1 Standardized Emergency Codes May Minimize “Code Confusion”
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7 Patient Flow in the ED: Phase II—Diagnostic Evaluation through Disposition Decision
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OBJECTIVE
The Pennsylvania Patient Safety Authority provides timely original scientific evidence and reviews of scientific evidence that can be used by healthcare systems and providers to improve healthcare delivery systems and educate providers about safe healthcare practices. The emphasis is on problems reported to the Pennsylvania Patient Safety Authority, especially those associated with a high combination of frequency, severity, and possibility of solution; novel problems and solutions; and problems in which urgent communication of information could have a significant impact on patient outcomes.

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CONSIDERATION OF SUBMITTED MANUSCRIPTS
Manuscripts consistent with the objectives of the Pennsylvania Patient Safety Advisory are welcome. For information and guidance about submission and instructions for authors, please contact the editor.
Standardized Emergency Codes May Minimize “Code Confusion”

INTRODUCTION

Emergency code terms, used to notify staff in a healthcare facility about an event that requires immediate action, vary significantly from facility to facility in Pennsylvania, which can cause confusion for healthcare providers.1 (For the purpose of this article, emergency code terminology will be referred to as “emergency codes” or “codes.”) This variation may lead to code confusion and cause a potential delay in care, a patient safety event, or confusion for healthcare providers who work in more than one facility.2,3

A survey by the Northeast Pennsylvania Regional Task Force’s Health, Medical and EMS Committee and a search of the Pennsylvania Patient Safety Reporting System (PA-PSRS) database for reports involving emergency codes revealed that from July 2004 through the end of 2013, Pennsylvania healthcare facilities used 80 different emergency codes. These codes were grouped by analysts into 37 categories that varied significantly in their purpose. For example, “code green” was used in different facilities to report a patient needing a rapid response, a combative person, a missing patient, a stroke, a fall, and an “all clear.”

A literature search showed that hospital associations in more than 25 states have recommended standardized emergency codes for their respective healthcare facilities. Several hospital associations have advocated using “plain language” codes based on recommendations from government agencies such as the US Department of Homeland Security.4 To help promote consistency for patient safety, Pennsylvania healthcare facilities may consider developing standardized emergency codes. This voluntary code standardization could reduce terminology variations, increase awareness and knowledge of healthcare professionals working in multiple facilities, and promote transparency of code meanings.

METHODS

To understand the range of codes and the possible complications associated with them in Pennsylvania, Pennsylvania Patient Safety Authority analysts queried the PA-PSRS database for all relevant events reported from July 2004 through December 2013, using keywords such as “code” and “condition.”

Using text mining (IBM SPSS Modeler 16.0), analysts were able to identify relevant terms through keyword proximity to other terms associated with emergency conditions in the descriptions of unsafe conditions and patient safety events, such as letters, numbers, colors, and other descriptive nouns (e.g., Armstrong, stroke, manpower), and to eliminate irrelevant terms, such as patient conditions, “barcode,” “codeine,” and electronic health record codes. Further analysis of the data was performed using terms that could be associated with emergency code events, such as “wrong,” “mistake,” “delay,” and “not called.” This was done to review if any events occurred when announcing an emergency code that compromised the safety of the patient.

In addition, Stephanie A. Gryboski, MS, manager, emergency management, Geisinger Health System, and chair of the Northeast Pennsylvania Regional Task Force’s Health, Medical and EMS Committee, which consists of about 80 members, conducted a survey in January 2014 to ascertain the differences in the code terms used in each of the committee’s healthcare facilities. Authority analysts reviewed the survey and incorporated the answers of the 34 respondents into the results found in the PA-PSRS database.
RESULTS
Types of Codes
Examination disclosed 80 emergency codes (in 37 categories) contained in PA-PSRS reports and the hospital survey from Pennsylvania healthcare facilities. These codes were used in 154 combinations of terminology and intended meanings. Analysts then categorized the terms as letters (e.g., code R, code STEMI), numbers (e.g., code 99, code 222), colors (e.g., code orange, code green), words (e.g., code triage), or names (e.g., Dr. Quick).

For example, there were over 15 different emergency codes used by Pennsylvania healthcare facilities to identify a combative person, including “code gray,” “Dr. Armstrong,” “code manpower,” “code 12,” “code control,” and “code green.”

In another example, “code yellow” meant a bomb threat in one facility and meant patient fall, internal/external emergency, and hazardous material spill in three other facilities. See Figures 1 and 2 for treemap representations of the number of codes used for specific conditions (Figure 1) and the number of different conditions associated with distinct codes, by category (Figure 2).

Figure 1. Number of Distinct Codes by Condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Code(s)</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disruptive/combative person</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Adult medical emergencies</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Emergency internal/external</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Bomb threat</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Rapid response</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Pediatric medical emergencies</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Infant/child abduction</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Fire</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Patient assist/lift</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Active shooter</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Lockdown</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Weather event</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>STEMI alert</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Note: Based on reports submitted to the Pennsylvania Patient Safety Authority from July 2004 through 2013 and a survey by the Northeast Pennsylvania Regional Task Force. The 16 conditions with only one distinct code were as follows: all clear, biological incident, blood needed, change in patient behavior, emergency department baby delivery, emergency department predive/ high census, emergency patient, hostage incident, labor and delivery requiring blood, medical gas system emergency, oxygen shut down, patient/family care concern, power failure, radiation incident, therapeutic hypothermia, and unusual event.

Figure 2. Number of Conditions Associated with Distinct Codes, by Category

<table>
<thead>
<tr>
<th>Color</th>
<th>Letter(s)</th>
<th>Name</th>
<th>Number</th>
<th>Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purple</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gray/grey</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pink</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stroke</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Based on reports submitted to the Pennsylvania Patient Safety Authority from July 2004 through 2013 and a survey by the Northeast Pennsylvania Regional Task Force. Fifty-nine distinct codes were used once for various conditions, as follows:

- Color (n = 5): crimson, gold, lavender, neon, rainbow
- Letter(s) (n = 16): A, condition A, condition C, condition O, D, H, I, MET, NBC, O, OB, O2, PALS, PCI, PERT, R, Z
- Name (n = 4): Dr. Armstrong, Dr. Gray, Dr. Quick, Dr. Strong
- Number (n = 12): 1, 2, 3, 6, 12, 30, 44, 45, 68, 77, 88, 222
- Word (n = 22): alpha, AVIOL, barker, chill, control, elopement, fall alert, hazmat, heart/heart alert, ice alert, lake, lift, MI alert, rapid response, STEMI, stork, stroke/alert, team, team delta, triage, wintergreen, wireless
Code Events

Analysis of the event reports identified 12 instances in which there was confusion when announcing an emergency code. No harm was reported for any of these events, but the potential for harm from delays in care or incorrect response team activation could be significant.

Examples representative of events caused by code confusion are as follows:

- **Operator called a “[Code] Team” instead of a “Code Green.”** The three warning bells were not used prior to calling the code. The room number was not entered on the text pager. The patient had an unresponsive episode. Unable to arouse. “Code Red” called by mistake, then “Code Blue” called immediately. Patient responded well.
- **Infant delivered and required resuscitation. Code pink button pushed but code blue paged overhead by operator.**

**DISCUSSION**

An emergency code system notifies staff in healthcare facilities about an event that requires immediate action. The intent is to relay urgent information in a timely, understandable manner and elicit the proper staff response.

Agency workers such as nurses; clinical staff such as physicians; first responders such as police, firemen, and paramedics; and nonclinical staff such as environmental services and security professionals may work at several facilities and may be particularly confused when having to remember several discrepant sets of emergency code definitions. A lack of standardization increases the potential for misunderstanding and delayed or inappropriate responses during serious and urgent situations.4

It is likely that the examples identified by the analysts underrepresent the actual number of emergency codes used in Pennsylvania. Additional emergency codes used by hospitals that were not associated with a specific event reported through PA-PSRS—and some types of emergency conditions and terms identified in the Northeast Pennsylvania Regional Task Force’s survey (e.g., medical gas system emergency)—would not be collected in the PA-PSRS reports submitted to the Authority, as they would be categorized as Infrastructure Failures.

**Standardization of Codes to Decrease Confusion**

Over 25 state hospital associations have recommended voluntary adoption of standardized emergency codes on a state level. As of 2014, Maryland is the only state that approved regulations (in 2003) mandating hospitals to adopt and implement uniform code terminology as part of their emergency or disaster plans.5

The Hospital Association of Southern California (HASC) was one of the first to propose voluntary standardization with its 2000 guidelines, as a result of a tragedy occurring after an emergency code was broadcast on an overhead speaker.5

In 1999, the West Anaheim Medical Center announced a code meant for a violent/combative person after a man entered the hospital carrying a gun. Following established response protocols, several hospital employees proceeded to the area where the gunman was located, unaware that the man was armed with a gun. The man opened fire and killed three hospital employees.6

A year after the tragedy, HASC adopted standardized healthcare emergency codes (see Table 1). The association recently published its fourth edition of *Health Care Emergency Codes: A Guide for Code Standardization*, which is aimed at assisting healthcare staff respond in a uniform way to situations that may occur in and around the hospital.2

After rollout of the voluntary emergency codes, a 2011 survey of California hospitals showed improved consistency in

<table>
<thead>
<tr>
<th>CODE NAME</th>
<th>EVENT TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>Adult medical emergency</td>
</tr>
<tr>
<td>Gray</td>
<td>Combative person</td>
</tr>
<tr>
<td>Green</td>
<td>Patient elopement</td>
</tr>
<tr>
<td>Orange</td>
<td>Hazardous material spill/release</td>
</tr>
<tr>
<td>Pink</td>
<td>Infant abduction</td>
</tr>
<tr>
<td>Purple</td>
<td>Child abduction</td>
</tr>
<tr>
<td>Red</td>
<td>Fire</td>
</tr>
<tr>
<td>Silver</td>
<td>Person with a weapon and/or active shooter and/or hostage situation</td>
</tr>
<tr>
<td>Triage external</td>
<td>External disaster</td>
</tr>
<tr>
<td>Triage internal</td>
<td>Internal disaster</td>
</tr>
<tr>
<td>White</td>
<td>Pediatric medical emergency</td>
</tr>
<tr>
<td>Yellow</td>
<td>Bomb threat</td>
</tr>
</tbody>
</table>

emergency response activation. Of the 240 hospitals that responded to the 2011 survey, 75% or more reported using the HASC-recommended emergency codes for a majority of their codes. About 80% of survey respondents separated the codes for a violent/combative person (i.e., code gray) and a person with a weapon (i.e., code silver).7

Review of codes recommended by several state hospital associations shows that there are inconsistencies among state code systems. Healthcare workers who travel between states need to know different code systems even if the healthcare facilities adhere to state-recommended standardized codes. HASC plans to recommend its code designations for all healthcare systems on a national level, according to Darren Morgan, chair, HASC Safety and Security Committee.8

Use of Plain Language to Clarify Meaning

State recommendations. In an effort to increase safety and better communication among staff, patients, and visitors, several hospital associations, including Colorado,9 Florida,4 Iowa,10 Minnesota,3 Missouri,11 and Wisconsin,12 have recommended the use of plain language. Plain-language systems, instead of systems based on colors, letters, names, or numbers, communicate information in a manner that is easily understood by listeners, which may include patients and visitors in addition to staff.3

A facility using plain language would announce the alert category, the specific code description, and the location of the emergency. For example, the announcer would state: “medical emergency, cardiac arrest, room 123.”

The Minnesota Hospital Association (MHA) Patient Safety Committee published a plain-language implementation guide. Steve Mulder, MD, chair of the committee, stated that he served on the medical staff of five different hospitals during his career and never knew all the “color codes” at any of the five.3 In a letter to Minnesota healthcare facilities, he stated, “I don’t think this level of ignorance is unique to me. The clear language policy offers a more practical and sustainable approach.”3

The Iowa Hospital Association (IHA) recommends the use of plain language instead of a color system.10 Kirk Norris, president and chief executive officer, IHA, states that alerts like “code blue,” “code pink,” and “code yellow” have been in existence for many years, but there is no uniform standard as to what they mean and this can cause confusion. Plain language helps to fulfill IHA’s commitment to safety and transparency. See Table 2 for the plain-language codes recommended by IHA.

National recommendations. The US Department of Homeland Security Federal Emergency Management Agency (FEMA) and the US Department of Health and Human Services advocate the use of plain language for all emergency communications. FEMA states, “It is important that responders and incident managers use common terminology.

<table>
<thead>
<tr>
<th>EVENT TYPE</th>
<th>PLAIN-LANGUAGE CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility</td>
<td></td>
</tr>
<tr>
<td>Evacuation</td>
<td>Evacuation + location + action required</td>
</tr>
<tr>
<td>Fire</td>
<td>Fire alarm + location + action required</td>
</tr>
<tr>
<td>Weather</td>
<td></td>
</tr>
<tr>
<td>Severe weather</td>
<td>Weather alert + descriptor + action required</td>
</tr>
<tr>
<td>Security</td>
<td></td>
</tr>
<tr>
<td>Abduction or elopement</td>
<td>Missing person + descriptor + action required</td>
</tr>
<tr>
<td>Acts of violence</td>
<td>Active shooter + location + action required</td>
</tr>
<tr>
<td>Bomb threat</td>
<td>Violent intruder + location + action required</td>
</tr>
<tr>
<td>Combative patient/person or show of force</td>
<td>Bomb threat + location + action required</td>
</tr>
<tr>
<td>Disaster (internal or external) (e.g., hazardous agent, chemical spill, power outage)</td>
<td>Security assistance requested + location + action required</td>
</tr>
<tr>
<td>Internal emergency + descriptor + activate incident command system</td>
<td></td>
</tr>
<tr>
<td>External emergency + descriptor + activate incident command system</td>
<td></td>
</tr>
<tr>
<td>Medical</td>
<td></td>
</tr>
<tr>
<td>Mass casualty</td>
<td>Mass casualty + descriptor</td>
</tr>
<tr>
<td>Medical emergency</td>
<td>Medical emergency + location</td>
</tr>
<tr>
<td>Obstetrics (OB) team activation</td>
<td>OB team + location</td>
</tr>
<tr>
<td>Rapid response team activation</td>
<td>Rapid response team + location</td>
</tr>
<tr>
<td>Stroke team activation</td>
<td>Stroke team + location</td>
</tr>
<tr>
<td>Trauma team activation</td>
<td>Trauma team + location</td>
</tr>
</tbody>
</table>

There simply is little or no room for misunderstanding in an emergency situation. The use of plain language in emergency response is a matter of public safety, especially the safety of first responders and those affected by the incident.13

The US Department of Homeland Security requires plain language for multiagency, multijurisdictional, and multidisciplinary events, such as major disasters and exercises.14 There is no requirement at the federal government level (or known state requirement) that mandates the use of plain language in daily operations inside of a single organization, such as a healthcare facility.

Uniformity Sought in Pennsylvania

Pennsylvania does not have a statewide standardized emergency codes system, according to Thomas L. Grace, RN, PhD, vice president, emergency preparedness, Hospital and Healthsystem Association of Pennsylvania (HAP).1

“While PA DOH [the Pennsylvania Department of Health] and HAP have not implemented specific guidance on the topic of emergency codes, our emergency preparedness staff have encouraged facilities to consider use of plain English announcement in place of codes,” Grace said. “Such an approach is guided by NIMS [the National Incident Management System] to reduce confusion and delays that can be experienced when codes are used during a crisis.”

Gryboski, of the Northeast Pennsylvania Regional Task Force, leads emergency management training for 8 hospitals, 5 helicopter transports, 78 clinic and outpatient facilities, and 2 research centers across the state.14 She advocated for uniformity of emergency codes for the facilities she manages and all Pennsylvania healthcare facilities.

Uniformity of codes is important for patients and staff safety, she said. “It is confusing for staff who go from one facility to another, and also for patients who go to different hospitals, when emergency codes have different meaning,” she said.

It is not only about the healthcare facilities, because the response needed to handle emergencies often requires help from others, such as the fire and police departments and other external emergency responders, she said.

The answers to the Northeast Pennsylvania Regional Task Force’s survey showed the lack of uniformity in the use of codes among these facilities. Some of the codes, such as “code red” and “code blue,” were common, but for a combative person, there was an array of codes used, Gryboski said. The committee would favor a uniform statewide system, she said.

Implementation

A transition to new emergency codes requires commitment, consensus, comprehensive education, and training. Several hospital associations provide consensus on terminology, training guides, policies and procedures, emergency code posters, and competency tests.15 Training is recommended for all staff, including physicians, as well as external emergency responders; a commitment from leadership is necessary.

CONCLUSION

There are no national or statewide standard definitions for emergency codes,15 and a variety of emergency codes, sometimes with conflicting meanings, are used throughout Pennsylvania’s healthcare facilities. More than 25 state hospital associations have recommended standardizing emergency codes within their states. Federal organizations and several state organizations recommend the use of plain language. Standardizing hospital emergency codes can benefit hospital employees and external emergency responders, as well as patients, by reducing code confusion and aiding staff in providing the correct response to emergencies.

