

Characteristics of Patient Care Management Problems Identified in Emergency Department Morbidity and Mortality Investigations During 15 Years

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Study objective: We describe cases referred for physician review because of concern about quality of patient care and identify factors that contributed to patient care management problems.

Methods: We performed a retrospective review of 636 cases investigated by an emergency department physician review committee at an urban public teaching hospital over a 15-year period. At referral, cases were initially investigated and analyzed, and specific patient care management problems were noted. Two independent physicians subsequently classified problems into 1 or more of 4 major categories according to the phase of work in which each occurred (diagnosis, treatment, disposition, and public health) and identified contributing factors that likely affected outcome (patient factors, triage, clinical tasks, teamwork, and system). Primary outcome measures were death and disability. Secondary outcome measures included specific life-threatening events and adverse events. Patient outcomes were compared with the expected outcome with ideal care and the likely outcome of no care.

Results: Physician reviewers identified multiple problems and contributing factors in the majority of cases (92%). The diagnostic process was the leading phase of work in which problems were observed (71%). Three leading contributing factors were identified: clinical tasks (99%), patient factors (61%), and teamwork (61%). Despite imperfections in care, half of all patients received some benefit from their medical care compared with the likely outcome with no care.

Conclusion: These reviews suggest that physicians would be especially interested in strategies to improve the diagnostic process and clinical tasks, address patient factors, and develop more effective medical teams. Our investigation allowed us to demonstrate the practical application of a framework for case analysis. We discuss the limitations of retrospective cases analyses and recommend future directions in safety research. [Ann Emerg Med. 2008;51:251-261.]

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Editor's Capsule Summary*What is already known on this topic*

Morbidity and mortality conferences and other forms of quality review are commonplace. Their content has not been well studied.

What question this study addressed

What types of events and what causal and contributing factors are common in morbidity and mortality reviews?

What this study adds to our knowledge

The diagnostic process was judged the most common locus of failure in more than 600 cases, spanning 15 years. Despite imperfections in care, more than half the patients still received some benefit compared with the likely outcome with no care at all.

How this might change clinical practice

Detailed case reviews provide useful information for practice improvement but have selection bias in the choice of cases and biases produced by the retrospective interpretation of incomplete information.

SEE EDITORIAL, P. 262.**INTRODUCTION****Background**

Several major studies have reported the incidence of medical error and risks associated with health care.¹⁻⁶ These studies have raised awareness of imperfections in care but offer little understanding of the nature of the work or solutions to improve safety. Although the focus on patient safety is relatively new, processes for improvement have existed for decades. We suggest that cumulative reviews of existing data, available in most health care organizations, can be used to guide current efforts to improve safety.

Our study was initially aimed at detecting "medical errors." Although the concept of error has been widely disseminated in the medical literature during the last decade, the term "error" carries with it connotations of carelessness, implies blame, and often focuses unduly on humans as the source of harm. As our understanding of these problems grew, we modified our study to describe events once labeled errors as "patient care management problems." This subtle change is intended to promote a healthier perspective and constructive analysis. The term "problem" implies something to be solved and states more directly our intent to seek strategies and solutions for improvement.

Importance

Demand for improvement has led to changes throughout health care, including new safety regulations for health care organizations, proposed legislation for error reporting and

malpractice reform, and advancements in information technology applications for medical settings.⁷⁻¹⁰ Reforms in medical education have led to restrictions in house staff working hours, development of curriculums for patient safety, increased rigor in requirements for lifelong learning for physicians, and new emphasis on competency standards.^{11,12} Although we are anxious to improve, recommended changes should be founded on a thorough understanding of the types of patient care management problems that occur in medicine and factors that may increase risk.

Goals of This Investigation

The objective of this study was to characterize the types of cases referred to a physician review committee of an urban emergency department (ED) and identify the phase of work in which problems were detected and specific factors that affected quality of patient care. Our long-term goal is to use our existing morbidity and mortality investigations to guide safety interventions and to develop valid methods for future study of patient safety targets. The ED has been described as a high-risk practice environment, particularly under conditions of crowding, and serves as a natural setting to study safety in health care.^{13,14}

MATERIALS AND METHODS**Study Design and Setting**

This was a retrospective study to characterize patient care management problems identified by routine mortality and morbidity surveillance at an urban public teaching hospital during the 15-year period spanning 1989 through 2003. The annual adult ED census during those years ranged from 109,000 to 128,000. All cases referred for emergency physician review between 1989 and 2003 were eligible. Our institution has separate reporting mechanisms for pediatric and trauma care; these populations are not included in our study. Case referrals came from ED staff, admitting services, consultants, or quality assurance managers. Two independent emergency physician reviewers assessed each case by using an existing framework described previously.^{15,16} The lead author designed the data collection form and performed review 1 in every case. Cases were randomly assigned to one of 8 coinvestigators for review 2. Whenever possible, reviewers were disqualified from cases in which they had direct involvement or firsthand knowledge. The study was exempted from review by our institutional review board.

