Determining Medical Error
Three Case Reports

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The Institute of Medicine urges us to reduce error.[1] To do so, we need to have a clear definition of the term *error* and know how to determine when errors lead to bad outcomes.[2] Given the complexity of these tasks, it is not surprising that the prevalence of error varies widely in published reports.[2–14]

In our institution, we have a patient safety committee that meets weekly to determine whether adverse events—bad patient outcomes, such as injury, prolonged hospitalization, or excessive cost—were the result of medical error. In this paper, we describe our approach to adverse events and medical errors and present three case reports to illustrate our methods.

Approach of the Patient Safety Committee

Our patient safety committee is a multidisciplinary body that investigates whether adverse events are the result of error. Committee members come from nursing, radiology, laboratory, pharmacy, transport, finance, admitting, risk management, and administration. Adverse events are generally brought to the committee voluntarily through an adverse event reporting system run by our office of risk management. Reporting is initiated when an adverse-event report sheet is sent to the office of risk management. In general, nurses fill out these sheets. A quality-of-care committee assesses the severity of the adverse events; over 300 adverse events are reported monthly to the risk management office, but only about 30 are considered severe enough to be sent for review by the patient safety committee. Two members of the patient safety committee evaluate each case—they review charts and interview providers to develop the temporal sequence of events that preceded the adverse event—and present a report to the group. The reviewers decide individually if an error has occurred, but the entire group decides by consensus on a final classification of error.

We define *error* (see Glossary) as a failure in decision making or a failure in the process of care needed to implement good decision making that results in an adverse event.[2] Therefore, we use adverse events as the starting point in our search for error. Finding error proceeds, in our view, by building chains of events—a series of decisions and processes of care—leading from the first management decision to the adverse event. Two basic types of errors are recognized. *Decision-making errors* are decisions that do not provide benefit in excess of harm and that set in motion a chain of events leading to the adverse event. *Process-of-care errors* refer to key constraints in the delivery of care, which lead to adverse events.[15] Once an error has been classified, the committee decides if the error sufficiently caused the chain of events leading to the adverse event. We then perform a root-cause analysis—a procedure that further classifies the error within one of three domains: human (e.g., an error in judgment), organizational (e.g., insufficient staff), or technical (e.g., inexperience). This root-cause analysis is useful because the domain of error itself often suggests what could have been done better. For example, human error might imply a need for further education, organizational error might suggest the need for greater staffing, and technical error might indicate a need for increased supervision.

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Glossary

Adverse event	**Bad patient outcomes, such as injury, prolonged hospitalization, or excessive cost.**
Error	**A failure in decision making or a failure in the process of care needed to implement good decision making that results in an adverse event.**
Types of error	***Decision-making errors*** **are decisions that do not provide benefit in excess of harm and that set in motion a chain of events leading to an adverse event.**
	Process-of-care errors **are key constraints in the delivery of care, which lead to adverse events.**
Root-cause analysis	**Procedure that identifies potential causes of error within three main domains of cause:** • **Human (e.g., error in judgment)** • **Organizational (e.g., insufficient staff)** • **Technical (e.g., inexperienced operator)**

Case 1: Death in the Radiology Suite

The case involved the death of a patient with metastatic cancer who had been transferred to the radiology suite for ultrasound-guided abdominal paracentesis. The patient had been given chemotherapy 2 weeks before admission. The chart documented that the patient had poor functional health (Karnofsky score <40) and was rapidly losing weight. One week after chemotherapy, the patient developed fever and was admitted to the hospital. During the work-up, the patient was sent to radiology to test for peritonitis. (The patient was already receiving antibiotics for pneumonia.) Paracentesis was aborted when the patient became restless and had a fatal cardiopulmonary arrest in the radiology suite. The patient safety committee was asked to determine if the absence of clinical staff during transfer (who might have been able to recognize the impending arrest sooner) constituted an error.

Review

Each member of the committee identified a different error. One reviewer classified the error as failure to recognize that the patient was already adequately treated for bacterial peritonitis by the antibiotics used for pneumonia (and therefore did not need the paracentesis). A second reviewer felt that the error was in not recognizing that the patient was too sick for aggressive interventions of any kind. This reviewer did not focus on the unnecessary diagnosis of bacterial peritonitis, but felt that no treatment was needed (other than antibiotics for comfort) due to the impending death of a very sick patient. A third reviewer thought the initial decision to give chemotherapy was the error because chemotherapy could not provide benefit due to the patient's poor health status at the outset.[16, 17] This reviewer felt that all of the subsequent adverse events were set in motion by this single event, including the decisions that were made during hospitalization. The fourth reviewer classified the error as a failure in the process for transporting patients. He felt that clinical personnel should have noted an impending respiratory arrest sooner.