NOTES

8. Morgan, Darrien (Chair, Hospital Association of Southern California Safety and Security Committee). E-mail to: Pennsylvania Patient Safety Authority. 2014 Jun 6.
Patient Flow in the ED: Phase II—Diagnostic Evaluation through Disposition Decision

INTRODUCTION
In a survey of departmental chairs and emergency department (ED) medical directors in Pennsylvania, 83.0% agreed that crowding was a problem, 84.0% reported that a high proportion of patients leave without being seen, 79.0% stated that quality of care suffers, and 65.0% reported that crowding had worsened in the past two years (the survey was conducted in 2008).1 EDs are an integral and unique part of the healthcare delivery system.2 Between 1995 and 2010, the total number of visits to EDs increased from 97 million to 130 million (34.0%), and the visit rate, which accounts for changes in population size over time, increased from 37 to 43 visits per 100 individuals (16.2%).3 According to the American Hospital Association, between 1991 and 2011, the number of hospitals with EDs decreased by 647.4 In Pennsylvania, 41 hospitals have closed since 2001, according to the Pennsylvania Health Care Cost Containment Council.5 The number of ED visits continues to rise.6,7

The care that is provided in EDs includes both emergency and primary care. ED staff must maintain the capacity to manage expected variation in patient volume as well as unpredictable surges caused by events such as natural disasters and multivehicle accidents, which may occur with limited or no advance warning.8 This article addresses patient safety related to ED flow, and it focuses on strategies to improve processes of care and patient safety during the diagnostic evaluation through disposition decision phase of ED care.

At present, most EDs have developed dashboards to help track quality improvement performance over time.2,3,5,9,10

COMPONENTS OF ED PHASE II
Phase II of ED flow, the focus of this article, encompasses much of the patient and caregiver activity in the ED and comprises key components of inputs (e.g., information) and outputs (e.g., decisions) and related activities, recognizing that these may be iterative and nonlinear processes.

Inputs
— Treatments and procedures (including medication): nursing and physician interventions, including ordering, completing, and patient response
— Diagnostic testing: radiologic, laboratory, respiratory (e.g., arterial blood gas), cardiac (e.g., electrocardiogram), or other test ordering, completion, and results reporting
REVIEWS & ANALYSES

— Monitoring and reassessment: routine observation, nursing reassessments, and physician reassessments
— Consults: specialists and hospitalists ordering, communicating, and completing consults (including requests for additional testing and treatment)

Output
— Diagnosis and disposition decisions (admit, discharge, or transfer): interpreting and assimilating the information from the inputs to reach a diagnosis, then determining disposition.

Figure 2 provides an illustration of the components of phase II.

---

Figure 1. Emergency Department Flow Phases

### PHASE I
Patient Arrival in the Emergency Department (ED) to Diagnostic Evaluation

**Includes:**
- Patient arrival in ED
- Patient triage
- Placement in treatment area
- Practitioner arrival/initial assessment

**Patient safety hazards:**
- Patients who leave without triage
- Unmonitored patients in waiting area
- Rushed or inaccurate triage process
- Patients who leave without being seen
- Unmonitored patients in rooms
- Rushed, incomplete, or inaccurate patient assessment

### PHASE II
Diagnostic Evaluation through Disposition Decision

**Includes:**
- Treatments and procedures
- Diagnostic testing
- Monitoring and reassessment (including continued physician and nursing assessments)
- Consults
- Diagnosing (including medical decision making)
- Disposition decision

**Patient safety hazards:**
- Patients who leave without being seen, leave without treatment, or leave against medical advice
- Unmonitored patients in treatment room
- Errors in ordering, executing, and resulting
- Delays in ordering, executing, and resulting
- Rushed, incomplete, or inaccurate patient assessment
- Diagnostic decision errors or failure to diagnose

### PHASE III
Disposition Decision to Departure from the ED

**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:**
- Gaps in treatment responsibility 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
Hazards

Each component is susceptible to patient safety hazards, including (1) rushed, incomplete, inaccurate, or omitted patient assessments and monitoring; (2) delays and errors in ordering, communicating, executing, and providing results of diagnostic tests, treatments, procedures, and consults; and (3) errors in interpreting, assimilating, and diagnosing to determine the correct disposition for the patient. Additionally, untoward events—such as falls and patients leaving without being seen or leaving against medical advice (AMA)—may occur, particularly when patients are left unattended in examination rooms or hallways or feel they have waited too long.

ED flow can both impact and be impacted by these components. A mass-casualty incident resulting in a sudden surge in patient volume or other causes of crowding creates an environment more susceptible to error, and any error or delay can interrupt or halt patient flow. When ED crowding occurs, the number of patients can outweigh available resources, potentially increasing patient safety hazards. ED crowding is also a hospital-wide problem. Escalation in ED patient population increases the demand on hospital resources such as ancillary services, operating rooms, and inpatient beds. Lack of availability of inpatient beds may result in admitted patients being “boarded” in the ED.

METHODS

Authority analysts queried the Pennsylvania Patient Safety Reporting System (PA-PSRS) database for events reported during calendar year 2013 that identified the ED as the care area; facilities reported 23,749 such events. An illustration of the data analysis methodology, Emergency Department (ED) Flow Phase II Methodology Algorithm, is available exclusively in the online version of this article.

Analysts identified events associated with phase II by first excluding reports with keywords relevant to phases I and III (e.g., “triage,” “arrived,” and “arrival” [phase I]; “discharge,” “dispo,” “inpatient,” and “admit” [phase III]). Of the remaining 17,561 reports, 14,642 were reported as an unsafe condition or no-harm event, with a harm score of A through C, and were excluded from analysis. The Authority’s event reporting system uses an adaptation of the National Coordinating Council for Medication Error Reporting and Prevention harm index and the Veterans’ Administration National Center for Patient Safety severity assessment code system to distinguish between harm and no-harm events. The Pennsylvania Patient Safety Authority Harm Score Taxonomy is available exclusively in the online version of this article.

The remaining 2,919 reports submitted as no-harm events requiring monitoring (i.e., harm score D) or as events resulting in harm or even death (i.e., harm scores E through I) were included in the analysis to ensure a large enough sample size to reflect the activity of this phase and to capture events resulting in harm that were reported as harm score D. These reports were individually analyzed to confirm they were ED events that occurred between diagnostic evaluation and disposition decision.

Non-ED and additional phase I and III reports were excluded (n = 90, 84, and 221, respectively). There was a small number of reports submitted as “unplanned returns to the ED” (n = 29); these events could not be attributed to a single phase and were also excluded from the analysis. Analysts sorted the resulting 2,495 reports into one of the phase II components depicted in Figure 2. Once sorted, analysts identified events associated with a stated or inferred delay (e.g., delay in administering the medication, wrong test ordered) using the key terms in “Types of Stated or Inferred Delay Key Terms,” available exclusively in the online version of this article.

RESULTS

As can be seen in Figure 3, the predominant number of events reported in phase II involved treatments and procedures (e.g., errors in ordering and executing, complications, adverse reactions). Stated and inferred delays were not frequently reported in this component.

Diagnostic testing reports comprised the third largest number of phase II input events submitted to the Authority but included the largest number of stated or inferred delays, both in absolute terms and as a percentage of total reports in each category. Reports also included errors in ordering, executing, and resulting, such as misidentification of patients, delays, contrast infiltrations, and laboratory or radiology test problems.

Monitoring and reassessment comprised the second largest number of phase II
REVIEWS & ANALYSES

input reports submitted to the Authority. Reports included unwitnessed falls with injury, leaving AMA or without treatment being completed, clinical status changes, equipment malfunctions, unplanned extubations, self-inflicted injuries, and accidental injuries during care (e.g., skin tears, injured body part). Falls comprised the largest number of reports in this component (n = 494, 77.5%).

Consults comprised the smallest number of phase II input reports submitted to the Authority. Stated and inferred delays were 50% of the reported consult events. The Table displays the number of phase II reports by component and provides examples of report narratives for each component. The potential hazards to patient safety are outlined in Figure 1.

DISCUSSION

EDs face the challenge of managing patient flow, crowding, and unpredictable surges in volume while maintaining patient safety. Phase II components comprise much of the patient and caregiver activity in the ED, often simultaneously (nonlinear) and iteratively (clinicians often must restart their care in light of new information [e.g., change in patient condition, new diagnosis]).

It is important to ensure patient safety during these activities. Delays can impact patient safety and flow. This is consistent with data from the survey conducted by Pines et al., which identified several factors affecting ED crowding in Pennsylvania hospitals, including ED inefficiency, radiology delays, and delays in consultation. Additionally, Farley et al. studied the use of electronic health record (EHR) systems in the ED and their impact on the quality and safety of the care delivered and reported the potential harm from an inferior EHR product or suboptimal execution of that product in the clinical setting.

Because of the numerous and varied activities of each component, as seen in the narratives, general principles are provided to enhance patient safety during ED phase II.

Inputs

Treatments and procedures. The Joint Commission states these general principles to minimize safety hazards when administering treatments and procedures:

- Use two patient identifiers when providing care, treatment, or services, including blood transfusions, and label specimen containers in the presence of the patient.
- Check for allergies and, if possible, set alerts in the EHR to warn of allergies, contraindications, and interactions.
- Use checklists when performing complex procedures such as central-line or chest tube insertions.
- Reconcile medications.
- Reduce the likelihood of patient harm associated with anticoagulant use, such as by using approved protocols and programmable pumps.
- Involve the patient whenever possible.

Diagnostic testing. Review testing protocols to assess for opportunities for improvement. For example, in an arterial blood gas needle study, larger-gauge needles caused more complications and had a poorer success rate than smaller needles. In addition to the recommendations above, the following are general principles to increase the likelihood of success without incident:

- Simplify and standardize patient identification and specimen labeling procedures.
- Verify the identity of the patient before entering orders or performing testing, especially where laterality is concerned.
<table>
<thead>
<tr>
<th>NO. OF REPORTS</th>
<th>COMPONENT</th>
<th>NARRATIVE EXAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,191</td>
<td>Treatments and procedures</td>
<td>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. Patient was emergently intubated, and upon reviewing x-rays, a tracheal tear [was suspected]. [Patient was taken to surgery,] and tracheal tear repaired. [There were several] IV [intravenous] attempts, causing delay in [administering] IV medications, hydration, and CT [computed tomography] scan.</td>
</tr>
<tr>
<td>623</td>
<td>Diagnostic testing</td>
<td>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]. Respiratory therapist drew an ABG [arterial blood gas], which resulted in a large hematoma formation. [Lab] specimens were in one bag with two different [patient identification] labels. Specimen[s] were re-collected. Due to [multiple other patients], there was a [four-] hour delay in having a CT scan performed on the patient. Specimen tubes were sent to lab via the [pneumatic] tube system; however, lab never received them. After waiting [nearly an hour] for maintenance to repair system, had to redraw patient’s blood work.</td>
</tr>
<tr>
<td>637</td>
<td>Monitoring and reassessment</td>
<td>Patient was [found unresponsive] while toileting. Patient required intubation and admission. A noise was heard in patient’s room. The patient was found on the floor. A CT scan showed a subarachnoid bleed and [nasal] fractures. Patient was waiting for results, became tired of waiting, and left with the IV [line] in place. Unable to reach patient by phone, and police were notified. Police unable to locate patient. Monitor alarming and pulse ox decreased and heart rate correlated; however, the oxygen tank ran out, and patient was [experiencing] of shortness of breath.</td>
</tr>
<tr>
<td>22</td>
<td>Consults</td>
<td>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 cath lab. Neurology consult was not called in when ordered [resulting in a delay]. Patient was assigned to a physician who was not on duty in the ED at the time. This resulted in a critical test result not being reported to a physician.</td>
</tr>
<tr>
<td>22</td>
<td>Diagnostic decision process</td>
<td>The ED read the EKG as [normal] without significant changes, and cardiology read as ST [segment] elevation, possible ACS [acute coronary syndrome]. 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. Patient was diagnosed with fractured ribs. X-rays [done and read by the ED] stated no pneumothorax. [Radiology] read the x-ray as [positive for] pneumothorax.</td>
</tr>
</tbody>
</table>
(continued from page 10)

**Monitoring and reassessment.** Protocols and toolkits are available to evaluate and improve patient monitoring and assessments. A falls risk assessment is considered best practice, regardless of the clinical setting, including assessing for risk of injury, screening for a history of falls within the previous 12-month period, asking about gait or balance problems in patients who have not had a fall in that time period, and performing simple mobility testing (e.g., Timed Up and Go). Effective falls prevention interventions are multifaceted and can be tailored to patient characteristics, risk factors, and clinical settings.

Patients requiring mechanical support or device-related monitoring (e.g., ventilator, telemetry, pulse oximetry) require expert care and ongoing monitoring of their clinical status. Monitoring failures such as alarm fatigue and limitations of monitoring systems have been discussed in the literature. Being aware of the monitoring device limitations, tailoring device default settings to the individual patient, using unit-wide alarm notification, and ensuring staff competency are some strategies to reduce hazards and enhance outcomes when employing mechanical support and device-related monitoring.

Patients leaving the ED before being seen or receiving treatment are also reported in the literature. According to the Agency for Healthcare Research and Quality’s guide for hospitals, “In 2007, the most recent year for which data are available, 1.9 million people—representing 2 percent of all ED visits—left the ED before being seen, typically because of long wait times.” Patients who leave AMA are at an increased risk of mortality and readmission and are a significant source of stress for ED physicians. Strategies to prevent patients from leaving the ED prematurely include decreasing wait times, providing frequent communication and updates about wait times and statuses, determining what constitutes a medically safe treatment plan, understanding what motivates the patient, and actively inviting the patient back for continued care and treatment.

**Consults.** The timeliness of consults can be enhanced. Delays in specialty consultations in the ED and for admitted ED patients contribute to increased lengths of stay, long wait times, and patients leaving before treatment is complete. Critical specialists are often unavailable to the ED, and three-quarters of hospitals report difficulty finding specialists to take call and cover these types of ED patients. In 2003, 53% of ED directors in Pennsylvania reported that on-call specialist availability had worsened and contributes to poor flow and crowding.

Recent literature points to some unique approaches to addressing consultant and hospitalist response times, such as implementing short electronic messaging reminders (e.g., via pager or cell phone), organizational response time guidelines, and active bed management strategies (e.g., hospitalist-managed admissions). In one study, the department of general internal medicine used a quality improvement initiative involving education, goal-setting, and performance feedback to improve ED flow of admitted medical patients. Timeliness goals were set, such as a one-hour target from consultation request to admission order entry, and personal performance feedback was provided to the resident every two weeks with comparative mean data. In addition, telemedicine has been shown to improve timeliness and quality of care in rural settings, with stroke care, and in the prehospital setting.

**Output**

**Diagnostic decision process.** Events related to the diagnostic decision process comprised less than 1% of the total number of ED phase II event reports submitted to the Authority in 2013. The diagnostic decision process reports included unplanned returns to the ED within 24 to 48 hours requiring an admission, discrepancy between the ED interpretation of the x-ray or EKG and the final reading, incorrect readings, and delays. Only one report stated that a delay contributed to the event.

While it is beyond the scope of this article to address diagnostic error, it is worth mentioning in the context of this component. The impact of diagnostic errors on patient care is receiving increasing attention. A diagnostic error is defined as a “diagnosis that is wrong, missed or delayed.” Diagnostic error rates have been estimated to be between 0.6% and 12.0%. In a webinar, Dr. Mark Graber stated that “most diagnostic errors are made by excellent clinicians in first-rate healthcare organizations.” Organizations exist that focus on efforts to study and address diagnostic errors. Strategies to prevent diagnostic errors include identification and measurement. Practical steps include finding and learning from errors, hosting grand rounds on diagnostic error, and establishing ways for providers to receive feedback. Errors in radiologic diagnosis in particular have received attention and arise during acquisition and processing of images (diagnostic testing errors) and during interpretation.