Our department actively sought referrals from hospital staff of cases in which there were concerns about quality of care and encouraged reports of administrative and system problems, as well as questions about medical management. This process began as routine surveillance for morbidity and mortality cases but became a significant part of the quality process in our department. Cases underwent an investigation at referral that included interviews with medical staff involved in each case and a review of medical records and clinical data. Medical staff were invited to record details of their cases to explain circumstances

as they existed at the time. Unlike many retrospective medical record reviews, these investigations yielded thick files rich in context and content. Each case was typically presented for discussion at 1 or more forums, including physician review committees, morbidity and mortality conferences, and faculty meetings. Once investigations were complete, the original medical records, notes from interviews and committee discussions, formal recommendations, and final case summaries were placed in an investigations library. Throughout the 15-year period of case collection summarized in this study, a common philosophy guided case review: cases were scrutinized with the intent to detect all patient care management problems, their potential causes, and contributing factors, with the ultimate goal to find solutions and seek improvement. These records constitute the source data reviewed for this study.

Data Collection

At the start of this study, a research assistant deidentified the source data from the investigations library. Study investigators reviewed the case files, identified management problems, and then classified the problems by the phase of work in which they occurred, their contributing factors, and patient outcome. Investigators were allowed to use summary statements and conclusions from the initial reviews but were also encouraged to record any other relevant factors they identified during their reviews of file documents. To ensure internal validity throughout the study, specific criteria were established for each data field before data collection. Reviewers were asked to consider each study category. If they selected a category, they were required to check at least 1 of the category criteria to justify their selection. Reviewers participated in educational sessions and a pilot study, with feedback to verify consistent application of study definitions.

The framework that guided this investigation applies a variety of approaches to categorizing problems in care.¹⁵ We determine the stage at which a problem occurred and what factors likely contributed. Identified problems were classified into 1 or more broad categories according to the phase of work in which they occurred: diagnostic, treatment, disposition, and public health (Table 1). Reviewers were then asked to determine whether any of the following contributing factors added risk, contributed to a problem in care, or had a negative impact on patient outcome: patient factors, triage, clinical factors, teamwork, and system. Clinical factors included medical reasoning, specific interpretive and procedural skill sets, task-based problems, and affective influences. The concept of task-based problems has been described previously: they involve specific tasks that are so routine and basic to care that they are relegated to lower-order thinking, that is, they are done as a matter of habit and typically with little conscious thought.^{15,17} Problems in these basic tasks are observed as a failed human behavior but likely reflect a system weakness. Such events tend to occur when the system is overloaded, workers are distracted, or altered staffing patterns affect work flow. They can be used as a marker of system overload or disorganization. The category of

affective influences includes the human tendency to be influenced by factors other than objective facts; it includes the sometimes unconscious effects of personality, external pressures, and conflict on reasoning.¹⁸ Individual assessments were made for each team of clinicians. System problems included any process, service, equipment, or supplies that failed or were unavailable, broken, or faulty. System problems were further classified by location: ED microsystem, hospital-wide failure, administrative factors, and community resources. Specific problems were also characterized according to Reason's¹⁷ scheme as problems in "planning," "execution," or both. This classification distinguishes problems that are primarily cognitive from those that are primarily related to process failure; this distinction offers additional insight into potential solutions. None of these descriptors or classifications was mutually exclusive. Judgments about care were based on whether actions and decisions were accurate, timely, and effective. An example of a training case analysis is demonstrated in Figure 1.

Outcome Measures

Primary patient outcome was categorized as death, permanent disability, long-term disability (between 30 days and 12 months), short-term disability (up to 30 days), or no disability. These outcomes were mutually exclusive. Final outcomes, however, do not always reflect significant events. Thus, we added 2 additional secondary outcome measures to capture events that deserve attention: acute but short-lived life-threatening events and adverse events (harm caused by medical management itself, independent of the patient's disease). These secondary outcome measures were not mutually exclusive and could also overlap with the primary outcomes. Finally, each reviewer was asked to compare the actual patient outcome for each patient in this series to the outcome expected for optimal care and the likely outcome of no care to determine to what extent our management met expectations or caused harm.

Primary Data Analysis

The results for both reviewers were entered in a SAS data set. To increase data entry accuracy, 2 personnel collaborated: one to read aloud results from the data collection forms and validate the keystroke entry and the other to perform keystrokes. Observer agreement between reviewers 1 and 2 was quantified using the κ statistic. For rates and proportions, 95% confidence intervals were calculated. All analyses were performed with SAS version 7 (SAS Institute, Cary, NC).