To resolve our differences, we first agreed on the chain of events leading to the patient's death (**Figure 1**). Events preceding the patient's death were listed in chronological order. Drawing out the decisions and processes of care involved in the clinical course allowed us to link events in a temporal sequence. We then determined that the prehospitalization decision to give chemotherapy (which could provide little benefit to this particular patient because of his poor health status) constituted the primary error in decision making. This decision was an error because it led to a low leukocyte count, which led to a greater risk for pneumonia, which led to hospitalization, which led to antibiotics for pneumonia, which by chance led to empirical treatment for peritonitis.

Ordering the paracentesis was a second error. We felt that this judgment was not necessarily a result of the chemotherapy decision (i.e., the chemotherapy decision did not direct the decision makers to pursue the diagnosis of bacterial peritonitis in a patient already receiving antibiotics). This error fell into the category of deciding to perform testing that could provide no benefit. The decision to transport the patient to radiology was a direct consequence of the decision to test for peritonitis. Because we could find no documentation that an arrest was imminent either in the chart or in interviews with the nurses who cared for the patient, we did not finally classify the transfer decision or the failure to clinically monitor the patient in radiology as an error. Hence, we found two errors in decision making, each with its own set of consequences.

Lessons

- **To determine error, it helps to build a temporal sequence of actions leading to the adverse event.**

- **A decision-making error occurs if the decision does not provide benefit and that decision then sets in motion a sequence of events leading to the adverse outcome.**
- **Often, more than one error is found.**
- **Injury during hospitalization can be caused by errors that occur before hospitalization.**

Case 2: Delayed Arthrocentesis, Delayed Antibiotics

The patient was admitted at 2:00 pm with a painful, presumably septic, knee. At 4:00 pm the attending physician noted effusion in the knee and ordered intravenous (IV) antibiotics. He then instructed the residents to perform arthrocentesis and send the fluid for culture before starting the antibiotics. He also wanted fluid removed for pain relief.

At 12:00 midnight (8 hours after the order for antibiotics and the request for the diagnostic test), the intern arrived to perform the arthrocentesis. The patient asked why it had taken so long and expressed worry that antibiotics had not yet been started. The intern replied that he had been evaluating other patients who were being admitted to his service. The intern attempted the arthrocentesis but failed to obtain fluid. The intern then called the senior resident for help. The senior resident arrived 2 hours later and also failed to obtain fluid. The senior resident then called the attending physician and asked if the antibiotic should be started before the arthrocentesis. The attending agreed, and antibiotics were started 10 hours after the order was originally written.

The patient continued to have pain. It was now after 2:00 am. Pain medication was ordered, but the medication did not arrive for 2 hours. The order had been placed in an entry system and electronically sent to pharmacy where it sat.

Review

We started our evaluation for this case by building the chain of events beginning with the decision to order the antibiotics and the arthrocentesis (**Figure 2**). We then asked if the chain of events was started by a poor decision. Our committee felt that the decisions for the antibiotic and the arthrocentesis were appropriate.

We agreed, however, that the process of care failed for this patient. Twelve hours had passed before antibiotics were started. While we could not be absolutely sure that the patient would have gone home sooner without the delay, the patient's physician predetermined the length of time the patient needed to be on IV antibiotics and felt that the delay in IV antibiotics "pushed back" the discharge. Therefore, we found two adverse events and errors. First, a delay in the delivery of IV antibiotics (process-of-care error) led to a prolonged hospitalization