Dispositions include decisions to admit, transfer, or discharge a patient with follow-up care or instructions. The disposition decision is one of the most important decisions made during the ED visit and is the culmination of the inputs received and diagnosis formed. According to a Centers for Disease Control and Prevention report, “In 2009-2010, 81% of emergency department visits were discharged for follow-up care as needed, 16% ended with the patient being admitted to the hospital, 2% ended with patient leaving without completing the visit, and less than 1% ended in the
not just treat it as an ED problem.12 It is important for hospitals to manage patient flow and reduce ED crowding.10

**Patient Flow Best Practices**

The 2011 Agency for Healthcare Research and Quality guide for hospitals Improving Patient Flow and Reducing Emergency Department Crowding provides comprehensive information on addressing ED flow and was “compiled from the experiences of the hospitals affiliated with Urgent Matters, a national program funded by the Robert Wood Johnson Foundation dedicated to finding, developing, and disseminating strategies to improve patient flow and reduce ED crowding.”10 It is important for hospitals to manage patient flow as an organization-wide concern and not just treat it as an ED problem.12

**Patient Tracking Systems**

Patient tracking systems vary and are often used in combination. For example, white boards or computerized boards with or without manual or electronic interfaces may be used to provide information at the system (ED) level while electronic and passive radio-frequency identification locators may provide information at the individual patient level. Regardless of the system, tracking ED patients in real time provides information to the provider about the patient’s status relative to interventions and location. Ensuring the ED staff can track waiting patients is an efficient care strategy to improve flow.20 Early warning systems and overcrowding quantifiers such as the Emergency Department Work Index and the Emergency Department Overcrowding Scale have been employed to alert clinical and administrative staff prior to overcrowding.53

EDs may also benefit from using a gatekeeper for patient flow. One study empowered the charge nurse to be the gatekeeper by problem-solving during volume surges, coordinating assessments and interventions, and expediting bed access.2 In an interview with Thomas Kurtz, MHS, PA-C, EMT-P, CHEP, senior director of clinical operations at Aria Health, he described the successful use of the ED charge nurse in the role of bed coordinator for improved bed assignment and flow.14 Additionally, staff wear walkie-talkies with earpieces, and according to Mr. Kurtz, “This improves communication and decreases the amount of walking through a large department to assess bed status and communicate with staff.”14

In a systematic review of the literature, Dobson et al. found 22 relevant articles supporting the use of tracking technology to enhance patient safety or improve efficiency.55 In an interview, John J. Kelly, DO, FACEP, associate chair and director of ED quality improvement and patient safety at Einstein Medical Center (EMC), describes the use of a passive tracking system in the form of an electronic badge attached to patients, staff, ED physicians, and consultants and equipment with sensors in the ceiling that provide real-time information and help the ED to adjust operations to enhance flow.56 This system interfaces with the EHR system to provide visual cues on the computers. Some best practices for improving patient flow with technology include examining variations in work processes and in patient volume, viewing patient flow as a system-wide phenomenon, and using a multidisciplinary team to identify opportunities for improvement; aggregated data can support computer simulation to identify system bottlenecks and inform interventions to improve patient flow.57,58

**Robust Hospital Surge Capacity Plans**

In an ED, patient volume can increase suddenly and unexpectedly and can negatively impact patient flow and safety. Hospitals are “first responders” to disasters, and regulatory agencies mandate that hospitals have surge plans in place.3,4,17 The key to adequately managing this increase is to have a hospital-wide surge capacity plan, which, according to an American College of Emergency Physicians’ position statement, “requires augmenting existing capacity as well as creating capacity by limiting elective appointments and procedures and practicing ‘surge discharge’ of patients that can be effectively managed in non-hospital environments.”59

Since September 11, 2001, substantial resources have been allocated to surge capacity capabilities.50 Non-surge or disaster patients continue to arrive at the ED during surge or disaster events, and EDs must be prepared to manage surges while continuing to manage normal operations. Aspects of a comprehensive surge capacity plan include ensuring the plan is hospital-wide; addressing the need for increased staff, space, and supplies; clearing the ED to accommodate casualties; avoiding ED crowding to preserve access; and maintaining preparedness by conducting drills.50,62

**Flow Enhancement Mechanisms**

The following are mechanisms that can enhance ED operations and improve efficiency:

**Chest pain/observation units.** Chest pain is a common complaint among ED patients, and conducting a comprehensive cardiac evaluation takes time. Implementation of a separate chest pain unit can improve care for patients and decompress the ED. Chest pain units have been shown to increase the number of patients discharged, thus decreasing both unnecessary admissions and the number of patients leaving AMA.63,64 Dr. Kelly attributes improved ED efficiencies to having a stand-alone observation unit, managed by ED staff, for those patients not needing admission but requiring longer stays for observational purposes.56 The American College of Emergency
Physicians endorse and has set forth principles of best practice for the observation of appropriate ED patients.63

**Diagnostic services within the ED.** Having diagnostic testing services, such as point-of-care (POC) laboratory testing and radiology available within the ED, can improve turnaround times. POC laboratory testing has been available for decades and includes blood glucose, urine dipsticks, and rapid strep tests. New POC testing is emerging, such as complete blood count, platelet functioning, and platelet reactivity tests.66,67 While POC testing provides rapid results and is efficient, the testing does have a risk of error if quality controls and staff competency are not maintained.68

Dr. Kelly attributes improved radiology turnaround times to in-department x-ray and ultrasound rooms, a 64-slice computed axial tomography (CAT) scanner, and radiology technicians to staff the rooms.56 When Aria Health built its expanded ED at the Torresdale campus, x-ray and CAT scan rooms were built within the ED and staffed with dedicated radiology technologists. “These rooms improve the radiology turnaround times,” says Mr. Kurtz.84

POC ultrasound in the ED positively affects safety and flow.69 POC ultrasound, including echocardiogram, is commonplace in the ED, and it is imperative that practitioners be accurately trained. Errors may be reduced by improvements in knowledge and systems, such as ensuring careful selection of the proper study and awareness that the clinical picture takes priority over images, defining the benefits of appropriate use, limiting unnecessary imaging, and analyzing error.91,69,70

**Scribes or voice recognition software (VRS).** Studies have shown that EHR and computerized physician order entry systems can have negative effects on ED flow and patient satisfaction.71,72 Scribes have shown to improve “doc-to-dispo” time (phase II) and patient satisfaction scores.71 Another study found that scribes improved the number of patients treated per hour and the relative value units generated per hour but not the overall turnaround time to discharge.73

Similarly, VRS can aid physicians with clinical documentation. In one study, VRS used for physician charting in the ED resulted in shorter turnaround times; it was also less expensive and nearly as accurate as traditional transcription.74 Dr. Kelly’s facility uses a voice recognition program, and he says that “it is essential to optimizing the use of the EHR.”56 At EMC, VRS is used in real time during patient care, at the end of care to summarize the visit, and for creating discharge instructions.75 Mr. Kurtz’s facility uses scribes and says, “Scribes are able to assist the physicians with their workflow, such as reminding them of tasks and presenting them with test results, and this additional support improves flow.”84

**In situ simulations.** These simulations, which involve care providers managing a simulated patient in an actual patient care environment, may be used to identify and mitigate conditions that adversely impact flow. Protocols and focus groups do not always bring to light the actual conditions under which patient care is accomplished. Healthcare providers, in their determination to provide optimal care, often compensate for resource or other limitations by creating workarounds or temporary solutions. Simulation provides an opportunity to identify process problems and to iteratively test potential improvements.76

**Measuring ED Performance**

Measurement is a basic quality improvement principle. In order to manage patient flow and improve safety, facilities are encouraged to understand performance through measurement. The Centers for Medicare and Medicaid Services has mandated the collection and reporting of ED throughput and clinical measures.26 The Joint Commission prescribes adherence to standards to manage the flow of patients throughout the hospital, boarded patients in the ED, ambulance diversion, the safety of areas where patients receive care, and care of patients in overflow areas such as hallways.17

Measures to assess ED flow include patient volume by hour, staffing measures (number and complement per shift), and total ED length of stay and its submeasures (e.g., time of patient arrival to triage, time in treatment room until being seen by a provider, time from provider assessment to disposition decision, time from disposition to departure from ED).2,3,10,36 Measures specific to crowding include ambulance diversions (number by hour and month), boarding of patients (number and duration), wait times (minutes), and patients leaving before care is complete (AMA, left without being treated, and elopements).2,10

In 2011, Hwang et al. published results of a comprehensive systematic review of measures of crowding in the ED and concluded that a combination of time interval measures (e.g., length of stay) and patient count measures (e.g., census) is emerging as the most promising approach for measures of flow and nonflow, respectively.77 An ED dashboard, inclusive of a set of representative measures, is a sound operational tool to capture performance over time to allow for tracking, trending, and improvement.

**LIMITATIONS**

Data searched was limited to events reported under the ED care area; relevant reports for which an ED location was misclassified would not have been captured. Similarly, removing reports based on the phase I and III keyword sort at the beginning of the analysis may have eliminated some phase II reports. The search for reports on inferred delays is limited by the information provided in PA-PSRS event report narratives. Instances of diagnostic
CONCLUSION

EDs provide 24/7 emergent, urgent, and nonurgent care, including specialized resources. EDs care for all patients regardless of ability to pay and must ensure staff and facilities are prepared to care for sudden large influxes of patients. As the number of EDs decreases and volume of patients increases, EDs are challenged to provide safe, timely, efficient, and efficacious care to the communities they serve. Analyzing and understanding the key components of phase II, employing best practices in patient flow, and improving and standardizing operations from diagnostic evaluation through disposition decision improves timeliness of care, limits the opportunity for hazard occurrence, and directly contributes to the safety of patients in this phase of ED treatment. Managing patient flow with mindfulness toward safety can positively impact patient care. Balancing the management of patient flow while mitigating hazards to patient safety is a continuous process. Further analysis and research on individual hazards to patient safety within each component could expand the cumulative knowledge of error prevention and safety in the ED. A review and analysis of event reports for phase III, from disposition decision to departure from the ED, is planned.

Acknowledgments
Edward Finley, BS, data analyst, Pennsylvania Patient Safety Authority, contributed to the abstraction, analysis, and preparation of data for this article.

NOTES

20. ECRI Institute PSO. ED wait times: don’t just “go with the flow,” improve it! PSO Monthly Brief 2012 Feb.


LEARNING OBJECTIVES

— Recognize common emergency department (ED) flow and throughput performance measures.
— Distinguish ED crowding measures from ED flow and throughput measures.
— Recall the most frequent phase II component events reported to the Pennsylvania Patient Safety Authority.
— Select the phase II component delay type depicted in a scenario.
— Identify best practices that can be implemented to manage patient flow.

SELF-ASSESSMENT QUESTIONS

The following questions about this article may be useful for internal education and assessment. You may use the following examples or come up with your own questions.

1. Which of the following is not a measure of ED flow and throughput?
   a. Number and complement of staff per shift
   b. Patient arrival time to discharge time in minutes
   c. Patient volume by hour
   d. Total ED length of stay (arrival time to departure time) in minutes
   e. Number of ambulance diversions per hour

2. Which of the following is not a measure of ED crowding?
   a. Boarding patients (number and duration)
   b. Patient arrival time to triage time in minutes
   c. Number of patients leaving before treatment is complete
   d. Patient wait times in minutes
   e. Number of ambulance diversions per hour

3. Which component was involved in the greatest number of phase II events reported to the Authority?
   a. Treatments and procedures
   b. Diagnostic testing
   c. Monitoring and reassessment
   d. Consults
   e. Diagnosing

Question 4 refers to the following scenario:

A patient’s elbow was aspirated for synovial fluid. The resident sent the tubes to the lab and then gave the ED unit secretary the lab order sheet with the orders for a routine synovial fluid analysis, including a culture and sensitivity (C&S) test. The unit secretary became distracted when entering the orders and only entered orders for the C&S. The lab “held” the other synovial fluid tubes but failed to cross-check the computer orders with the ED order sheet. The routine synovial fluid analysis was not run until the resident, who was looking for the results two hours later, discovered the error.

4. Which of the following components represents the delay type depicted in this scenario?
   a. Treatments and procedures
   b. Diagnostic testing
   c. Monitoring and reassessment
   d. Consults
   e. Diagnosing

5. All of the following are examples of patient flow best practices except:
   a. Consults
   b. Robust hospital surge capacity plan
   c. Diagnostic services in the ED
   d. Patient tracking systems
   e. Use of dashboards
Wrong-Site Orthopedic Operations on the Extremities: The Pennsylvania Experience

INTRODUCTION

Wrong-site procedures (procedures done on the wrong side, wrong body part, or wrong patient, or the wrong procedure) occurred once for every 63,603 procedures in Pennsylvania in 2010-2011. The probability of performing a wrong-site procedure is reportedly 25% for orthopedic surgeons and 21% for hand surgeons. PIAs, formerly the Physician Insurers Association of America, reported medical liability averaging $133,047 for wrong-site orthopedic procedures in 2008 US dollars. Since June 28, 2004, the Commonwealth of Pennsylvania has required all hospitals and ambulatory surgical facilities to report all medical errors involving patients, including all wrong-site procedures, to the Pennsylvania Patient Safety Authority. The Joint Commission implemented its Universal Protocol July 1, 2004.

Over the first nine years of reporting (July 2004 through June 2013), the Authority received 541 reports of wrong-site procedures in the operating rooms (ORs) of Pennsylvania hospitals and ambulatory surgical facilities. Since June 2007, the Authority has focused efforts on a program to prevent wrong-site procedures in ORs. The program to prevent wrong-site surgery has identified 21 evidence-based best practices to prevent wrong-site surgery, from indicating the site of the surgery when scheduling the procedure to doing intraoperative verification of vertebral levels for spinal surgery (see “Principles for Reliable Performance of Correct-Site Surgery” online at http://patientsafetyauthority.org/EducationalTools/PatientSafetyTools/PWSS/Pages/principles.aspx). Although identification of these best practices was not sufficient to reduce wrong-site surgery, collaborative efforts with facilities to implement the practices has resulted in a 37% reduction of wrong-site procedures.

Given the number of wrong-site procedures analyzed, the Authority has been able to discern differences in the relative importance of best practices and nuances in best practices within different specialty areas—for example, anesthetic blocks, procedures for pain relief, stenting of the ureters, spinal operations, and excisions of skin and subcutaneous lesions. Because procedures on the hand and on the knee are among the seven most common procedures to be done at the wrong site and represent 11% of all wrong-site procedures in the OR, the Authority undertook an analysis looking for specific information about causes of wrong-site surgery and possible preventive steps for extremity procedures typically done by orthopedic surgeons.

METHODS

Using a combination of search terms, including event location, event type, and keywords in the narratives, all potential wrong-site procedures in Pennsylvania ORs are identified weekly in reports to the Pennsylvania Patient Safety Reporting System. The potential events are reviewed separately by two patient safety analysts to identify actual wrong-site procedures. The National Quality Forum definitions of wrong-site procedures are used; specifically, the procedure begins when the skin is punctured, even if corrected intraoperatively. Relocation of the operative site to the correct site resulting from recommended intraoperative radiographic verification, such as with vertebral surgery, is not considered a wrong-site procedure. Discrepancies in the reviews of potential wrong-site procedures are resolved by a combination of follow-up questions to the reporting facilities and/or discussion until consensus is reached. The wrong-site procedures are then classified as to type of wrong-site error, type of procedure, and compliance or noncompliance with the 21 evidence-based best practices for preventing wrong-site surgery.
Procedures not done in hospital ORs or ambulatory surgical facilities are excluded from this analysis. Because the usual causes are different, the Authority excludes wrong implants, such as a left knee implant incorrectly inserted during a correct right knee replacement, from the analysis even though wrong implants meet the National Quality Forum definition of wrong procedure.17

For this analysis, all wrong-site procedures classified as procedures on the extremities were considered. The following were then excluded from the cohort: anesthesia blocks done by anesthesia providers, vascular procedures, insertions of implantable medical devices (such as delivery systems), and excisions of skin and subcutaneous lesions.

Included were procedures involving feet (including toes), ankles, tibias and fibulas, knees, femurs, hips, pelvic bones, shoulders, humeri, elbows, forearms, wrists, and hands (including digits).

The collection and analysis of the information reported through the Pennsylvania Patient Safety Reporting System is mandated by Pennsylvania law.5 Because the Pennsylvania law prohibits identification of individual patients or providers in the reports,1 it is impossible to confirm the specialty of the providers. All of the procedures could have been done by orthopedic surgeons, although some may have been done by plastic surgeons or general surgeons doing hand surgery, neurosurgeons doing peripheral nerve surgery, or podiatrists.

The analysis presents the results of the classifications of the wrong-site OR extremity procedures within the domain of orthopedic surgery and identifies common patterns.

RESULTS

Of the 541 reports of wrong-site procedures in Pennsylvania hospital and ambulatory surgical facility ORs in the nine years from July 2004 through June 2013, 83 (15%) were extremity-related procedures within the domain of orthopedic surgery (see Table 1). The most common parts of the extremities involved were the hand (6% of all reports), the knee (5%), and the foot (3%).