RESULTS

Of the original library of 673 cases, 37 were excluded from the study because of incomplete or illegible records, inadequate 30-day follow-up, incomplete investigations, or inconclusive summaries (4 unexplained deaths). The final study group of 636 patients includes 353 male patients, 276 female patients, and 7 with undesignated sex. (Seven cases had sex designation inadvertently removed from the original source data.)

Table 1. Study definitions.

| Term | Definition | Example |
|---|--|---|
| Phases of work in which problems were observed | | |
| Diagnosis | Failure to make a correct diagnosis or A delay in diagnosis that affects outcome or An unnecessary or excessive diagnostic evaluation that itself caused harm | Failure to diagnose pneumonia Delay in recognizing a cord compression leads to paralysis Contrast used in unnecessary test causes renal failure |
| Treatment | Failure to provide appropriate treatment (error of omission) or An inappropriate treatment (error of commission) | Failure to give antibiotics for meningitis Treating a viral infection with antibiotics |
| Disposition | Failure to provide appropriate level of care according to acuity or Inadequate plan for follow-up care | Patient moved to higher level of care after admission; deterioration in condition not anticipated Neck mass not referred for biopsy; inadequate follow-up plan leads to delay in care and poor prognosis |
| Public health | Care that poses no specific threat to the patient but places others at risk | Failing to isolate tuberculosis Failure of contact tracing for meningitis Failing to recognize risk to relatives of victims of carbon monoxide exposure |
| Reason's classification | | |
| Problem with planning | A poor plan at the outset | Failing to recognize and thus treat a condition |
| Problem with execution | Failure to carry out the plan as intended | Intending to deliver a treatment but mistakenly delivering the wrong drug |
| Contributing factors | | |
| Patient factors | A specific patient characteristic that poses risk Inability to communicate Inability to cooperate Specific anatomy poses risk Characteristic elicits destructive affective bias in care provider | Unconscious or altered mental status Language barrier Delirium, dementia, or under the influence of substances Anatomically difficult airway, morbid obesity, difficult venous access Borderline personality disorder alienates medical staff |
| Triage factors | Failure to apply triage protocol or failure of criteria to accurately assess severity of illness. May be cognitive (knowledge deficit), design (inadequate criteria), or situational (excessive demand) | Failure to detect acute coronary syndrome |
| Clinical factors/tasks | | |
| Medical reasoning | Incorrect clinical impression or a flawed decision | Failing to recognize a clinical pattern of illness |
| Specific skill set | Inaccurate interpretation of clinical data, such as ECGs, laboratory data, imaging studies; or Complication from invasive procedures | Missing a relevant radiographic abnormality Pneumothorax from central line placement |
| Task based | Failure in routine bedside tasks such as measurement of vital signs | Failing to detect a change in vital signs when staffing ratio exceeds established margins of safety |
| Affective influences | Personal bias, evidence of interpersonal conflict, or the influence of factors other than objective facts in clinical decisions | Interpersonal conflict interferes with clinical judgment |
| Teamwork factors | Miscommunication, poor team transition, authority gradients, or failure to supervise | Confusion about treatment given in ED leads to failure to give medication |
| System factors | | |
| ED microsystem | Failure due to inadequate supplies, equipment, services, or policies | Airway supplies not restocked |
| Hospital-wide system | | Hospital call system not updated Paging system down |
| Administration | | Consultants not available |
| Community | | Community dialysis center closes, limiting access for care |

There was significant overlap between the main categories of work in which problems were noted, with diagnosis being the most commonly identified classification (451; 71%), followed by disposition (280; 44%) and then treatment (265; 42%). Public health decisions comprised the smallest fraction of cases

(23; 4%). Multiple categories were selected in more than half the cases (322; 51%) (Figure 2).

Problems were most likely to occur in the planning stage (591; 93%) compared with the execution stage (170; 27%), although some events had problems in both (144, 23%).

TRAINING CASE EXAMPLE DEMONSTRATING THE FRAMEWORK FOR ANALYSIS

Case Summary

A prominent business man with crushing chest pain and severe hypertension arrives in a remote rural community ED that lacks an interventional cardiologist. By triage policy he is rapidly moved to an acute care area where an EKG is promptly interpreted as evidence of an acute myocardial infarction. A chest x-ray is viewed by the treating physician, but the radiologist is unavailable to review it. The nearest hospital with cardiology support is more than an hour away. A decision is made to offer the patient thrombolytic therapy. Consent is obtained and the medication delivered. The patient later dies of an aortic dissection.

After interviews with medical staff and further investigation, additional details were obtained and the case analyzed.

The critique of this case concluded that failures occurred in two main categories of work:

1. **Diagnosis** (failure to diagnose aortic dissection), and
2. **Treatment** (thrombolytic therapy given in the face of severe, uncontrolled hypertension).