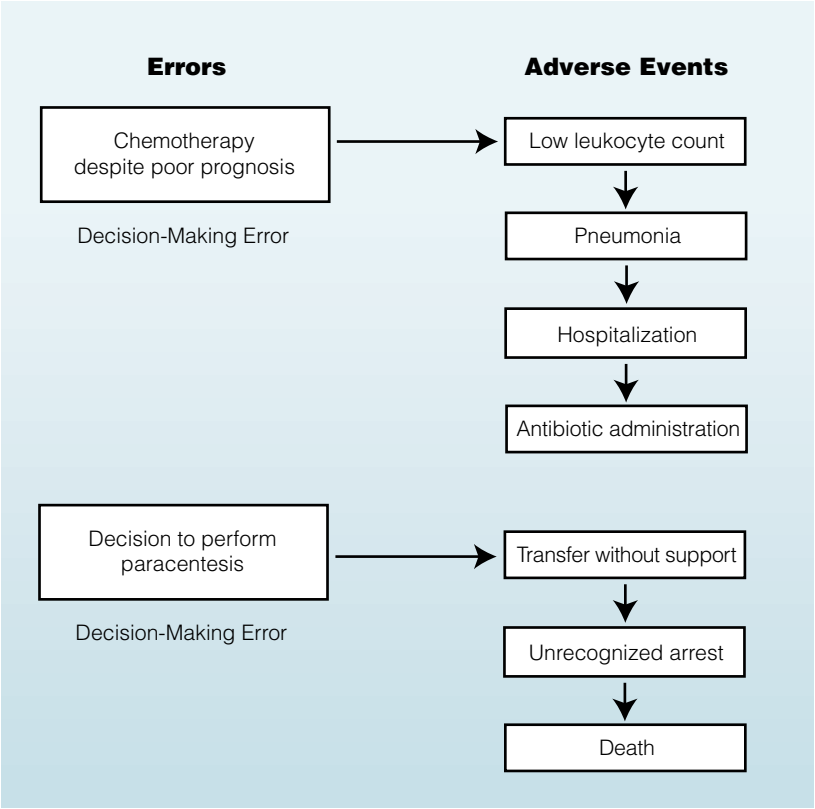

FIGURE 1. Case 1: chain of events.

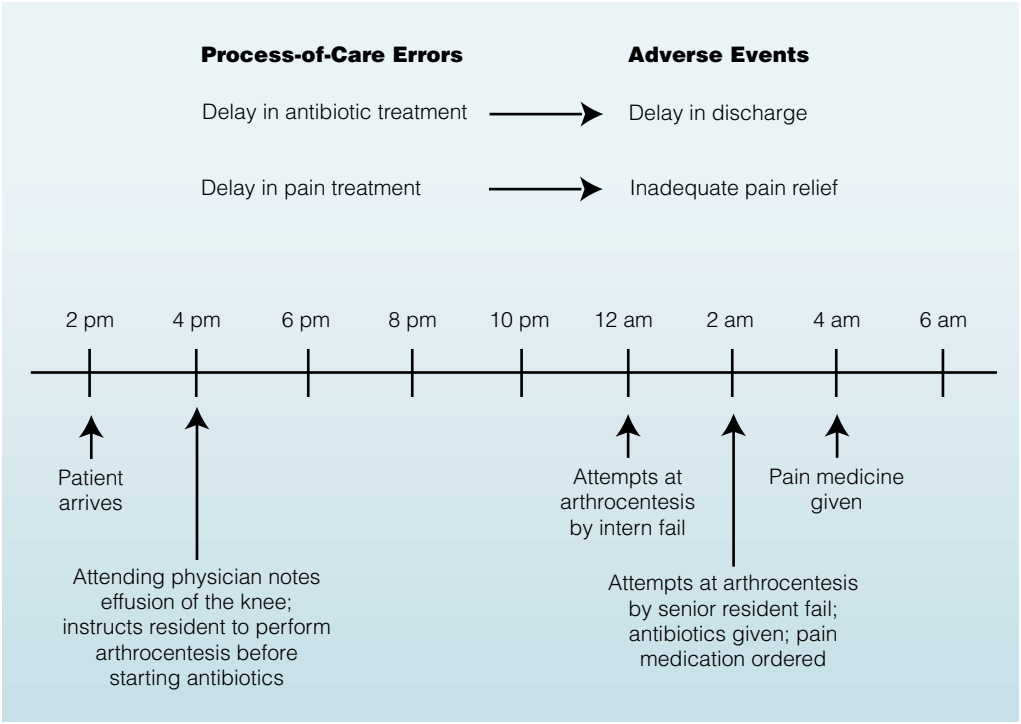

FIGURE 2. Case 2: prolonged hospitalization and inadequate pain relief.

(adverse event). Similarly, a delay in appropriate pain medicine (process-of-care error) led to inadequate pain relief (adverse event).