Three wrong-side hip procedures were identified: one was for the repair of a hip

Table 1. Wrong-Site Operating Room Procedures of the Extremities within the Domain of Orthopedic Surgery in Pennsylvania Hospitals and Ambulatory Surgical Facilities, July 2004 through June 2013, by Body Area

<table>
<thead>
<tr>
<th>AREA</th>
<th>WRONG-SITE PROCEDURES</th>
<th>% OF TOTAL</th>
<th>WRONG SIDE</th>
<th>WRONG SITE GENERAL</th>
<th>WRONG LEVEL</th>
<th>WRONG SITE UNSPECIFIED</th>
<th>WRONG PROCEDURE</th>
<th>WRONG PATIENT</th>
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</thead>
<tbody>
<tr>
<td>Foot</td>
<td>14</td>
<td>2.6</td>
<td>7.5*</td>
<td>5.5</td>
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<td>0</td>
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<td>Ankle</td>
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<td>0</td>
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<td>Knee</td>
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<td>6.3</td>
<td>0</td>
<td>19</td>
<td>0</td>
<td>2</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Elbow</td>
<td>4</td>
<td>0.7</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Total extremity</td>
<td>83</td>
<td>15.3</td>
<td>35.5</td>
<td>29.5</td>
<td>0</td>
<td>2</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>Spine</td>
<td>74</td>
<td>13.7</td>
<td>10.5†</td>
<td>0</td>
<td>63.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Procedures in other surgical domains</td>
<td>211</td>
<td>39.0</td>
<td>125</td>
<td>36</td>
<td>1</td>
<td>0</td>
<td>42</td>
<td>7</td>
</tr>
<tr>
<td>Blocks by anesthesia professioners</td>
<td>115</td>
<td>21.3</td>
<td>113</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Procedures for pain relief</td>
<td>58</td>
<td>10.7</td>
<td>44</td>
<td>0</td>
<td>7</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td><strong>Grand total</strong></td>
<td><strong>541</strong></td>
<td><strong>100.0</strong></td>
<td><strong>328</strong></td>
<td><strong>66.5</strong></td>
<td><strong>71.5</strong></td>
<td><strong>3</strong></td>
<td><strong>63</strong></td>
<td><strong>9</strong></td>
</tr>
</tbody>
</table>

* One procedure was done at the wrong site of the wrong foot.
† One procedure was done on the wrong side of the wrong spinal level.
fracture, one for a total hip replacement, and one for an injection into the hip joint for pain relief. All three just involved violation of the skin and were identified in the OR, with the correct procedure then being performed.

Of the four wrongsite elbow procedures, three involved the wrong part of the correct elbow and one involved a wrong procedure.

Two wrong-side ankle procedures were identified, and both involved arthroscopies.

One wrongsite procedure involved operating on the wrong end of the femoral shaft to remove hardware.

Wrongsite procedures on the hand, knee, and foot were analyzed in detail for patterns.

**OR Procedures on the Hand**

Wrongsite hand procedures were the most common wrongsite extremity-related procedures (n = 34) within the domain of orthopedic surgery (see Table 1) and were the fourth most common type of wrongsite procedures overall.

All of the reported wrongsite hand procedures were incisions made at the wrong site on the correct hand, when the site was specified in the report. (Two reports provided no detailed information beyond the report of an operation at the wrong site.) Of the 32 reports providing information for analysis (see Tables 2 and 3), 19 were classified as procedures that were started or done at wrong sites. The other 13 were classified as starting or completing the wrong procedure.

Of the 19 procedures at the wrong site, 12 involved operating on an adjacent finger. Another five wrongsite procedures involved remote digits (one), fingers versus metacarpals (two), palm versus wrist (one), and anterior versus posterior wrist (one). Two other reports described the sites in nonanatomic terms.

Of the 19 procedures at the wrong site, 6 procedures (4 involving the wrong finger and 2 confusing fingers and metacarpals) mentioned pins, K wires, or open reductions and fixation of fractures or dislocations.

Of the other 13 reports classified as starting or completing the wrong procedure, 9 stated that an incision was made for a carpal tunnel release instead of an intended trigger finger release. Two of those carpal tunnel releases were completed before the error was detected. Making an incision for a carpal tunnel release when the intended procedure was a trigger finger release was the second most common wrongsite error made for extremity procedures within the domain of orthopedic surgery, behind wrongknee injections (see below). This one scenario represented 26% of all wrongsite hand procedures and 11% of all wrongsite extremity procedures within the domain of orthopedic surgery. It was also the subject of a case report in the New England Journal of Medicine.18 Another two of the four remaining reports also stated that an incision was made for a carpal tunnel release instead of the intended procedure.

Failure to follow evidence-based best practices9 for two steps of the Universal Protocol6 (marking the site and doing a time-out) was cited in multiple reports of wrongsite hand procedures.

Site markings were mentioned in 11 reports, with suboptimal practices mentioned in 8 of the 11. Examples of suboptimal site marking practices included marks made remote from the site (on the arm, on the forearm), made in areas that could be confused with the operative site (the palm), made ambiguously (“X,” below the incision site), not done, washed off by the skin prep, and done in the OR rather than before entering the OR.

Time-outs were mentioned in 17 reports. They were noted to have been done before beginning the operation in 12 of the 17, with specific mention that they were done correctly in 7 of the 12 and that the correct site was stated in 6 of the 7 prior to the incision being made at a wrong site. Time-outs were not done according to two reports, and the surgeon began to operate before or during the time-out in another three.

Problems with site markings and time-outs are illustrated by these contextually deidentified reports:

48-year-old scheduled for left trigger thumb release. Left arm site marked per policy. Left hand positioned on OR table and draped. Hand positioned by assistant for left carpal tunnel. Time-out called by circulating nurse, noting procedure: trigger thumb release on left hand. Procedure started with a 2 cm incision of the skin for a carpal tunnel release.

Patient scheduled for release of a trigger finger of the right hand. Consent indicated the same. Site was marked by the surgeon. The area was prepped. During the prep, site mark washed off with the alcohol. The surgeon proceeded to do a carpal tunnel [release], then realized he was to do a trigger finger [release]. . . . The surgeon told the staff he was thinking about a patient he had done the previous day. The surgeon said the time-out had been done.

Patient brought to the OR for open reduction and pin fixation realignment of a middle phalanx fracture of the left long finger. The left long finger was marked with an “X” between the first and second knuckles preoperatively by the surgeon. Time-out completed, with all parties in the room participating and confirming. Consent read by the nurse. Surgeon then marked an incision line on left, fourth finger. Surgeon asked for scalpel and made skin incision on the fourth finger. The assistant questioned the surgeon about the finger marked with an “X.”
## REVIEWS & ANALYSES

### Table 2. Reports of Procedures on the Wrong Site of the Correct Hand, as Reported to the Pennsylvania Patient Safety Authority July 2004 through June 2013

<table>
<thead>
<tr>
<th>REPORT</th>
<th>VERIFICATION</th>
<th>SITE MARK</th>
<th>STERILE PREP</th>
<th>DRAPED HAND POSITIONED</th>
<th>TIME-OUT</th>
<th>INCOMPLETE/COMPLETE</th>
<th>WRONG SITE ADJACENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td>Confusion during marking of [correct] finger</td>
<td></td>
<td></td>
<td>Complete</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>“Below incision site”</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Incomplete</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>“X” on middle finger</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Incomplete</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>On correct finger, in addition to pin fixation of distal interphalangeal joint</td>
<td>Complete</td>
<td>Yes</td>
<td>Yes</td>
<td>Started incision prior to time-out</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Forearm, not finger</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Incomplete</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Marked patient in OR</td>
<td>Start incision during time-out</td>
<td>Yes</td>
<td>Yes</td>
<td>Incomplete</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Not done</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Incomplete</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Marked patient in OR</td>
<td>Start incision during time-out</td>
<td>Yes</td>
<td>Yes</td>
<td>Incomplete</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Not done</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Incomplete</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Marked patient in OR</td>
<td>Start incision during time-out</td>
<td>Yes</td>
<td>Yes</td>
<td>Incomplete</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Not done</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Incomplete</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Done correctly</td>
<td>Start incision during time-out</td>
<td>Yes</td>
<td>Yes</td>
<td>Incomplete</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Done correctly, stating correct procedure and site</td>
<td>Complete</td>
<td>Yes</td>
<td>Yes</td>
<td>Start incision during time-out</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Complete</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Start incision during time-out</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Complete</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Start incision during time-out</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Complete</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Start incision during time-out</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Complete</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Start incision during time-out</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Incomplete</td>
<td>Not specified</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Incomplete</td>
<td>Not specified</td>
<td></td>
</tr>
</tbody>
</table>

Note: Blank cells indicate that this information was not available in the report.

---

Patient here for release of a right ring trigger finger. Nurse attending patient and did not perform the surgical pause right away. Surgeon then marked the patient and started an incision on the right thumb as the nurse read the consent. Surgeon realized the incision was [supposed] to be on the right ring finger.

Surgeon marked the right palm in the pre-op area during the procedure review with the patient. . . . The circulating RN confirmed the procedure with the patient in the pre-op area as well. Patient taken to OR and prepped and draped. Prior to final time-out, the surgeon nicked the right palm in preparation for a carpal tunnel release. The circulating RN told the surgeon to stop, and the correct procedure was discussed and completed.

---

**OR Procedures on the Knee**

Wrong-site procedures on the knee were the most common wrong-site procedures of the legs, the second most common wrong-site extremity procedures within the domain of orthopedic surgery, and the seventh most common type of wrong-site procedures overall, behind anesthetic blocks, spinal operations, procedures for pain relief, hand procedures, eye procedures, and stenting of the ureters.
Table 3. Reports of Wrong Procedures on the Correct Hand, as Reported to the Pennsylvania Patient Safety Authority July 2004 through June 2013

<table>
<thead>
<tr>
<th>REPORT</th>
<th>VERIFICATION</th>
<th>SITE MARK</th>
<th>STERILE PREP</th>
<th>DRAPED HAND POSITIONED</th>
<th>TIME-OUT</th>
<th>INCOMPLETE/COMPLETE</th>
<th>PROCEDURE STARTED/ DONE</th>
<th>PROCEDURE PLANNED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Correct digit</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Done correctly, stating correct procedure and site</td>
<td>Incomplete (injection)</td>
<td>Carpal tunnel release</td>
<td>Trigger finger release</td>
</tr>
<tr>
<td>2</td>
<td>Arm</td>
<td>Yes</td>
<td>Yes</td>
<td>For carpal tunnel release</td>
<td>Done correctly, stating correct procedure and site</td>
<td>Incomplete</td>
<td>Carpal tunnel release</td>
<td>Trigger finger release</td>
</tr>
<tr>
<td>4</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td>Incomplete</td>
<td>Carpal tunnel release</td>
<td>Trigger finger release</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Incomplete</td>
<td>Carpal tunnel release</td>
<td>Trigger finger release</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td>Incomplete</td>
<td>Carpal tunnel release</td>
<td>Trigger finger release</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not done</td>
<td>Carpal tunnel release</td>
<td>Trigger finger release</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Washed off by prep</td>
<td>Yes</td>
<td></td>
<td></td>
<td>Complete</td>
<td>Carpal tunnel release</td>
<td>Trigger finger release</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Complete</td>
<td>Carpal tunnel release</td>
<td>Trigger finger release</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Complete</td>
<td>Carpal tunnel release</td>
<td>Tenosynovectomy</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td>Started incision prior to time-out</td>
<td>Incomplete</td>
<td>Carpal tunnel release</td>
<td>Excision of ganglion</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Scheduling error without proper verification</td>
<td></td>
<td></td>
<td></td>
<td>Incomplete</td>
<td>Excision of cyst from tendon sheath</td>
<td>Excision of mass from finger tip</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Complete</td>
<td>De Quervain tendon release</td>
<td>A1 pulley release</td>
<td></td>
</tr>
</tbody>
</table>

Note: Blank cells indicate that this information was not available in the report.

Most of the 25 wrong-site knee procedures were performed on the wrong side. One surgeon lost intraoperative orientation and positioned an anterior cruciate reconstruction of the correct knee in a direction appropriate for the opposite knee. One patient had the wrong arthroscopic procedure done on the correct side. Of the 23 knee procedures on the wrong side, 15 reported the injection of local anesthetic into the joint of the wrong knee at the beginning of the procedure. This one type of wrongsite event constituted 60% of all the wrong-site knee procedures, 18% of all wrong-site extremity procedures within the domain of orthopedic surgery, and 3% of all wrong-site OR procedures. Another six reports involved arthroscopy of the wrong knee, and two reports did not specify the type of surgery on the knee (see Tables 4 and 5).

Wrong-Side Injections of Local Anesthetic into the Knee Joint

The narrative reports of 8 of the 15 injections of local anesthetic into the joint of the wrong knee mentioned that the correct knee had been marked. The
REVIEWS & ANALYSES

injections occurred after the wrong knee was put in the leg holder according to three reports and after the tourniquet was put on the wrong leg according to three reports (see Table 4 for the relationships of events reported for each wrong-knee injection). The injections were done after the wrong knee was prepped according to five reports and before any skin preparation according to one report. The injection was done after the wrong knee was draped according to one report and before any draping according to one other report. According to two reports, a time-out was done before the wrong knee was put in the leg holder. The wrong-knee injections were done before final time-outs according to six reports, during the final time-out according to one report, and after a final time-out according to one report.

One pathway to this problem is described in this contextually deidentified report:

Patient was interviewed in the holding area and verbally confirmed the limb and permit. When the patient was in the OR, one more check was

Table 4. Reports of Wrong-Knee Injection, as Reported to the Pennsylvania Patient Safety Authority July 2004 through June 2013

<table>
<thead>
<tr>
<th>REPORT</th>
<th>SITE MARK</th>
<th>LEG HOLDER</th>
<th>TOURNIQUET</th>
<th>STERILE PREP</th>
<th>DRAPIED</th>
<th>TIME-OUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wrong leg</td>
<td>Not Yet</td>
<td>Not Yet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Wrong leg</td>
<td>Wrong leg</td>
<td>Not Yet</td>
<td>Before putting leg in leg holder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Yes</td>
<td>Wrong leg</td>
<td>Wrong leg</td>
<td>Before putting leg in leg holder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Wrong leg</td>
<td>Wrong leg</td>
<td>Not Yet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Not Yet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Wrong leg</td>
<td>Not Yet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Yes</td>
<td>Wrong leg</td>
<td>Wrong leg</td>
<td>Not Yet</td>
<td>Not Yet</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Not Yet</td>
<td></td>
<td></td>
<td>Not Yet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Yes</td>
<td></td>
<td></td>
<td>Not Yet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Yes</td>
<td></td>
<td></td>
<td>Not Yet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Yes</td>
<td>Wrong leg</td>
<td>Wrong leg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Yes</td>
<td>Wrong leg</td>
<td></td>
<td>Not Yet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Yes</td>
<td>Wrong leg</td>
<td>Wrong leg</td>
<td>During</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Yes</td>
<td>Wrong leg</td>
<td>Wrong leg</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>No detailed information provided</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Blank cells indicate that this information was not available in the report.

Table 5. Reports of Wrong-Knee Operation, as Reported to the Pennsylvania Patient Safety Authority July 2004 through June 2013

<table>
<thead>
<tr>
<th>REPORT</th>
<th>SITE MARK</th>
<th>LEG HOLDER</th>
<th>TOURNIQUET</th>
<th>STERILE PREP</th>
<th>DRAPIED</th>
<th>TIME-OUT</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wrong leg</td>
<td></td>
<td></td>
<td>Correct procedure not followed</td>
<td>Not completed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Wrong leg</td>
<td>Wrong leg</td>
<td>Wrong leg</td>
<td>Done correctly, stating correct side</td>
<td>Not completed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Wrong leg</td>
<td>Wrong leg</td>
<td>Wrong leg</td>
<td>Correct procedure not followed</td>
<td>Not completed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Yes</td>
<td>Wrong leg</td>
<td>Wrong leg</td>
<td>Not Done</td>
<td>Completed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Yes</td>
<td>Wrong leg</td>
<td>Wrong leg</td>
<td>Yes</td>
<td>Completed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Yes</td>
<td>Wrong leg</td>
<td>Wrong leg</td>
<td>Done correctly, stating correct side</td>
<td>Completed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>No detailed information provided</td>
<td></td>
<td></td>
<td></td>
<td>Completed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>No detailed information provided</td>
<td></td>
<td></td>
<td></td>
<td>Completed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Blank cells indicate that this information was not available in the report.
Wrong-Side Knee Operations

The narrative reports of three of the eight wrong-side knee operations mentioned that the correct knee had been marked. Again, the operations occurred after the wrong knee was put in the leg holder according to one report, after the tourniquet was put on the wrong leg according to two reports, and after the wrong knee was prepped and draped according to three reports (see Table 5).

A time-out was not done according to one report and was not done correctly according to another report. A time-out was done unremarkably according to one report, and two reports specifically mentioned that the correct side was stated during the time-out prior to the wrong-knee operation.

Two contextually deidentified reports describing wrong-side knee procedures are as follows:

OR schedule lists operation as right knee arthroscopy. OR consent and H&P [history and physical] state left knee arthroscopy. Patient identified left knee as site of surgery. The left knee was marked. Time-out documentation indicated left knee as site of surgery. Arthroscopy performed on the right knee. [Analyst note: Possible that the room was set up for right knee arthroscopy based on the schedule.]

A [patient] was admitted for right knee arthroscopy. Patient properly identified; site properly marked; and patient brought to OR. Physician elevated the left leg for the procedure. Nurse prepped and draped the knee. During the time-out, no one recognized that the wrong leg had been prepared. The procedure was performed on the incorrect leg. [Analyst note: Possible confirmation bias following the physician’s elevation of the wrong leg.]