Contributing factors included:

1. **Flawed medical reasoning** (uncontrolled hypertension not treated; thrombolytics given despite uncontrolled blood pressure).
2. **Specific skill-set failure** (failure to recognize radiographic evidence for dissection, findings later verified by expert review).
3. **Ineffective team communication** (the medical team did not communicate to the radiologist the urgent need for his assistance).
4. **Task-based failure** (the radiologist noted that he was distracted by competing demands).
5. **Adverse affective influences** (the physician later noted that he was influenced by his desire to act aggressively because he recognized the patient to be an influential community leader, as well as his desire to conform to local standards to decrease "door-to-needle time.")

A limited group discussion centered around the question of whether or not the community should support local chest pain centers and improve resources for similar cases, but ultimately no system factors were identified.

Figure 1. Training case example demonstrating the framework for case analysis.

Problems in specific clinical tasks were the most common contributing factor identified (632; 99%) (Table 2). Problems in clinical tasks most commonly involved medical reasoning (595; 94%) but also included specific skill sets (212; 33%), routine task-based problems (173; 27%), and destructive affective influences (38; 6%). In almost half of all cases, more than 1 group of clinicians participated in specific management problems (289; 45%). Thus, many clinical problems did not occur in isolation and were often not the result of a single person, team, or process. Other leading factors that affected outcome included patient factors (391; 61%) and teamwork (387; 61%). System and triage factors were selected to a lesser

extent (41% and 16%, respectively). The distribution of contributing factors was similar across all phases of work.

More than 1 contributing factor was identified for most cases. In fact, 2 or more factors were identified in all but 56 cases (92%); 420 cases (66%) had 3 or more factors identified; 113 cases (18%) had 5 or more factors identified. Specific problems in care were typically not the result of failure by 1 factor (person or process) alone but rather the result of the complex interplay of multiple factors that ultimately influenced clinical work.

Two thirds (66%) of patients in this series had death, major permanent disability, or disability exceeding 30 days; 34%

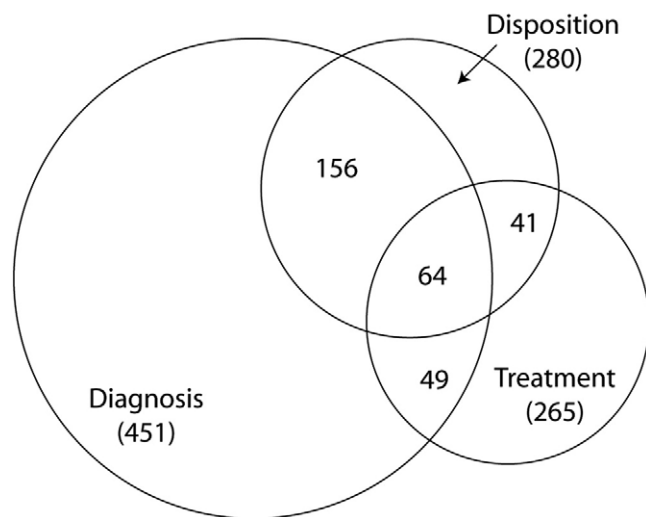


Figure 2. Major categories of work in which problems were observed. This Venn diagram illustrates the number of events identified in each phase of work and their overlap. Numbers in parentheses indicate total numbers for each major heading. Public health decisions, not shown in this diagram, accounted for an additional 23 events (4% of all events).

returned to their baseline state of health within 30 days or had no disability (Table 2).

Acute life-threatening events occurred sometime during the ED or hospital course in 66 cases (10%), including cardiac arrest, airway emergency, respiratory failure, shock, anaphylaxis, or major dysrhythmia. Adverse events (harm from medical management itself) occurred in 86 cases (14%). Of all adverse events, 24 (28%) resulted in death and 23 (27%) were associated with an acute life-threatening event.

Despite these identified events, 50% of all patients in this series received net benefit from their care; 40% had an outcome similar to that expected for no care. The remaining 11% had an outcome that was worse than expected according to the natural history of their disease. The majority of cases in this data set failed to achieve the full benefit expected from optimal care (590; 93%).

Observer agreement was measured with the κ statistic. Observer agreement was highest in categories with well-defined, objective criteria such as phases of work (86% to 100% agreement; κ 0.71 to 1.00) and patient outcomes (100% agreement; κ 0.98 to 1.00). When reviewers were asked to assess more subjective factors such as destructive affective influences, the observer agreement was only fair (92% agreement; κ 0.34) (Table 3).

LIMITATIONS

This study is a retrospective review of investigations completed on cases referred because of poor outcome, flawed processes, or the perception of imperfections in care. There are several limitations inherent to the study design.

First, the study has selection bias. Because our cases came largely from physician referrals, our data are weighted toward the types of problems that physicians find interesting or important and do not necessarily reflect a broad sampling of all types of cases. This does not mean that they represent the most common or even the “worst” management problems; our cases probably represent the most visible events or those most likely to have immediate impact on patient outcome. There is no control group of randomly selected patients during the same study period. Thus, many of the same factors identified in the study sample may have been present in other cases without harm. Cases with significant problems or harm may have occurred during the same period but gone unreported.