It was clear to our committee that errors occurred but it was less clear why they occurred. The root-cause analysis helps to determine appropriate remedies by identifying the cause that is most likely to constrain care. In this case, human factors were partially responsible because some patients were not receiving timely care in order for the residents to keep up with new admissions. The residents failed to prioritize care, but each felt they were providing the care that was necessary.

Ultimately, we felt that our policy to have care on the wards provided by the same team responsible for admitting new patients was the core problem—that is, we identified an organizational root cause of error: insufficient staffing. Therefore, we proposed to establish a "buffer" system for certain types of care,[18] changing our procedure policy to include an on-call "procedure team." In addition, the procedure policy would mandate that a cart containing pain medications and materials that may be hard to obtain late at night be available. Interns and residents might rotate on the procedure team to gain more experience performing procedures. We hope that this may also reduce delays due to inexperience, addressing a second (in this case technical) root cause of error: insufficient operator experience in performing arthrocentesis.

Lessons

- **Error detection requires in-depth chart review and interviews with providers.**
- **Process-of-care errors may have numerous causes.**
- **For process errors, the direct link between the cause and the error is often not obvious.**
- **Many factors may contribute to error. However, finding the step that most constrains the delivery of care (weakest link) may lead to greater reduction in errors.**
- **Root-cause analysis can help establish a list of the potential causes of error, prioritize them, and suggest solutions.**

Case 3: Anticoagulating a Hematoma

A patient was admitted at midnight with a swollen, tender left leg. She had been discharged 4 days earlier after a surgical procedure. Adequate prophylaxis for deep venous thrombosis (DVT) had been given during that admission. The admitting team viewing the leg made a presumptive diagnosis of DVT. An ultrasound was ordered, but there was no technician available in the hospital. The technician, at home on call, was notified. However, two more orders for ultrasound examinations were already awaiting the technician. The ultrasound team told the admitting team that there might be a 6-hour delay until the examination could be done, since the others were more urgent. The admitting team said they could wait but decided that the probability of DVT

was high enough to treat with anticoagulants. Anticoagulation occurred without incident, and laboratory values confirmed that anticoagulation was adequate. Other laboratory values remained normal, including the hemoglobin concentration. The ultrasound team finally arrived at 6:00 am. The ultrasound found a moderate-sized hematoma and no DVT.

The admitting intern informed the patient that she had "made a mistake" because she had made the wrong diagnosis and, hence, given the wrong treatment. The patient became upset and asked to be discharged from the hospital. Anticoagulation was stopped, and the effects reversed. The patient was discharged without complication. However, she asked us to forgive all expenses for her care.

Review

Our committee found no injury, no error in decision making, and no error in processes of care. The patient did not suffer an adverse event unless we considered the admission to be inappropriate, which we did not, because the definitive test to differentiate between a hematoma and DVT was not available at the time of admission. We also decided that the decision to use empirical anticoagulation was appropriate. Empirical therapy for serious illness when diagnostic testing is delayed or dangerous is common. Decision analysis experts use the concept of treatment thresholds as a standard for decision-making excellence when decisions are made under uncertain conditions.[19, 20]

No process-of-care error was noted, as anticoagulation was carried out without incident. We also did not consider the delay for the ultrasound a process error. Since the need for ultrasound testing is uncommon late at night, we did not feel that having a technician available at all hours was appropriate. Also, by chance, several ultrasound examinations were ordered at the same time and the triage was appropriate. Since our team did not find an adverse event or an error, the intern's disclosure of a mistake was premature. The intern stated that she had heard that all errors must be disclosed and she felt that she had to tell the patient. However, our committee identified no error. Hence, we felt the disclosure was a "false-positive," and trouble ensued.

Lessons

- **Not every adverse event is caused by an error.**
- **Physicians should be sure that an error has occurred before using the term *error*.**
- **When in doubt about error, consult colleagues or establish a committee that develops a standardized process for identifying error.**

Conclusion

We hope that these case presentations illustrate the difficult process required to fully understand medical error. Standard criteria are imperative if we are to agree on the definitions of decision-making and process-of-care errors. Also, a standard approach to determining whether an error has occurred requires extensive chart review and interviews with providers to fully understand the sequence of actions leading to an adverse outcome. It is useful to convene a committee of providers who will have the time to focus on defining, finding, and then reducing the risk for error.

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