OR Procedures on the Foot

The 14 wrong-site procedures done on feet represented a diverse group of problems: 7 procedures were done on the wrong foot, 1 was done on both the wrong foot and a different part of the foot (great toe instead of fifth toe), 5 were done on an adjacent structure on the correct foot, and 1 was an incorrect procedure done at the correct location.

Of the seven procedures done on the wrong foot, three were injections into the wrong foot, all caught before the planned procedure was done.

This contextually deidentified report is illustrative:

3 mL of bupivacaine 0.5% mixed with 3 mL of lidocaine 1% were injected into the patient’s left foot by the surgeon. The circulating nurse noticed the surgeon injecting the wrong foot and told him the correct operative site was the right foot. . . . No attempt had been made by the surgeon prior to this occurrence to position, place a tourniquet, prep, or drape the correct operative site. A time-out had not been done before this occurrence happened.

Four procedures were done on the wrong foot, and none was recognized until after the procedure was complete. Two of these patients had both symmetrical pathology and were being operated on in the prone position. One of the two was also having two different procedures done on the two feet.

This contextually deidentified report describes the situation:

The patient consented to the removal of a left heel bone spur and a right bunionectomy. He had identical pathologies in both feet. The patient was identified, the time-out was done, and the surgical sites were marked appropriately with the patient supine. The patient was turned prone, removing the site markings from the visual field, and the procedures were performed in the reverse.

Problems resulting from asymmetric procedures on different feet are also described in two other contextually deidentified reports, including one more of the above injections into the wrong foot:

Patient was scheduled for fusion of toes two through five on the left foot and matricectomy of the fifth toe on the right foot. Surgeon verified and marked the sites in the pre-op holding area. Patient was taken to the OR. Procedures were confirmed [and performed]. In the recovery room [after the procedures were completed], it was discovered that the matricectomy had been done on the left great toe instead of the right fifth toe. . . . The patient stated that he wondered why the surgeon marked the great toe, but he did not say anything.

Five patients had procedures on structures adjacent to the correct structure. Three involved operating on the second toe instead of the third toe and were identified and corrected in the course of the procedure. The other two involved metatarsals; one was corrected and one was completed at the incorrect site.
One patient had an incorrect procedure performed as the result of scheduling the procedure incorrectly.

**DISCUSSION**

Three predominant anatomic locations—hands, knees, and feet—represented 88% of all wrong-site extremity procedures within the domain of orthopedic surgery. The nature and causes of wrong-site extremity procedures vary with the anatomic locations of the procedures.

Most wrong-site knee procedures (92%) were wrong-side procedures. All 34 hand procedures were on the correct hand but involved a wrong site or wrong procedure. Wrong-site foot procedures were a mix of both. No procedures were performed on the wrong patient.

Surgeons performed 19 wrong-site injections in the OR before the scheduled procedure: 15 intra-articular injections into wrong knees, 3 local anesthetics into wrong feet, and 1 local anesthetic into the wrong site on the correct hand. Eight reports specifically noted that the surgical site had been marked. Thirteen of the 18 lower-extremity injections appear to have been done without the benefit of a proper time-out, and one was done after an unremarkable time-out. Seven of the 13 were specifically noted to have been done before the time-out, one before the surgeon entered the room, two before the prep, one during the time-out, and two after a time-out conducted before the (wrong) leg was positioned in the leg holder.

The Authority has identified that misinformation in the documents used for verification prior to surgery and misperception by the surgeon in the OR are the two major causes of wrong-site procedures.19 Positioning the patient prone can elicit misperception with right-left confusion. Most orthopedic procedures on the extremities are done with the patient supine. Two wrong-site procedures of the foot were with the patient prone.

Another common cause of misperception is confirmation bias, the psychological process of being attentive to information that confirms existing beliefs and ignoring information that contradicts them.20 Confirmation bias was inferred as a possible factor in the analysis of 16 reports indicating a misleading setup for the procedure: 1 release of a trigger finger positioned for a carpal tunnel release, 1 application of a tourniquet on the wrong leg for foot surgery, 1 fixation of a hip fracture prepped and draped on the wrong side, and 13 reports of wrong-knee surgery. The wrong-side setups for the 13 knee procedures (see Tables 4 and 5) included putting the wrong leg in the leg holder (four times), putting the tourniquet on the wrong leg (five times), prepping the wrong knee prior to the intra-articular injection (four times), and prepping and draping the wrong knee (four times). Four wrong-site event narratives (one for the hand, one for the hip, and two for the knee) noted a proper time-out had been done after the incorrect setup, with three of the four specifically mentioning that the correct site was stated in the time-out process.

More than one out of every four wrong-site hand procedures consisted of making an incision for a carpal tunnel release when the intended procedure was a trigger finger release, suggesting a common risk factor. Excluding the one report of the patient being positioned for a carpal tunnel release mentioned above, possible factors are automated behavior and distraction. One of the narratives, mentioned above, said the surgeon was thinking about another patient. The Authority’s 21 evidence-based best practices to prevent wrong-site surgery7 include the practice of having the surgeon state the correct information, rather than just agree with the stated information, to avoid automated behavior. Two narratives specifically mentioned distractions of the surgeons prior to doing wrong-site hand procedures. One surgeon had to wait for a missing antibiotic to be infused after the time-out. The other surgeon consulted his office records between the time-out and grabbing the wrong finger to begin the operation.

The presence of trauma was not sufficient to preclude wrong-site surgery for one fractured hip, one fractured metacarpal, fractured finger phalanges of two patients, and one dislocated distal interphalangeal joint.

There were no wrong-site shoulder operations. However, 11 of the 115 wrongsite anesthesia blocks done by anesthesiologists (10%) were blocks of the wrong shoulder. The narrative of one suggests that the site had not been marked by the surgeon (“Block was done on left . . . right side was then marked.”). In addition, the narrative for a leg block stated that the site of the operation had not been previously marked, although it did not state the planned operation.

The analysis of information in the patient safety reporting system has to be incident-based, rather than rate-based, because the relevant information for procedures without errors is not available to the Authority. The analyses were based on information submitted in the narratives of the events. An analysis of root-cause analyses might be more informative.

Nevertheless, the patterns identified by the case analyses suggest practices to prevent specific extremity procedures within the domain of orthopedic surgery from being done at the wrong site, in addition to the general 21 principles7 that have been effective in reducing wrong-site surgery in all OR procedures.13,10,11 They are as follows (in chronological order):

1. To minimize the risk of a wrong-site anesthesia block, mark the operative site before the anesthesiologist does the block.
2. Make the site marking as close to the incision as possible and reference it
during the positioning of the extremity, the application of any tourniquet, and the prepping and draping of the operative site, as well as during the final time-out just prior to the incision. This appears to be especially important for hand procedures, where the entire hand is in the operative field.

3. Do a separate time-out for any injection not done in continuity with the incision, such as a preoperative intra-articular injection of the knee.

4. Have the surgeon state the procedure and site, rather than agree to the stated procedure and site, to minimize the risks of automated behavior.

5. When doing separate procedures on the same patient, do separate time-outs immediately before each procedure instead of a single time-out referencing the multiple procedures and sites.

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NOTES


ABSTRACT
Pennsylvania hospitals reported more than 19,000 pressure ulcer events to the Pennsylvania Patient Safety Authority in 2013. Hospital-acquired pressure ulcers (HAPUs) are a recognized patient safety concern and meet the definition of a reportable event under the Pennsylvania Medical Care Availability and Reduction of Error Act. Despite changes to the Centers for Medicare and Medicaid Services’ inpatient prospective payment system in 2008 that established regulatory and financial incentives for hospitals to prevent HAPUs, they remain a frequently reported hospital-acquired condition. An analysis of pressure ulcers reported through the Pennsylvania Patient Safety Reporting System from 2007 through 2013 suggests the need for improvement in identification of pressure ulcers present on admission; accurate staging of pressure ulcers; and prevention of HAPUs, in particular stage III, suspected deep-tissue injury, and unstageable pressure ulcers. Patient safety and quality agencies, as well as wound care specialty organizations, have established evidence-based best practices in pressure ulcer risk assessment and prevention. Hospitals that have implemented these practices, such as those participating in the Pennsylvania Hospital Engagement Network Pressure Ulcer Prevention project, have reported successful reductions in the incidence of HAPUs stage II or greater. (Pa Patient Saf Adv 2015 Mar;12[1]:28-36.)

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INTRODUCTION
Hospital-acquired pressure ulcers (HAPUs) are reportable events under the Pennsylvania Medical Care Availability and Reduction of Error (MCARE) Act. The MCARE Act requires healthcare facilities to report events “involving the clinical care of a patient in a medical facility” that either resulted in, or had the potential to result in, “an unanticipated injury requiring the delivery of additional health care services to the patient.”

Pressure ulcers are a frequently reported hospital-acquired condition in Pennsylvania. In 2013, Pennsylvania healthcare facilities reported 33,545 events involving impaired skin integrity to the Pennsylvania Patient Safety Authority through its Pennsylvania Patient Safety Reporting System (PA-PSRS). This represents the fifth most frequently reported patient safety event type, following (1) errors related to procedures, treatments, or tests, (2) medication errors, (3) complications of procedures, treatments, or tests, and (4) falls. The majority of impaired skin integrity events (n = 19,009, 56.7%) were hospital-reported pressure ulcers.

In December 2008, the Authority published “Pressure Ulcers: New Staging, Reporting, and Risk Reduction Strategies” following two important changes in pressure ulcer staging and reimbursement policies. The first change occurred in 2007 when the National Pressure Ulcer Advisory Panel (NPUAP) added two new pressure ulcer stages: suspected deep-tissue injury (SDTI) and unstageable (see “Pressure Ulcer Staging Guidelines”). PA-PSRS added these categories in June 2008.

The second change occurred in October 2008 when the Centers for Medicare and Medicaid Services (CMS) modified the inpatient prospective payment system and established a list of hospital-acquired conditions subject to nonpayment. Prior to changes in the inpatient prospective payment system, hospitals received additional reimbursement from CMS for the care required for patients with pressure ulcers, regardless of whether the pressure ulcer was preexisting or developed in the course of hospitalization. However, effective October 1, 2008, hospitals were no longer reimbursed for stage III and IV pressure ulcers that were hospital-acquired.

While implementation of best practices in HAPU prevention and treatment had already been established as a priority for hospitals, these changes brought heightened attention to the need for physicians and nurses to perform thorough skin assessments, to accurately stage and document pressure ulcers at the time of admission and throughout the course of hospitalization, and to prevent the development of HAPUs. The Authority analyzed events of pressure ulcers reported through PA-PSRS in order to evaluate the impact these changes may have had on pressure ulcer reporting and to identify trends in pressure ulcer reporting.

METHODS
Analysts queried the PA-PSRS database for events of pressure ulcers reported over seven calendar years, from 2007 through 2013; events were categorized both by time of acquisition and pressure ulcer stage.

Three options exist for indicating the time of acquisition when entering pressure ulcer reports in PA-PSRS: “admitted from other facility with ulcer,” “new ulcer <24 hours after admission,” and “new ulcer >24 hours after admission.” Six options exist for indicating the pressure ulcer stage: I, II, III, IV, SDTI, or unstageable. Of note, time of pressure ulcer acquisition is a mandatory field in PA-PSRS, while pressure ulcer stage is not.

Additionally, pressure ulcer event reports, as with all event reports, may be submitted through PA-PSRS as Incidents (i.e., events resulting in no harm to the patient) or
Serious Events (i.e., events resulting in harm). Those events reported as Incidents may be reported via direct manual entry or via an interface mapped to PA-PSRS from an event reporting system within a hospital. Serious Events may only be reported via direct manual entry.

Analysts reviewed the pressure ulcer event reports according to (1) time of pressure ulcer acquisition reported for all events, (2) pressure ulcer stage and level of harm reported for all events, and (3) stage reported for all pressure ulcers identified as “new ulcer >24 hours after admission.”

RESULTS

Pressure Ulcer Reporting and Time of Acquisition

Figure 1 shows the number of pressure ulcers and the time of pressure ulcer acquisition reported through PA-PSRS from 2007 through 2013. The total number of reports increased from 2007 through 2009, with the largest increase of 39.2% having occurred from 2007 to 2008, concurrent with the addition of 10 reporting hospitals. Total pressure ulcer event reports decreased 10.0% in recent years, from a high of 21,120 in 2009 to 19,009 in 2013. Between 2012 and 2013 alone, there was a 5.9% decrease.

Analysis revealed that nearly 30% of pressure ulcers across the seven-year period were reported as “new ulcer >24 hours after admission,” a percentage that has remained relatively stable over time. An interesting phenomenon occurred between 2011 and 2012, when there was a decrease in the number and percentage of pressure ulcers reported as present on admission from another facility concurrent with a more than fourfold increase in the number and percentage of pressure ulcers reported as being “new ulcer >24 hours after admission.” In 2013 the number of pressure ulcers reported as “new ulcer >24 hours after admission” decreased somewhat, but the reported volume was notably greater than in years prior to 2012.

The increase in pressure ulcers reported as “new ulcer <24 hours after admission” seen between 2011 and 2012 occurred at the same time as when large increases were seen in the number of pressure ulcer events reported as Incidents, via interface, at less than 10 acute care hospitals in the state. Closer examination of report narratives suggests that this increase may be the result of reporting pressure ulcers present on admission (i.e., not hospital-acquired and therefore not reportable under the MCARE Act) using the “new ulcer <24 hours after admission” designation in PA-PSRS. Other potential contributing factors identified from analysis of report narratives included failure to identify pressure ulcers present on admission, missing or inadequate pressure ulcer risk assessment, and missing or inadequate implementation of pressure ulcer prevention measures.

Staging and Level of Harm for All Reported Pressure Ulcers

The number of pressure ulcers reported as stage I has increased in recent years, while the number of pressure ulcers reported as stages II, III, and IV increased between 2007 and 2009, then decreased through 2013 (see Figure 2, exclusively available in the online version of this article). Between 2009 and 2013, there was a 30.1% decrease in reports of stage II pressure ulcers, a 31.1% decrease in reports of stage III pressure ulcers, and a 55.3% decrease in reports of stage IV pressure ulcers.

The first full year in which SDTI and unstageable were included as stages in PA-PSRS was 2009. Although the number of pressure ulcers reported for each of these stages has varied from year to year, between 2009 and 2013, there was a 50.7% increase in the number reported.
as SDTI and a 19.0% decrease in the number reported as unstageable.

Of note, each year, approximately one-third of pressure ulcers reports were submitted without staging information, ranging from 29.4% in 2007 (n = 3,980 of 13,525 total pressure ulcer reports) to 41.0% in 2011 (n = 8,633 of 21,079 total pressure ulcer reports).

The majority of pressure ulcer events reported through PA-PSRS from 2007 through 2013 were reported as Incidents (see Figure 3). This holds true across all reported pressure ulcer stages. For example, in 2013, 97.1% (8,841 of 9,108) of all reported stage I and II pressure ulcers were labeled as Incidents. In the same year, 91.0% (3,270 of 3,592) of all reported stage III, IV, SDTI, and unstageable pressure ulcers were labeled as Incidents.

**Staging of Pressure Ulcers Acquired More Than 24 Hours after Admission**

Because pressure ulcers reported through PA-PSRS as “new ulcer <24 hours after admission” contained reports of pressure ulcers that may have been present on admission, analysts undertook a separate analysis of pressure ulcers reported as “new ulcer >24 hours after admission” to obtain a more accurate assessment of HAPUs being acquired within Pennsylvania hospitals. Figure 4, exclusively available in the online version of this article, shows a decrease from 2007 through 2013 in the number of these HAPUs reported as stages I, II, or IV, while the number reported as stage III remained relatively unchanged. Again, using 2009 as a baseline, the number of these HAPUs reported as SDTI and unstageable increased through 2013.

Similar to reports of all pressure ulcers, regardless of time of occurrence, about one-third of reports of pressure ulcers labeled “new ulcer >24 hours after admission” did not include staging information.

**DISCUSSION**

Through analysis of pressure ulcer events reported through PA-PSRS from 2007 through 2013, the Authority identified changes in pressure ulcer reporting perhaps influenced by the addition of SDTI and unstageable as new pressure ulcer stages in PA-PSRS as well as modifications to the CMS payment system, both of which occurred in 2008. The 10.0% decrease in the number of pressure ulcer event reports from 2009 to 2013 is encouraging; however, it is too soon to tell whether this represents a downward trend that will continue.

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*Time of acquisition is a mandatory field in the Pennsylvania Patient Safety Reporting System. In 2011, due to technical difficulties, there were two pressure ulcer event reports missing information on the time of acquisition.*
HAPUs acquired less than 24 hours after admission. The increase seen in the number and percentage of pressure ulcers reported as “new ulcer <24 hours after admission” (see Figure 1) suggests that hospitals need to closely examine protocols for skin inspection and pressure ulcer prevention that are part of the admission process. Because pressure ulcers can develop within as few as two to six hours,9,10 especially in critically ill patients, it is vital that nurses and other healthcare professionals assess risk and implement preventive measures as quickly as possible upon admission.