Second, post hoc critiques of care are inevitably subject to bias. Our cases were typically referred after outcome was known; thus, they have outcome bias, the tendency to judge similar events more harshly when the outcome is poor.¹⁹ In addition, our investigations were challenged by our ability to judge the events as they actually occurred, not as we might imagine them. Hindsight bias, the reconstruction of events in a way that makes sense to the investigator, can mislead judgments about events.²⁰ Even clinicians present at the time, in an effort to explain their actions, may reconstruct memories that are only partially true. We attempted to minimize the influence of bias by encouraging staff to record their impressions and recall specific information they had or lacked at the time of their decisions, what factors influenced their decisions, and what the ambient conditions were in the ED at the time. Timelines of actions were generated from electronic records and added to information from interviews to reconstruct, as much as possible, the actual events. The thick descriptions in our study files permit detailed analysis aimed at providing contextually rich detail to explain the circumstances surrounding care.

There are several other limitations to our study. The type of factors identified is constrained by the expertise of the reviewers and the quality of information they preserved. Although we observe the presence of factors that may have contributed to outcome, we do not make conclusions of causality.

Although our study attempted to define discrete phases of work in which problems occurred, we found overlap between the major categories, which suggests that our classifications (and perhaps the events themselves) were not independent of one another; clinical decisions in one phase of work likely affect other phases of work. Failure to discriminate between these categories also reflects several natural limitations in quality reviews. First, it is difficult to separate a single flawed step in the continuum of care. Second, a critical appraisal of many cases, with good or bad outcome, can often find multiple flaws. Last, such distinctions require judgments about what was in the mind of the clinician, facts that may be difficult for the involved clinicians to recall accurately and even more difficult for an independent reviewer remote from the event to determine.

The language of safety science and models of causation are controversial, particularly when applied to health care.²¹ Terms

Table 2a. Association between contributing factors and primary outcome measures.

| Contributing Factors* | Primary Outcome Measures, No. (%) | | | | | |
|------------------------|-----------------------------------|----------------|--------------------|---------------------|----------------------|---------------|
| | All Cases n=636 | Death n=226 | Disability | | | |
| | | | Permanent, n=24 | Long Term, n=171 | Short Term, n=178 | None, n=37 |
| Patient | 391 (61) | 170 (75) | 16 (67) | 86 (50) | 102 (57) | 17 (46) |
| Triage | 103 (16) | 47 (21) | 2 (8) | 20 (12) | 31 (17) | 3 (8) |
| Clinical (all subsets) | 632 (99) | 225 (99) | 23 (96) | 171 (100) | 177 (99) | 36 (97) |
| Reasoning | 595 (94) | 212 (94) | 21 (88) | 164 (96) | 169 (95) | 29 (78) |
| Skill set | 212 (33) | 77 (34) | 12 (50) | 47 (27) | 58 (33) | 18 (49) |
| Task based | 173 (27) | 91 (40) | 7 (29) | 29 (17) | 37 (21) | 9 (24) |
| Affective influences | 38 (6) | 11 (5) | 2 (8) | 9 (5) | 14 (8) | 2 (5) |
| Teamwork | 387 (61) | 155 (66) | 13 (54) | 92 (54) | 100 (56) | 27 (73) |
| System | 261 (41) | 103 (46) | 9 (38) | 79 (46) | 60 (34) | 10 (27) |

*Contributing factors are not mutually exclusive; thus, percentages do not sum to 100.

Table 2b. Association between contributing factors and secondary outcome measures.

| Contributing Factors† | All Cases, No. (%), n=636 | Secondary Outcome Measures, No. (%)* | |
|------------------------|------------------------------|--------------------------------------|-------------------------|
| | | Life Threats, n=66 | Adverse Events, n=86 |
| Patient | 391 (61) | 47 (71) | 59 (69) |
| Triage | 103 (16) | 11 (17) | 10 (12) |
| Clinical (all subsets) | 632 (99) | 66 (100) | 84 (98) |
| Reasoning | 595 (94) | 60 (91) | 69 (80) |
| Skill set | 212 (33) | 28 (42) | 49 (57) |
| Task based | 173 (27) | 23 (35) | 30 (35) |
| Affective influences | 38 (6) | 7 (11) | 5 (6) |
| Teamwork | 387 (61) | 40 (61) | 50 (58) |
| System | 261 (41) | 22 (33) | 30 (35) |

*Secondary outcomes note specific events that are a subset of all cases; thus, percentages do not sum to 100.

