardized and structured data collection at triage
4. Reservation of modal or interruptive alerts for only the most severe or high-risk alarms
5. Elimination of low-yield BPAs and alerts, and development of alternative solutions for intervening on rare events
6. Order sets and orders specific to ED care
7. Event-based notification for key positive and negative results that affect disposition or destination
8. A streamlined handoff process for admissions
9. Standardized discharge instructions
10. Further research dedicated to EDIS-specific and ED-specific communication

CONFLICTS OF INTEREST

The authors report no conflict of interest.

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