Additionally, it appears that some hospitals may utilize their internal reporting systems to capture reports of pressure ulcers that are community-acquired and present on admission. Some of these reports may have been mapped via the interface, and submitted through PA-PSRS, as “new ulcer <24 hours after admission” when in fact these are not HAPUs and do not need to be reported under the MCARE Act.1 Hospitals are encouraged to look more closely at what pressure ulcer event reports are being submitted through PA-PSRS, either manually or via electronic interface, and to ensure that only HAPUs are being reported.

HAPUs acquired more than 24 hours after admission. It is encouraging that the number of pressure ulcers reported as “new ulcer >24 hours after admission” has decreased in recent years. However, more information is needed to know whether this is a true decrease in the incidence of HAPUs in Pennsylvania hospitals. Despite this apparent improvement, these pressure ulcers continue to represent approximately 30% of all pressure ulcer events reported to the Authority, and the number of these HAPUs being reported at deeper stages of tissue damage (i.e., unstageable and SDTI) has increased (see Figure 4, exclusively available in the online version of this article). Hospitals are encouraged to examine this issue more closely and to gather more information on possible causes and opportunities for process improvements. Increased patient acuity and illness severity may also be considerations; while the majority of HAPUs are considered preventable, some pressure ulcers may be unavoidable, particularly in the critically ill11-13 or patients who are dying.14

Pressure ulcer staging. Staging information is missing in approximately one out of three PA-PSRS pressure ulcer event reports (see Figures 2 and 4, exclusively available in the online version of this article). It is not clear whether this correlates with missing documentation of pressure ulcer staging in the medical record. Appropriate staging information may help clinicians provide patients with appropriate wound care and take action when progression to deeper stages of tissue damage is recognized. Missing documentation of staging may also negatively impact reimbursement. Several organizations offer resources that address clinician education and pressure ulcer staging competency, including the Agency for Healthcare Research and Quality (AHRQ),15 ConvaTec,16 the National Database of Nursing Quality Indicators,17 and NPUAP.4

Incidents versus Serious Events. By definition, pressure ulcers are the result
The Pennsylvania Hospital Engagement Network (PA-HEN) Pressure Ulcer Prevention (PUP) project is a collaborative project led by the Hospital and Healthsystem Association of Pennsylvania (HAP) targeted at reducing the incidence of hospital-acquired pressure ulcers (HAPU) by 40% by the end of calendar year 2014. Twenty-four hospitals joined the collaboration in 2012, and as of June 2014, 18 continued to participate. Members of the collaboration seek to decrease rates of HAPUs by increasing implementation of best practices in pressure ulcer prevention.

**Project Interventions**

Interventions implemented by the HAP project leadership team and hospitals participating in the collaboration were varied and multifaceted.

**HAP Project Leadership Team Interventions**

- Formed an advisory group of skin care experts to offer guidance in program design, provide ongoing support, and ensure adherence to evidence-based best practices in pressure ulcer prevention
- Established a team of “skin care safety advisors,” trained in analysis of strengths, weaknesses, opportunities, and threats (i.e., SWOT analysis) and tracer methodology, who conducted on-site hospital visits and worked collaboratively with the hospital staff to analyze current pressure ulcer prevention initiatives and develop action plans for improvement
- Designed robust webinars and in-person educational programs provided by expert faculty
- Encouraged hospitals to incorporate patient and family engagement best practices in their work, and provided access to tools, documents, educational events, and the PA-HEN/HAP patient and family guidebook (available at https://www.haponline.org/Portals/0/docs/Quality/Patient_Family_Centered_Care/HAP_Patient_and_Family_Centered_Care_Guidebook_July2013.pdf)
- Collected, analyzed, and distributed actionable data as a means to drive improvement
- Identified and paired mentor with mentee hospitals, and utilized peer-to-peer learning to close gaps on performance and foster improvements

**Hospital Interventions**

- Developed individual hospital multidisciplinary skin care teams who implemented project tools, education, and training
- Designated hospital “skin care champions” who advocated for the project at the unit level and mobilized and motivated staff
- Completed a comprehensive self-assessment survey, which was utilized to create action plans and tailor educational content
- Participated in networking and coaching calls, in-person educational events, and on-site visits from skin care advisors

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of damage to the skin and its underlying structures; however, the majority of HAPUs are reported through PA-PSRS as Incidents. The reasons for this are not clear from the reports. As outlined in the MCARE Act, an Incident is defined as “an event, occurrence or situation involving the clinical care of a patient in a medical facility which could have injured the patient but did not either cause an unanticipated injury or require the delivery of additional health care services to the patient.” In light of this definition, and because HAPUs typically require the delivery of additional healthcare services, it is suggested that hospitals reconsider the level of harm assigned to these event reports. Further investigation and establishment of criteria to delineate HAPUs reportable as Serious Events is warranted.
Pennsylvania Hospitals Collaborating to Reduce HAPUs

The Pennsylvania Hospital Engagement Network (PA-HEN) Pressure Ulcer Prevention (PUP) project has reported success in reducing HAPUs. Led by the Pennsylvania Hospital and Healthcare Association of Pennsylvania (HAP), these hospitals have been working collaboratively since 2012 to increase implementation of best practices in pressure ulcer prevention and decrease the incidence of HAPUs. See “Pennsylvania Hospital Engagement Network Pressure Ulcer Prevention Project” for more details and for links to free resources developed by HAP to assist hospitals in implementing best practices in pressure ulcer prevention.

— Shared tools and best practices with other collaboration project members
— Collected and submitted monthly data on process and outcome measures
— Served as mentor or mentee hospitals

Of note, an important tenet of the PA-HEN PUP project has been the involvement of the bedside nurse and other direct care providers. On two separate instances, webinars directed to unlicensed direct care providers resulted in the highest attendance numbers for any PUP project webinars. Many hospitals provide “lunch and learn” educational events for their direct care providers during PA-HEN PUP webinars or use archived webinars for orientation and ongoing educational purposes.

Hospitals participating in the project work together in a spirit of collaboration by sharing pressure ulcer prevention practices and tools (e.g., policies and procedures, documents, forms, toolkits) and recounting experiences in working to prevent HAPUs, presenting success stories as well as challenges and opportunities for improvement. Hospitals report great benefit from this networking opportunity and celebrate the camaraderie that arises from working together toward a common goal.

We have implemented some great things with the PA-HEN and are focusing on how we can maintain our improved rate decrease in HAPUs. Our current focus is considering the purchase of new pressure-reduction surfaces and looking at ways to educate and engage patients and their families. It is my hope that we continue to make strides in preventing pressure ulcers!

— Barbara Gregory, team leader for Wayne Memorial Hospital

I am eagerly putting together my wound care team with a diverse group of passionate individuals which include performance improvement professionals, the patient experience director, nutritionist, registered nurses, nonlicensed professionals, and a physical therapist. I hope to have as many people as possible attend educational events, although I am aware that a few will be working and I am grateful that they can access it afterwards. WOCNs [wound ostomy continence nurses] in our hospital often feel like we float on a lonely dinghy in the sea. It’s nice to be part of a network! This is so exciting! Thanks for everything!

— Charissa Carfrey, team leader for Roxborough Hospital, which joined the PA-HEN PUP project in 2014

Data and Results

All PA-HEN hospitals, regardless of PUP program participation, are evaluated using Medicare PSI-03 data to calculate the incidence rate of stage III and IV HAPUs per 1,000 Medicare patient discharges. PA-HEN hospitals, as a group, achieved a 62.7% reduction in this rate, from a baseline of 0.51 in 2011 to 0.19 in the fourth quarter of 2013.

In addition, hospitals participating in the PUP project are required to self-report incidence rates of pressure ulcers, stage II or greater, per 1,000 patient-days. PUP project hospitals achieved a 41.7% decrease in this rate, from a baseline of 2.04 in the third quarter of 2012 to 1.19 in the third quarter of 2014.

While quarterly data reveals fluctuation and variability with the rate over time, hospitals report being able to move the needle steadily toward achievement in reduction of HAPUs by the prompt implementation of pressure ulcer prevention interventions for patients deemed at highest risk for ulcer development. Improvements noted are largely felt to be attributed to heightened awareness and the leveraging, sharing, and implementation of interventions and strategies from the project.

Looking Ahead

The PA-HEN PUP project has evolved from a unit-level, nurse-driven initiative to a statewide, hospital-based, multidisciplinary initiative to prevent HAPUs. In addition, HAP has offered PA-HEN hospitals that are not members of the PUP project access to educational events and other project resources such as the Pressure Ulcer Prevention Resource Guide and the PA-HEN/HAP patient and family guidebook (see HAP Project Leadership Team Interventions above), as well as on-site visits by the skin care safety advisors. Looking ahead, the PA-HEN PUP project continues to focus on spread and sustainability, with a goal of decreased rates of HAPUs for patients in all Pennsylvania hospitals.

Hospitals interested in learning more about the PA-HEN PUP project can contact HAP at (717) 564-9200.
RISK REDUCTION STRATEGIES
Evidence-based pressure ulcer prevention guidelines have been developed by several patient safety and quality agencies, such as AHRQ,15 the Hartford Institute for Geriatric Nursing,18 the Institute for Clinical Systems Improvement,19 and the National Quality Forum,20 as well as wound care specialty organizations, such as the Wound, Ostomy and Continence Nurses Society21 and NPUAP.22 See “Evidence-Based Pressure Ulcer Prevention Guidelines” for a list of these guidelines along with links for accessing them.

The following are strategies based upon these guidelines that hospitals can use to improve identification and reporting of HAPUs, as well as to prevent their occurrence:

- Consult evidence-based guidelines in developing a pressure ulcer prevention program (see “Evidence-Based Pressure Ulcer Prevention Guidelines”).
- Establish an interdisciplinary team with defined roles and responsibilities to develop and oversee a pressure ulcer prevention program.15,20
- Identify clinicians with pressure ulcer prevention and wound care expertise to serve as a resource for staff and to provide ongoing pressure ulcer prevention education, including with regard to accurate pressure ulcer staging.15
- Consider developing a team of unit-based champions to engage staff and support ongoing pressure ulcer prevention efforts.20
- Perform a pressure ulcer risk assessment for all patients upon admission using a validated risk assessment tool such as the Braden scale.15,18,22
- Reevaluate pressure ulcer risk daily and with changes in level of care or changes in condition.15,18,22
- Perform a head-to-toe skin inspection for all patients upon admission, and document any alteration in skin color, temperature, texture, turgor, consistency, or moisture.15,18,22
- Repeat a head-to-toe skin assessment every 8 to 24 hours, depending on the clinical condition of the patient. Patients at high risk for pressure ulcer formation and those who are critically ill may require more frequent assessments.15,18,22
- Establish a pressure ulcer prevention plan, targeted to the patient’s identified risk factors, that aims to
  □ minimize or eliminate friction and shear,
  □ minimize pressure with off-loading and support surfaces,
  □ manage moisture, and
  □ maintain adequate nutrition and hydration.15,18,20,21,22
- Document and communicate the results of the pressure ulcer risk assessment, skin assessments, and the pressure ulcer prevention plan to all members of the healthcare team.15,18,20,22
- Provide ongoing education to the patient, family, and all members of the healthcare team regarding pressure ulcer prevention and treatment.15,18,20,22
- Establish a protocol for clearly and consistently documenting and reporting pressure ulcers present on admission and those that are hospital-acquired.15,19
- Monitor compliance with pressure ulcer prevention practices through auditing of process measures (e.g., percentage of patients with documentation of a risk assessment and skin inspection within six hours of admission, percentage of at-risk patients with an appropriate pressure reduction surface in place).15,19,20

EVIDENCE-BASED PRESSURE ULCER PREVENTION GUIDELINES
The following guidelines are available to assist hospitals in developing pressure ulcer prevention programs:

- Hartford Institute for Geriatric Nursing—Nursing Standard of Practice Protocol: Pressure Ulcer Prevention & Skin Tear Prevention, available at http://consultgerirn.org/topics/pressure_ulcers_and_skin_tears/want_to_know_more
- Institute for Clinical Systems Improvement—Pressure Ulcer Prevention and Treatment Protocol, available at https://www.icsi.org/guidelines_more/catalog_guidelines_and_more/catalog_guidelines/catalog_patient_safetyreliability_guidelines/pressure_ulcer
— Evaluate the effectiveness of the pressure ulcer prevention program through ongoing monitoring of outcome measures. Recommended measures include prevalence rates (i.e., the number of patients with pressure ulcers at a certain point or period in time) and incidence rates (i.e., the number of patients developing HAPUs during a period in time).15,19,20

— Investigate every occurrence of stage III and stage IV pressure ulcers to
(1) identify systems failures and other factors contributing to the occurrence of these pressure ulcers and
(2) identify opportunities for improvement. Root-cause analysis may be a useful technique to accomplish this task.15

LIMITATIONS

Detailed analysis of HAPUs occurring in Pennsylvania hospitals is limited by the
information reported through PA-PSRS, which, by itself, cannot be used to calculate prevalence or incidence rates for HAPUs. Analysis of event report data reveals variation in pressure ulcer reporting practices among hospitals in Pennsylvania. Because of these limitations, decreases in the number of HAPUs reported through PA-PSRS or changes in the number of HAPUs reported at various times of acquisition or pressure ulcer stages may or may not represent improvements in pressure ulcer prevention practices or patient care results.

CONCLUSION

Pressure ulcer prevention remains a priority for hospitals because of identification of HAPUs as a measure of patient safety and quality of care, the establishment of regulatory and financial incentives for HAPU prevention, and the impact of HAPUs on patients. HAPUs meet the definition of a reportable event under the MCARE Act. Analysis suggests that Pennsylvania hospitals have room for improvement in identification of pressure ulcers present on admission; accurate staging of pressure ulcers; and prevention of HAPUs, in particular stage III, SDTI, and unstageable HAPUs.

Accurate staging and reporting of pressure ulcers provides data that can be trended over time to help hospitals assess the effectiveness of their current pressure ulcer prevention protocols and design and monitor the progress of quality improvement efforts. Hospitals, such as those participating in the PA-HEN PUP project, have demonstrated that the incidence of HAPUs can be successfully reduced through collaboration and implementation of evidence-based best practices in pressure ulcer prevention.

Acknowledgments

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NOTES


17. National Database of Nursing Quality Indicators. Pressure ulcer training [training program online]. [cited 2014 Jun 19]. https://members.nursingquality.org/NDNQIPressureUlcerTraining


Equipment, Environment, and Ergonomics: An Enigma of Infection Risk

INTRODUCTION

One of the most eloquent examples that expresses the merging of equipment and humans is the fifth statement in the United States Marine Corps creed “My Rifle”:

“My rifle is human, even as I, because it is my life. Thus, I will learn it as a brother. I will learn its weaknesses, its strength, its parts, its accessories, its sights and its barrel. I will ever guard it against the ravages of weather and damage as I will ever guard my legs, my arms, my eyes and my heart against damage. I will keep my rifle clean and ready. We will become part of each other. We will . . . .”

In healthcare, the workers never merge with their equipment in every aspect of its life cycle as a marine does with their rifle. The proceduralist may merge with an endoscope during a procedure, but after the procedure, the endoscope is handed off to another worker who merges with it for another purpose, such as cleaning and disinfection. Never do the workers reach the level of total care for equipment that the marine has with their rifle. It would be impractical for a proceduralist to assume total care of a piece of equipment; however, the healthcare system needs to care for its equipment, like the marine, because lives depend on the equipment functioning properly.

A modern healthcare delivery system is heavily reliant on the workers, the equipment, and the environment, which are components of that system. Worker skill and knowledge about equipment and environment will impact equipment effectiveness. Similarly, equipment and environmental attributes for assessment or treatment will impact the worker’s effectiveness. The aforementioned challenges can be magnified when equipment is retrofitted or newly installed into spaces that are suboptimal with respect to size, flow, or access. For example, if the new patient bed will not roll flat through the existing room door because the opening is too small, the patient cannot be transported in the bed. Staff experience increased workload because of the added manual labor required to transfer the patient from bed to litter when transport is necessary.

Equipment may also be inserted into a work system without assessing the direct impact of equipment design on the user. For example, if personal protective equipment is purchased in response to an infectious environmental threat but the equipment is not easily doffed, removal requires extensive assistance, and the available doffing space is suboptimal, the combination of equipment design and the environment increases workload and raises potential exposure risks. These two examples describe situations that may lead to staff dissatisfaction, variation of task performance, delays in treatment, and potential patient or staff harm.

Ergonomics (or human factors) is “the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and other methods to design in order to optimize human well-being and overall system performance.” It appears that within the medical literature on ergonomics, there exists a bias toward focusing on the prevention of worker injury. Medical literature that correlates ergonomics with patient safety is sparse, and literature that correlates ergonomics with a patient’s infection risk is almost nonexistent.