†Contributing factors are not mutually exclusive; thus, percentages do not sum to 100.

such as “error” tend to evoke accusations of blame, whereas terms such as “problems” or “failures” may be vague. Judgments about quality and causality are flawed by outcome knowledge. From a simple human perspective, we want patients to have the best possible outcome. When they do not, there is a natural tendency to cite any imperfection in their care as a contributing (if not causal) factor. No doubt, similar problems in the care of patients with satisfactory results are more easily forgiven and dismissed. This study is ultimately a summary of the aspects of clinical work that our reviewers found to be most prone to problems and thus most likely to contribute to risk. The development of safety systems in other fields has started by analysis of accidents or events and then progressed to more sophisticated, systematic, and prospective design. Studies such as ours provide a framework from which to begin.

DISCUSSION

Our data demonstrate that cases referred because of patient care management problems are often complex and not the result of the failure of any single individual or process at any one moment in time. The typical course of a “medical error” has been described as a cascade, in which one failure leads to

another.²² However, our study went beyond simply recognizing complexity to identifying specific factors that can be targeted to improve safety.

Our reviewers selected “diagnosis” as the leading phase of work in which problems were noticed, consistent with results from other major studies,^{2,4,23-25} which is not unexpected, because diagnosis is at the heart of clinical work and is the foundation on which all other actions are predicated. That judgment is likely influenced by the perspective of our reviewers, who may be inclined to focus on their own expertise and reluctant to judge factors outside their usual sphere of influence. Our results provide some clues about why the diagnostic process is difficult and at times imprecise. Two major contributing factors were consistently identified in most cases in our study and likely created an environment in which rapid decisions may be problematic: patient factors and teamwork.

Patient factors include conditions that impair the ability of patients to communicate or cooperate with medical staff, anatomic problems that add difficulty to the ability to provide care, and conditions that elicit affective bias in care providers. Patients who present to the ED with altered mental status or in distress may be unable to offer important details of their medical

Table 3. Summary of descriptive study statistics and observer agreement.*

| Variable | Number of Cases | Total, % (95% CI) | Observer Agreement | |
|---|-----------------|-------------------|--------------------|-------------------|
| | | | Agreement, % | κ (95% CI) |
| Phases of work in which problems were observed | | | | |
| Diagnosis | 451 | 71 (67–75) | 98 | 0.95 (0.93–0.98) |
| Treatment | 265 | 42 (38–46) | 93 | 0.85 (0.81–0.89) |
| Disposition | 280 | 44 (40–48) | 86 | 0.71 (0.66–0.77) |
| Public health | 23 | 4 (2–6) | 100 | 1.00 (1.00–1.00) |
| Reason's classification | | | | |
| Planning | 591 | 93 (96–98) | 92 | 0.43 (0.30–0.56) |
| Execution | 170 | 27 (24–30) | 79 | 0.50 (0.43–0.58) |
| Planning and execution | 144 | 23 (20–26) | 79 | 0.47 (0.39–0.54) |
| Contributing factors | | | | |
| Patient | 391 | 61 (57–65) | 77 | 0.57 (0.50–0.63) |
| Triage | 103 | 16 (13–19) | 93 | 0.74 (0.67–0.81) |
| Clinical (all subsets) | | | | |
| Reasoning | 595 | 94 (92–96) | 94 | 0.45 (0.31–0.60) |
| Specific skill set | 212 | 33 (29–37) | 90 | 0.77 (0.73–0.83) |
| Task based | 173 | 27 (24–30) | 82 | 0.47 (0.39–0.55) |
| Affective influences | 38 | 6 (4–8) | 92 | 0.34 (0.20–0.48) |
| Teamwork | 387 | 61 (57–65) | 72 | 0.41 (0.34–0.48) |
| System | 261 | 41 (37–45) | 83 | 0.49 (0.38–0.55) |
| Primary outcomes | | | | |
| Death | 226 | 36 (32–40) | 100 | 0.99 (0.98–1.10) |
| Permanent disability | 24 | 4 (2–5) | 100 | 1.00 (1.00–1.00) |
| Long-term disability | 171 | 27 (23–30) | 100 | 0.99 (0.98–1.00) |
| Short-term disability | 178 | 28 (24–31) | 100 | 0.99 (0.98–1.00) |
| No disability | 37 | 6 (4–8) | 100 | 0.98 (0.96–1.01) |
| Secondary outcomes | | | | |
| Life-threatening events | 66 | 10 (8–12) | 100 | 0.99 (0.98–1.01) |
| Adverse events | 86 | 14 (11–17) | 100 | 0.99 (0.98–1.01) |

CI, Confidence interval.

*Categories are not mutually exclusive; thus, percentages do not sum to 100.

history, which contributes to the “information gap” described by Stiell et al,²⁶ in which physicians must act despite a paucity of reliable facts. Some of these factors are inherent to the practice of emergency medicine and contribute substantially to risk.