METHODS

As a result of consultation with a facility regarding a cluster of infections, Pennsylvania Patient Safety Authority analysts suspected a link between ergonomic design and the development of those infections. The analysts then queried the Pennsylvania Patient Safety Reporting System for data on the existence of other epidemiologic links,
specifically targeting procedural systems, procedural environments, and equipment. Analysts identified two specific clusters of patient exposures that warranted further investigation and examined the narratives included in each of the event reports for both epidemiologic clusters.

RESULTS
The first cluster involved patients exposed to a contaminated endoscope. The narratives describe that several endoscopes had been sent out for repair. Loaner endoscopes (i.e., endoscopes loaned by the manufacturer) were placed into the system to temporarily supplement supply until the repaired endoscopes could be returned to service. The loaner endoscopes varied in design from the endoscopes the technicians were used to cleaning, as they contained an additional channel. Because the technicians were unfamiliar with the new equipment, the additional channel was not manually brushed (i.e., debrided) as part of the endoscope cleaning process.

The second cluster involved equipment purchased and retrofitted to an existing procedure room. The room was also used to perform other procedures and housed equipment related to those procedures, which in turn affected available space. The proceduralist had to change their surgical approach due to the room size and position of the equipment. This change in approach resulted in a cluster of ophthalmic infections.

DISCUSSION
The science of ergonomics addresses the parts or qualities of equipment or environmental design that facilitate easy and effective use. With any reusable equipment (such as endoscopes), use includes reprocessing. In the first cluster of infections, the design of the endoscopes did not make reprocessing intuitive in regard to the reprocessing staff being made aware of the additional channel. Considering how the reprocessor uses the endoscope, there may be an opportunity for a systems fix if a facility is aware of equipment changes.

For example, a facility could tag the loaned endoscopes with a traditional break lock (commonly used on code/crash carts/medication boxes), which would be placed postprocedure. The assistant or proceduralist could write on the break lock the number of channels the particular scope possessed. The reprocessing staff would then be aware of differences in endoscopes.

This concept may have particular value where there tends to be a lack of a critical control point for loaner equipment entering the system as well as in ambulatory surgical centers, where ancillary departments, such as biomedical engineering, tend to be nonexistent. The addition of the break locks to the endoscope is heavily dependent on individual personnel’s knowledge of the process. This process would also be dependent on the facility knowing the loaner endoscopes varied in design from those that had been sent out for repair.

A more permanent, intuitive fix would be for the manufacturers of endoscopes to label the number of channels and any other pertinent reprocessing information on the handle or body of the endoscope. Labeling to guide action has been described in the literature for at least 35 years. A seminal example is the case of a data scope M/D3 defibrillator/monitor, where there was confusion related to switch activation required to deliver a shock to the patient. Following investigation, the manufacturer issued new labels that made the functions and operation of the defibrillator more intuitive for the operator.9

MMWR Case Example
In January 2014, an article in the Morbidity and Mortality Weekly Report (MMWR) highlighted a carbapenem-resistant Enterobacteriaceae outbreak associated with endoscopic retrograde cholangiopancreatography.12 The article reported that “retrospective review and direct observation of endoscope reprocessing did not identify lapses in protocol.”10 Other studies have identified that the design of these particular endoscopes may make disinfection challenging.11,13

In an effort to address the findings related to the case highlighted in MMWR, enhanced training of reprocessing staff in terms of brushing, spending extra time cleaning the elevator port, and detergent flushing is emphasized.12 The intended suggestion does not evade the work but tries to vary the process to circumvent design problems that impede reprocessing; the variation may be effective but will fail if a user forgets the variation. Perhaps labeling could play a role in this case, combined with the additions to suggested reprocessing. The scope could be labeled with a simple phrase to remind the operator about the elevator channel cleaning step—for example, “Warning: Forceps Elevator Channel—refer to instructions for reprocessing.”

If the endoscopes from the outbreak case highlighted in MMWR were designed with all of the users in mind, they may have had characteristics supportive of effective and safe reprocessing (such as additional labeling). An ergonomics perspective includes consideration of whether the design of the endoscope and its parts and qualities, as well as instructional materials, consider the needs of all users.

The Environment
The second cluster of patient infections—involving equipment purchased and retrofitted to an existing procedure room—demonstrates how the physical environment impacts the proper use of equipment. In this example, the equipment was used in a space with insufficient clearance, and the user had to change how they performed the procedure. Again, it appears variation has been created to
compensate for poor ergonomic design. The equipment may have been designed properly, but the environment where the equipment was used was not optimal for the intended function. Space limitations impact the interaction between the user and equipment, resulting in preventable patient harm.

**Design Evaluation**

Usability engineering methodology that incorporates ergonomic principles and a user-driven approach can be utilized to optimize equipment selection and environmental characteristics while also considering other crucial operations such as cleaning and disinfection. There are six steps classically associated with the process of usability engineering: user studies, goal-setting, concept development, design detail, specification, and field testing. Usually an institution will have little if any influence over the goals, concept, detail, or specification of the equipment that has been designed, though an institution may be involved in user studies and perhaps specification if there is a relationship with the manufacturer and industry. Considering the examples presented herein, user studies would be of key importance when evaluating equipment for use or purchase.

When evaluating equipment, user studies, particularly interviews following field testing or simulation, have proven beneficial before finalizing equipment design. For example, Wiklund notes, “User interviews and [field] testing revealed that a thumbwheel was the best way to achieve single-handed control of articulation for the illumination catheter of [a particular type] of endoscope.” Field testing during the planning and evaluation phase will provide information about how a particular piece of equipment will affect users in a facility.

At the facility level, field testing is easily accomplished through simulation by way of placing a prototype, the real equipment or mock equipment, into a real or simulated environment, which would allow equipment use and its impact on users to be traced during diverse scenarios. Simulation observations and user interviews can be compiled to select equipment that would be the most ergonomic for all users and to select or design environments that address all aspects of clinical use, including cleaning and reprocessing. Furthermore, there needs to be a defined critical control point that is the single way equipment is evaluated and purchased or placed into use in a facility or system. Once a critical control point is established, only then can checklists, simulations, and user interviews become effective at mitigating device-related patient harm.

**Medical Device Evaluation Tool**

In order to provide a structured assessment, the Authority has developed a sample tool that focuses on ergonomic factors and related patient risk. Depending on respondent answers, the Authority tool may point to the National Aeronautics and Space Administration’s Task Load Index assessment tool in order to gather further information about a device’s impact upon its users in their own environment. The tool accompanying this article is available at [http://patientsafetyauthority.org/EducationalTools/PatientSafetyTools/Pages/home.aspx](http://patientsafetyauthority.org/EducationalTools/PatientSafetyTools/Pages/home.aspx).

**CONCLUSION**

A structured format that includes consideration of the entire continuum of processes involved in patient care provides opportunities to identify and address ergonomic problems to minimize infection risk and prevent patient harm. The Figure is typical of the continuum of processes institutions face when delivering care to a patient. The environment encircles and flows through the patient, the healthcare workers, and the equipment. All of the elements are interconnected and must be considered individually and as part of a larger whole in order to fully comprehend efficiency or inefficiency of design.

![Figure. Ergonomic Factors and the Continuum of Care Delivery](image-url)
To mitigate infection risk, it is essential to consider the ergonomic relationships involving the patient, the care providers, and the equipment reprocessors, as well as the equipment itself and the related work environments. The patient, healthcare staff, equipment, and environments may be combined either in a structured format or haphazardly. If the combination of people, processes, equipment, and environment is left to chance, poor decision making or ill-conceived ergonomics will likely lead to a game of Russian roulette in terms of a patient’s infection risk mitigation.

Acknowledgments
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NOTES
Quarterly Update on Wrong-Site Surgery: Do You Really Want to Wake the Patient Up and Start Over?

Fifteen reports of wrong-site surgery in Pennsylvania operating rooms (ORs) during the fourth quarter of 2014 represents a continued regression in the first half of the academic year from the nadir of 2012, despite continued progress in the first quarter of the academic year noted in the last update (see the Figure). The majority of reports involved injections or spinal procedures, including four wrong-side paravertebral pain blocks, two wrong-level spinal procedures, two wrongside preoperative regional blocks by anesthesiologists, and one wrongside local anesthetic injection by the surgeon prior to the formal time-out. The majority of all 611 wrong-site procedures in Pennsylvania operating suites since July 2004 have been anesthetic blocks by anesthesiologists and surgeons (170), wrong-level spinal procedures (75), or pain management procedures (68)—the persistent top three wrong-side operating suite procedures by type.

Some of the problems, such as the role of confirmation bias and the importance of referencing the site mark, are illustrated by the following contextually deidentified report:

Patient was placed in pre-op holding area for placement of right femoral nerve block before right ankle surgery. Equipment was brought into the holding area and happened to be placed in an orientation consistent with performing a left femoral nerve block (ultrasound on patient’s right side). Anesthesiologist was standing on patient’s left side when time-out was performed with CRNA. CRNA left to obtain sedation while anesthesiologist drew up medications necessary for block on counter behind patient. After drawing up drugs, anesthesiologist proceeded to prep and drape the wrong side. Block was performed without incident. Following completion of block, the patient’s covers (which were covering from thigh down) were pulled back to assess adequacy of block when surgical signature was noted on the contralateral ankle.

ANOTHER CRITERION FOR INTRAOPERATIVE SITE VERIFICATION

Some fractures need intraoperative verification of their location before internal fixation, as illustrated by the following wrong-site surgery report:

Surgeon prepped right foot and after completing the timeout, using flouro to locate the fracture of the 3rd metatarsal and marking it, she placed the first piece of hardware into the metatarsal. After viewing the x-ray when done with the first piece of hardware, the surgeon noted that she had done the 2nd metatarsal. The 3rd was then done as planned.

Intraoperative verification of the location of some fractures by imaging studies prior to internal fixation needs to be added to the current list of procedures needing intraoperative site verification:

- Spinal level prior to spinal surgery
- Location of ureteral stent after placement
- Rib number prior to resection

CRITICAL NEAR MISSES

Near-miss reports continue to demonstrate vulnerability to risks for wrong-site surgery and the importance of safeguards to minimize those risks. In particular, three patients had to be awakened from sedation or anesthesia because of the failure to reconcile information during the preoperative visits by the surgeons—information that could have been reconciled by the surgeons during their verifications of the documents prior to marking the sites:

Patient presented for an arteriovenous graft. During the time-out, it was noted that the informed consent form specified right side and the OR schedule indicated left. At
the time of the time-out, the patient was under anesthesia and unable to clarify information. Next of kin unavailable. Patient awakened from anesthesia, and procedure completed after laterality confirmed.

Surgeon obtained consent in holding area. Both patient and surgeon agreed that it was the left knee, and the left knee was marked appropriately. Staff in the area heard the verification. The patient was [then] sedated and taken to the operating room. The circulating RN during the time-out noted the consent said right. The time-out was stopped. The patient was awakened. She verified the site was the left, along with her husband. The consent was corrected. The patient was sedated again, and the procedure started without issue. Procedure was cancelled after patient was intubated and asleep. Surgeon assessed patient and stated, “Inflammation at operative site.” Discovered before doing the time-out.

Another report illustrates the confusion that can be sown from an improperly scheduled operation:

Patient was scheduled for surgery: “ORIF Right Proximal Tibia/Fibula.” OR informed x-ray and anesthesia of the scheduled case. Anesthesia went up to see the patient . . . [and became] aware that the patient did not have a right proximal tib/fib fracture. The patient had a left proximal humeral fracture. Anesthesia checked the consent. The surgical consent was for “ORIF Left Proximal Humerus.” Because the case was scheduled incorrectly, the incorrect instrumentation was picked. This was a near miss, and it caused a lot of confusion between multiple departments (OR, x-ray, ICU, anesthesia, central supply) and the patient.

Contrast those patient experiences with these good catches by other providers helping to make sure the surgeon’s patient got the correct procedure at the correct location:

Patient seen in preadmission testing area for surgery workup. [Identified] OR reservation from doctor’s office had wrong side.

Consent for above-knee amputation had incorrect side listed. Identified by floor nurse and corrected prior to OR.

Patient transferred via ED from another hospital for surgical emergency. Patient was to be evaluated and stabilized in ED and then taken to OR. Consent for OR and anesthesia printed out by charge nurse. Right before consents were signed, the nurse noticed the wrong patient’s name and information were printed out on the consents. Correct stickers applied. Anesthesia and surgeon informed, and consents then signed by patient with correct labels on consent forms.

During morning briefing, it was discovered that case was scheduled incorrectly. Case booked as exploratory laparotomy, right colon resection.

Surgeon said case is laparoscopic right colectomy. Patient consent and H&P reflected open procedure. Surgeon notified [to clarify].

Order written: needle localization right breast mass @ 6:00. Reports and films reviewed by radiologist prior to procedure identified site to be localized as atypical area on stereotactic biopsy films, not benign mass at 6:00 diagnosed by previous sono core biopsy. Verified with doctor. Diagnostic mammogram done per procedure to identify correct marking clip to be localized.

More near-miss reports point to lack of compliance by surgeons marking the sites with verification of information from both documents and the patients in the preoperative holding area:

Patient came to operating room without having side/site marked. Surgeon
The following is another report of a surgeon being noncompliant with procedures to minimize the risk of wrong-site surgery to the potential detriment of his or her own patient:

Patient brought into room and positioned on bed. Nurse noticed laparoscopy equipment was not working. Patient prepped [by surgeon] while nurse troubleshooted laparoscopy equipment. Nurse told surgeon to wait while she was fixing the equipment. While she was doing so, the surgeon proceeded with making the incision before time-out [was done]. Time-out complete after incision was made. All components to time-out were agreed upon by the OR team. OR tech and nurse discussed with the surgeon about procedure prior to incision, but not as a formal team. Entire team spoken to in regard to proper procedure and priorities and methods to handle the situation differently.

Other reports indicate an overreliance on the time-out to catch information errors that could more conveniently and safely be caught preoperatively, by the surgeon or others, before the patient is brought into the OR:

While doing the time-out, it was discovered that the [patient’s chart did not have a signed] surgical consent. Doctor’s office was contacted to fax a copy of the surgical consent, which the patient had previously signed, from the office.

Patient scheduled for procedure “Incision and Drainage of Left Buttock” in operating room. Upon time-out completion, surgical consent stated “Incision and Drainage”; no location or side/site noted on consent. Consent updated through confirmation with surgeon and patient’s wife.

[Pediatric] patient admitted to OR for treatment of left forearm fracture. During surgical time-out, after patient was asleep, wrong site noted on surgical consent. X-rays and chart reviewed and confirmed left forearm as planned operative site. Parents were informed of inaccurate consent. Consent was changed to correct site. Father initialed change, and his initials were witnessed.

Patient was going to the OR for L3-4 microdiscectomy, and case was scheduled as being on the right side. Time-out stated as a left-side case. Consent that was completed in the office by patient and surgeon was noted as right, but the narrative note from that day clearly spells out the left lateral foraminal stenosis. Case was completed on the correct side of left.

RN performed the time-out, stating the procedure to include right breast lumpectomy with sentinel lymph node biopsy on right and left breast lumpectomy. Another RN took over the case. Upon obtaining the specimen from the left breast, the new RN saw that the consent did not include the procedure to the left breast. RN was present during the pre-op discussion between surgeon, the patient, and her sister when they discussed including left breast biopsy in the procedure. Surgeon added the left breast lumpectomy to the consent at the end of the procedure; deviation from established protocol.

However, some informational discrepancy could only have been caught in the OR:

Patient was prepped and draped for a left nephrectomy. Surgeon halted the surgery due to inconsistency with radiology films that were displayed in the operating room. The charge nurse and administrators were then notified of the situation. Surgeon reevaluated radiology films and report and determined that incorrect films were placed in patient’s records. Surgeon spoke with the patient’s family, evaluated all available patient information, and determined that the left kidney was the correct kidney.

The time-out, the critical last step in the Universal Protocol, can be compromised by inappropriate handoffs, as illustrated by this report:

CRNA was relieved for a break minutes before the time-out. . . . One of
The elements of the time-out is [asking,] “Are the antibiotics given?” Two grams of Ancef were ordered, and [the relief CRNA] reported to the entire team that none had been documented and that she did not have any in her Pixis in the room. I went to the Pixis in the core, retrieved the 2 grams, and gave the patient the 2 grams at [8:30 a.m.] and the procedure began. When [the original CRNA] returned from her break, I asked her to reverify the time the Ancef was given, and she reported that she had given the patient 2 grams at [about 8:10 a.m.]. The patient had received a double dose.

Several reports of identification problems in this past quarter illustrate the continued possibility of wrong-patient surgery despite the occurrence of only nine surgical procedures on the wrong patient since July 2004:

Wrong patient registered. Two different patients with the same name in the system, one DOB [in December and the other in October of the same year].

Nursing floor printed off and placed wrong H&P on the patient’s chart. Physician discussed incorrect medical issues with the patient, based on the wrong H&P’s information. Anesthesia did the preoperative evaluation based on misinformation. All issues were corrected prior to patient going to OR.

Patient was sent from floor to PACU to check in for pre-op procedure. Patient was sent with wrong patient’s chart. Floor unit called and made aware. Patient’s correct chart brought to PACU at that time. While looking through patient’s chart, which was the correct chart, the wrong patient’s H&P was placed on the chart. The wrong antibiotic dose was sent to PACU with patient. Surgeon made aware. Anesthesia staff and OR nursing made aware. All incorrect patient documentation removed from chart, and the antibiotic administered by anesthesia was the correct medication and dose.

Patients were identical twins presenting for same procedure, which was insertion of ear tubes. Anesthesia provider brought in second scheduled [twin] patient, thus deviating from OR schedule. Upon completion of the first timeout, it was discovered that the incorrect patient was brought to the room.

CONCLUSION

Surgeons, anesthesiologists, and pain management specialists would all benefit from doing a proper preoperative verification of the site, using both the documents and the patient as sources for verification. Those doing the procedures would also benefit from being fully engaged in the time-out process with all other members of the OR team, who are fully engaged in making sure the patient gets the correct procedure at the correct site.
Healthcare Providers Committed to Patient Safety Recognized

INTRODUCTION

The Pennsylvania Patient Safety Authority held its annual I Am Patient Safety poster recognition contest during the last several months to recognize individuals and groups within Pennsylvania’s healthcare facilities who have demonstrated a personal commitment to patient safety. The recognition poster contest is held each year, with posters delivered to facilities in time for Patient Safety Awareness Week, March 8 to 14, 2015. The contest helps patient safety officers promote progress being made within their facilities to improve patient safety. As one of the judges for the competition, I am impressed by the number of patient safety improvements individuals and groups are making throughout Pennsylvania. This year, we had three times as many nominations as last year, so judging them was a bit more difficult, but even more enlightening.

I want to thank everyone who participated in the contest. Keep an eye out for that person or group you think should be recognized for their patient safety efforts next year, and nominate those individuals or groups for the next poster recognition contest beginning in May. I appreciate the time taken to tell us what your colleagues are doing to improve patient safety in Pennsylvania.

Several Authority board members and management staff comprised the judging panel. The panel judged submissions upon the following criteria: the person or group (1) had a discernible impact on patient safety for one or many patients, (2) demonstrated a personal commitment to patient safety, and (3) demonstrated that a strong patient safety culture is present in the facility. Bonus points were awarded for submissions that demonstrated initiative taken by an individual.

Winners received their photos and patient safety efforts highlighted on posters that can be displayed within their facilities. They also received a certificate and an I Am Patient Safety recognition pin from the Authority. Winners were invited to attend the March 2015 Patient Safety Authority Board of Directors meeting for lunch and to meet the Authority board members and staff.

I AM PATIENT SAFETY: 2015 WINNERS

The individuals and groups recognized for the I Am Patient Safety poster contest and their achievements are as follows (in alphabetical order by name of facility):

Lorena Romero-Prato, Admissions Office Secretary
Lisa Sarnowski, RN, CEN
Jodi Celender, Monitor Tech, Nursing Assistant II
Allegheny Health Network, West Penn Hospital

A patient was trying to call her doctor but accidentally reached a West Penn Hospital voice mailbox. She left her phone number but not her name or address, stating she was in pain and thought she was having a heart attack. Lorena Romero-Prato heard the distress in the patient’s voice and tried to call her back, but there was no answer. Lorena dialed 911 to get emergency medical services to respond. The call center, however, was unable to help without a name or address. Lorena then called the West Penn Hospital Emergency Department (ED) to ask for help. She reached Lisa Sarnowski, RN, who knew there was a way to look up the phone number of a person without the name, but she wasn’t sure how. Lisa called Jodi Celender, a nursing assistant and monitoring technician in the ED. Lisa and Jodi were able to find the caller through a reverse phone number search. Once they identified her, they contacted 911 and emergency medical
services were dispatched. The ambulance reached the patient and brought her to the ED for further evaluation.

David Ezdon, PharmD, Clinical Pharmacist
Einstein Medical Center Montgomery

As a clinical pharmacist, David has focused on improving patient care by building a culture of patient safety. He has worked with the hospital’s falls committee and natural sleep initiative team to reduce patient falls due to certain medications. He was also instrumental in improving patient safety in the neonatal intensive care unit by demonstrating how staff can use electronic ordering plans efficiently, rebuilding the unit’s pump libraries to maximize safety software, and educating staff pharmacists on properly compounding medications. David has also led the effort to establish an antibiotic stewardship program to minimize the use of antibiotics and reduce *Clostridium difficile* (C. diff) rates. He also developed electronic order pathways to help prescribers avoid harmful drug interactions when ordering new oral anticoagulants. David’s efforts to improve gaps in Einstein’s communication systems have encouraged all who work with him to seek his expertise and recommendations.

Tom Miller, MLT, ASCP, Medical Laboratory Technician
Einstein Medical Center Montgomery

As a medical laboratory technician at Einstein Medical Center Montgomery, Tom discovered why blood draws resulted at the bedside as compared to when resulted in a laboratory. Because of Tom’s persistence, infants in the NICU are safer and are spared from unnecessary blood draws. This difference means that an infant’s glucose level will be higher when resulted at the bedside as compared to when resulted in a laboratory. Because of Tom’s persistence, infants in the NICU are safer and are spared from unnecessary blood draws.

Nora Ramirez, Environmental Services Worker
Einstein Medical Center Montgomery

As a member of the environmental services team, Nora shows her dedication to patient safety over and over again in the way she cleans each patient’s room. Always compliant with isolation precaution requirements, her cleaning process is so thorough that every surface in the patient’s room is wiped and disinfected every time. Nora understands the importance of her role in killing multidrug-resistant organisms (MDROs) to prevent healthcare-associated infections (HAIs) at Einstein Medical Center Montgomery. Her surfaces pass Einstein Medical Center’s infection prevention monitoring program 100 percent of the time. Nora’s cleaning methods are a model for our infection prevention control team.

Emily Coon, RN, BSN, Emergency Department
Fulton County Medical Center

As a nurse in the emergency department (ED), Emily works to improve the delivery of care to her patients. Part of this effort includes using the electronic medical record system to ensure her patient’s medications are updated regularly with outside pharmacy information. The medication reconciliation process can be time consuming, but Emily recognized the value in obtaining a patient’s medication list and comparing it to external pharmacy records. Emily recently cared for a patient in the ED who had a strange set of symptoms, given the patient’s age and medical history. While performing medication reconciliation, Emily noticed the patient recently had a prescription filled for a class of drug which was not consistent with her medical history. She questioned the patient thoroughly, which took a significant amount of time. After reviewing the medications over the phone with the patient’s family, it was found that the patient received a prescription that was not intended for her. Emily’s persistence in this matter helped identify the cause and subsequent treatment of this patient’s symptoms.

Elizabeth Martin, RT(R)(VI), RCES
Lancaster General Health

As a radiologic technologist, Beth volunteered to serve as the electrophysiology and pacing department’s radiation safety officer. Her goals were to reduce patient radiation exposure and increase the safety of fellow staff members and physicians. Beth worked closely with the x-ray equipment vendor, staff and physicians to identify action steps to reduce radiation exposure for all. The team identified several key strategies, including, but not limited to: partnering with the x-ray equipment vendor to establish the lowest standard equipment settings that still provided accurate images; providing education and training opportunities for staff; developing a radiation time-out to alert the physician when 30 minutes of fluoroscopy time was reached; using Gafchromic film to measure radiation exposure; and developing a database to track patients’ exposure information. A post-implementation study shows a 44 percent decrease in radiation exposure to patients from calendar year 2011 to 2012. Beth continues to educate physicians and staff about the dangers of radiation exposure and the importance of compliance with the guidelines established through this project.

Kathleen Cochrane, RN, Neonatal Intensive Care Unit
Lehigh Valley Hospital

While checking medication stock in Lehigh Valley Hospital’s neonatal intensive care unit (NICU), Kathleen Cochrane noticed a difference. The vaccine was not the usual type of hepatitis B vaccine that was normally stocked. Kathleen called the pharmacist to question it. The pharmacist came to the NICU to check the vaccine
and determined that it was not the correct medication to be administered to babies. Kathleen’s attention to detail may have prevented a serious patient safety event.

Gloria Mazzie, RN, Behavioral Health Unit
Lehigh Valley Hospital

After the hospital purchased paper bags with handles to store patient clothing, Gloria discovered that a patient in the hospital’s behavioral health unit had tied together the bag handles to use as a belt. It was determined that this belt was strong enough for a patient to cause harm to himself or another patient. Gloria’s quick response to this concern initiated a search to find a bag that would be safer for patients to use in the behavioral health unit. Her dedication to patient safety may have prevented a serious patient safety event.

Christine Reesey, RN, Float Pool Center for Critical Care
Lehigh Valley Hospital

While reviewing a chest x-ray, Christine noticed that the patient’s partial denture plate had slipped out of place and was lodged in his throat. She noted this before it was seen by the radiologist. Christine notified the medical team and the plate was removed. Ten days later, while caring for another patient, she noticed the physician had placed an order for insulin that was much higher than what the patient had been receiving. Christine contacted the physician to question the order and obtained an order for a decreased dose. Her continual attention to detail may have prevented two potentially serious patient safety events.

Jolene Barbazzeni, RN, Stroke Coordinator
Penn Highlands Healthcare (DuBois)

Jolene leads the “Good Catch” committee, which recognizes Incidents or near-miss events that could have caused harm to patients but did not actually occur. She has also personally had many “good catches” that prevented patient harm. Most recently, Jolene’s effort was chosen as the “Good Catch of the Month” when she prevented a potential wrong-site surgery. A patient needed surgery on the right side of his neck to prevent a stroke. Jolene noticed the wrong side was documented in his record. She immediately notified the patient’s caregivers, and the patient received the proper surgery.

Tammy Angeletti, MS, RRT-NPS, RN, CPFT, AE-C
Clinical and ECMO Specialist, Department of Respiratory Care
Penn State Hershey Children’s Hospital

While providing care for a child with a tracheostomy tube, Tammy recognized a variable connection issue between the oxygen delivery device and the tracheostomy tube. She worked with a manufacturer to develop a device that would provide a standard connection, eliminating any variation to the oxygen set-up.

Marybeth Lahey, RN, BSN, Nurse Manager of the Well Mother and Baby Unit
Susan Meyers, MSN, RNC, CPNP-PC
Pennsylvania Hospital

In early 2012, Marybeth and Susan were made aware of significant safety concerns related to infant falls at the Pennsylvania Hospital. Infant falls were reviewed from March 2012 to March 2013. During this time, 10 infant falls occurred, translating to a rate of 21.5 infant falls per 10,000 births. Marybeth and Susan did an exhaustive literature search on infant falls and found little information published. As educators for Pennsylvania Hospital, Marybeth and Susan developed interventions within the facility that included: training all food service and environmental services staff about infant falls prevention and how to intervene when moms are noticed in a sleepy state; educating all nurses and physicians about the need for increased vigilance; recruiting physicians as champions to prevent infant falls; giving moms two hours of quiet time in the afternoon so they could sleep; revising a safety contract to inform parents about the risks involved in caring for an infant while fatigued; developing a Good Catch log to capture opportunities for further education; and developing a falls debriefing process. As a result of these implemented interventions, Pennsylvania Hospital experienced an 88 percent reduction in infant falls.

Karen Barbieri, RN
Cindy Valerio, RN
Progressive Care Unit/Telemetry
Phoenixville Hospital

Cindy noticed that a patient with heart failure had been discharged without his prescriptions after finding them on the discharge desk. Cindy voiced her concerns to her unit coordinator, Karen Barbieri, who agreed the patient was at risk for heart failure complications if he didn’t have his prescriptions. Karen called the patient and found he was not able to determine what medications he had at home. The patient had gained two pounds in a short period of time, which is a complication of heart failure. Karen recognized this patient was in danger at home and called medical home care services to help the patient. She also called the primary care physician to get the patient his needed prescriptions. During a daily safety call, this event was discussed and all staff used it as a learning opportunity.

Lisa Connolly, RN, Medical Surgical Unit
Phoenixville Hospital

As a medical-surgical nurse, Lisa was caring for a patient following joint replacement surgery. Upon reviewing her patient’s electronic medical record, she noticed the surgeon had ordered two specific blood thinner medications for him to take after surgery—one was the blood thinner he had taken at home before surgery and the second was another medication. Lisa immediately questioned why two of the same medications were ordered for her patient and held both doses until further review. The attending physician was notified, and new medication orders were obtained. It was discovered that both the surgeon and pharmacist received a clinical alert within the electronic medical record, but both ignored the alert. As a result of Lisa’s questioning and
subsequent follow-up to verify and validate the medications, the patient did not receive duplicate medications. The lessons learned from this near-miss event were shared at unit-based and leadership safety huddles.

**CONCLUSION**

Thank you, again, to all who participated in the I Am Patient Safety poster recognition contest, and join me in congratulating the individuals recognized for their efforts to improve patient safety in Pennsylvania’s healthcare facilities. Your commitment to patient safety does not go unnoticed.

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**LETTER TO THE EDITOR: PREVENTING AIR EMBOLISM WITH PICC LINE REMOVAL**

I read with interest your article “Reducing Risk of Air Embolism Associated with Central Venous Access Devices” in the Pennsylvania Patient Safety Advisory, June 2012. My concern with this document, and many others on the same topic, is that peripherally inserted central venous catheters (PICC lines) are lumped in with subclavian and internal jugular central venous catheters and tunneled catheters, when the risk of air embolism on removal is not at all the same.

In the 40 years since PICC lines have been in use, I cannot find a single report in the literature of an occurrence of air embolism following removal of a PICC line. If you have any instances of this occurring, I would be grateful if you could share this with me and encourage those involved to document these cases in the literature as evidence of the risk.

I work in a “Hospital in the Home” service, providing home infusion therapy, where PICCs are removed on the patient’s last day on the program. The dressing is not changed daily after removal, and the patient does not have to be observed for 30 minutes post removal. Patients are not put in the supine position for PICC removal.

I am finding it hard to justify implementing your recommendations.

I would be interested in your feedback on this issue.

Pauline Dobson  
Clinical Nurse Consultant, Immunology & Infectious Diseases Unit  
John Hunter Hospital, New Lambton Heights, Australia

**Editor’s Note**

Thank you for your inquiry regarding the risks for air embolism and the steps recommended to prevent air embolism occurrence with PICC line removal. In response, Pennsylvania Patient Safety Authority analysts performed an additional review of the literature and an updated analysis of events reported to the Pennsylvania Patient Safety Reporting System (PA-PSRS) from June 2004 through December 2014. No reports of air embolism occurring with PICC line removal were found in the literature, nor were any such events reported through PA-PSRS.

PICC lines are classified as central venous access devices (CVADs) because their tip lies within a central vein, usually the superior vena cava, where venous pressure is usually lower than atmospheric pressure. This pressure gradient favors the ingress of air. However, the insertion/exit site for a PICC line is in a peripheral vein, where venous pressure is usually higher than atmospheric pressure. This pressure gradient favors the outflow of venous blood and not the ingress of air. If all precautions are taken to maintain a closed system during PICC line removal (i.e., all lumens capped and/or clamped), the potential for air ingress is minimal. Therefore, the CVAD-associated air embolism prevention methods outlined in the Advisory article would apply to PICC line insertion, care, and maintenance but would not apply to PICC line removal. The Authority thanks you for calling this to our attention and providing us the opportunity to make this clarification.

Authority analysts sought additional input from Bruce Hansel, ECRI Institute, because of his extensive experience investigating catheter-related problems, including air embolism.

**External Reviewer Comment**

Air embolism is diagnosed based on manifested signs and symptoms. Air embolism may occur with PICC line removal, but the amount of air may be so minimal that it does not produce symptoms. The absence of symptoms is not sufficient to ensure that no air has entered the vessel. However, this discussion centers on symptomatic embolism. Because a PICC line is a central venous catheter, it carries with it the same risk of air embolism while it is in place as other CVADs. However, because it is peripherally inserted, it presents negligible risk of symptomatic air embolism during removal.

In that regard, the precautions suggested in the Advisory article and recommended in the literature for removing CVADs are unwarranted for PICCs for two reasons: (1) the pressure gradient favoring air ingress is much lower at a peripheral site than at a more centrally located CVAD insertion site, and (2) the diameter of a PICC track through the tissue is smaller than that of most CVADs. Furthermore, when removing a peripheral catheter, supine or Trendelenburg is less favorable pressure-wise than a more favorable seated position with the arm at waist level. To prevent air ingress when removing a peripheral intravenous catheter, the exit site needs to be lower than the heart. The same measures used for removing short peripheral intravenous catheters should be applied to PICCs. However, a PICC site may be more likely to bleed after removal because it will have a larger and more mature track through the tissues than a short peripheral intravenous catheter.

Bruce C. Hansel, PhD, CCE  
Executive Director, Accident and Forensic Investigation  
ECRI Institute
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