Other acute care specialties have recognized the importance of teamwork; our study confirmed that problems in care often involve ineffective team functioning.^{27,28} ED care tends to be punctuated by numerous transitions that can lead to dropped tasks and lost information. In addition, handoffs in care may hamper the ability of clinicians to recognize dynamic changes in a patient's condition.²⁹

There are implications from this study that can be used to design safer care. First, clinicians need reliable access to information and strategies for making decisions in the face of uncertainty. Cognitive psychologists can offer specific training in cognition, critical thinking, and decisionmaking.^{30–38} Clinical decision support systems and cognitive aids can reduce cognitive load and standardize clinical protocols.^{39,40} Medical simulation can provide opportunities to practice and refine performance.⁴¹

Second, our study reveals that patient factors contribute substantially to management problems. Vincent et al^{16,42} have observed that patient factors may contribute to the likelihood of

an adverse event; their framework for analyzing clinical events includes consideration of patient factors. Patient factors are often beyond our immediate control; harm caused by some patient factors has even been labeled “no fault.”^{38,43} Although a no-fault judgment may be fair to those present at the time, it prematurely limits discussions about how to improve care. We argue that all information from investigations can be used to improve care, even if problems are judged to be unavoidable at the time. Creative use of resources can address common patient factors, such as providing 24-hour access to interpreter services, improving electronic medical record databases for access to reliable medical information, and using ultrasonographic guidance to improve our ability to care for patients with difficult venous access, to name just a few.

Third, organization and teamwork in acute care medicine present specific challenges. Reliable and consistent processes for transitions and exchange of patient care responsibility and accurate communication of test results and patient information are fundamental to the design of safe health care systems, particularly in the dynamic setting of the ED.

The fact that system factors were not identified as a leading contributor to problems identified in this study contrasts sharply with current views in safety science.^{8,44} Our study was

performed by physicians, not safety scientists; thus, their reviews focus on medical judgments, not system design. Human tasks and the systems that support them are inextricably linked. The fact that our reviewers consistently selected human aspects of tasks over system factors may be due to fundamental attribution error, the tendency for organizational actors to attribute undesirable outcomes to the perceived character flaws of people rather than to the processes engendered by the organization's structure.⁴⁵ This tendency is reinforced by cultural pressures that promote an overriding sense of professional accountability but create "system blindness," that is, clinicians are largely unaware of the potential for system design to improve care.⁴⁶ The failure to detect a similar proportion of human and system factors may also reflect an imbalance in health care design that encourages reliance on individuals over development of support systems. If so, the recent focus on design and development of safe systems to support clinical work offers significant promise for improvement.

Future safety research will likely focus on prospective error reporting systems. The development of a national error reporting mechanism in the United States is under way but faces challenges to define process: how to collect case information, what information to collect, and how to analyze and then disseminate useful results. Once in place, reporting systems are often slow to produce actionable items. Meanwhile, studies such as ours can use historical cases to identify major problems needing correction and identify the types of factors that are worth tracking prospectively.

In the course of this study, we learned several lessons that can affect the success of future error reporting systems. During the early phases of the study, we attempted to identify a variety of potential contributing factors based on safety research, including cognitive bias, human factors, ergonomics, and ED design. Our efforts failed, primarily because physician reviewers were not familiar with the concepts and routine clinical investigations do not typically address them. We recommend that future studies and error reporting systems engage nonclinician experts from safety disciplines to provide fresh insight and perspective.

We also found that observer agreement was best for categories that were described by detailed checklists and definitions. Reviewers were less likely to agree when asked to make subjective assessments. Large-scale reporting systems need a workable reporting mechanism and may struggle between the need for uniformity and objective definitions and the desire for free-text reports. An ideal system may need both and may need to be modified periodically to allow for evolving standards of care and improved understanding of causes of medical failure.

For future work, there is a variety of sources of data that can be used to probe problems in patient care. Dramatic, visible, and highly publicized accounts of individual cases have been used successfully to drive safety initiatives.⁴⁷ In contrast, aggregate data from existing databases of cases may provide a broad overview of risk and help define particular tasks and moments in patient care that are most vulnerable and most in

need of system support. Several studies have used closed malpractice claims and risk management files to identify causes and contributing factors to adverse events.^{48,49} We suggest that collective reviews of existing mortality and morbidity investigations and internal review processes, available in most health care organizations, offer an additional source of data to guide improvement ([Appendix E1](#), available online at www.annemergmed.com). Finally, we suggest that collaboration with safety experts in other disciplines can expand our perspective on safety concepts and the potential for system improvements in health care.

In summary, the primary goal for understanding patient care management problems is to prevent them or at least mitigate harm. However, our efforts to improve care have been frustrated by the realization that health care and patient care processes are complex.^{5,16,36-38} Our data confirm that most problems are multifactorial. The leading factors that contributed to problems detected by physician reviewers in this study include medical reasoning, patient factors, and teamwork, although these problems occurred in a background of system imperfections. Efforts to improve safety in medicine should be directed at improving access to accurate medical information and communication across the continuum of medical care; coordination of care among health care teams; and improved processes, education, and support for decisionmaking in the uncertain environment of acute care medicine. Advances in system design to support these aspects of clinical care offer opportunities for improvement in health care safety.

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IMAGES IN EMERGENCY MEDICINE

(continued from p. 230)

DIAGNOSIS:

Emphysematous cystitis. Emphysematous cystitis is a rare, necrotizing infection characterized by gas collection in the urinary bladder wall and lumen, resulting from gas-producing pathogen infection.¹ The risk factors are diabetes (up to 80%), bladder outlet obstruction, recurrent urinary tract infection, urinary stasis, neurogenic bladder, immunosuppression, female sex, and being a transplant recipient.² The mechanism and pathogenesis of emphysematous cystitis are still unknown. The gas is suggested to be produced by the infected organism by the fermentation of albumin or glucose in urine. The most common organisms are *Escherichia coli*,³ *Enterobacter aerogenes*, and *Klebsiella pneumoniae*. Emphysematous cystitis has nonspecific clinical features and is often misdiagnosed. Clinically, emphysematous cystitis is often diagnosed by the unanticipated imaging findings. Plain abdominal radiograph usually makes the diagnosis, with high sensitivity (97.4%),⁴ but abdominal computed tomography scan was the most sensitive and specific diagnostic tool.⁵

About 18.8% of emphysematous cystitis cases have complicated courses.⁴ Emphysematous cystitis demands prompt diagnosis and intervention,⁶ including aggressive parenteral antibiotics and even bladder drainage.⁷ Generally, emphysematous cystitis has favorable prognosis, whereas delays in diagnosis and treatment may contribute to high mortality rate, which approaches 20%.

A favorable prognosis may be achieved by early recognition of emphysematous cystitis, by clinical and radiologic assessment, by appropriate antibiotic use, and by timely surgical intervention when indicated.

This patient was administered empiric antibiotic and promoted surgical drainage. *Escherichia coli* was isolated subsequently from both urine and drainage pus cultures. The patient was discharged after a 2-week hospitalization.

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APPENDIX E1.

Examples of actions resulting from morbidity and mortality investigations.

Uncommon Diagnosis Requiring Complex Evaluations and Multispecialty Interventions

The Problem: After observing difficulties in the timely diagnosis and treatment of aortic dissections, we reviewed a series of cases of aortic dissections from our morbidity and mortality database and identified key problem areas. The diagnosis was observed to be difficult, often overlapping more common chest pain entities. The evaluation for dissection could involve a variety of approaches (echocardiography, computed tomography, or angiography) and involved multiple consultants (chest surgeons, cardiologists, vascular surgeons, intensivists, and interventional radiologists). Because of the variation in practice, there was often conflict between specialists and services about the optimal testing and management of these cases; care was often delayed by conflict and indecision.

Actions Taken: After review of a series of problematic cases, the ED staff convened a multidisciplinary conference with all the involved specialties, eventually developing a standard approach agreed on by all disciplines. Once the policy was developed, hospital staff worked to ensure that services were available to follow the protocol. The result was a much more simplified and direct approach to caring for similar cases.

Cases With Evolving Standards of Care and Controversy About Optimal Management: Ectopic Pregnancy

The Problem: Multiple problems were observed in the timely diagnosis of ectopic pregnancy and in management of patients with first trimester bleeding. Because of evolving standards in the care of patients with first trimester pregnancy, the ED staff experienced conflict and inconsistent standards

within their own group, as well as consultants. In the process, the diagnosis of several ectopic pregnancies was delayed.

Actions Taken: The ED organized a literature review and grand rounds conference on ectopic pregnancy, developed a treatment protocol for first trimester pregnancy, and then met with a working group with obstetrics to standardize criteria for consultation, admission, and follow-up. Meanwhile, the ED improved its proficiency in bedside ultrasonography and began more liberal screening of all first trimester pregnancy bleeding.

Dealing With a Local Infectious Disease Threat: Tuberculosis

The Problem: A resurgence of tuberculosis in our city led to an increase in number of patients with active tuberculosis in our ED. There were a limited number of isolation beds available within the hospital, and medical staff had too few beds to isolate all potential cases. A number of patients admitted to general medical wards were found to have active tuberculosis; at the same time, there was an increase in the number of house staff who converted to positive tuberculin skin tests.

The Action: Cases with positive tuberculosis culture results were identified and their ED records tracked. The ED convened a multidisciplinary conference with the Infectious Disease and Radiology Departments to review the cases. Ultimately, we found that many active cases of tuberculosis could not be predicted according to clinical and radiographic criteria. Eventually, the medical staff obtained additional isolation rooms in the ED and in the hospital, applied new screening at triage to prioritize chest radiographs in patients with respiratory symptoms, prioritized movement of patients with suspected cases from triage to isolation beds in the ED, and successfully argued for increased resources to handle the challenge.