PENNSYLVANIA PATIENT SAFETY ADVISORY

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OBJECTIVE

The *Pennsylvania Patient Safety Advisory* 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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Distractions and Their Impact on Patient Safety

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ABSTRACT

Distraction is a common source of potential error that is well established within the fields of human factors research and cognitive psychology. High levels of distraction in healthcare settings pose a constant threat to patient safety. New technologies have increased the number and types of distractions present in these settings. Analysis of reports submitted to the Pennsylvania Patient Safety Authority in 2010 and 2011 containing relevant terms, namely "distract," "interrupt," or "forgot," identified 1,015 reports that could be attributed to distraction. The majority of events were classified as medication errors (59.6%), followed by errors related to procedures, treatments, or tests (27.8%). Thirteen events were reported that resulted in patient harm. A total of 40 reports specifically mention distractions from phones, computers, or other technologic devices contributing to errors. This article examines the broader issue of distractions that cause medical errors and outlines strategies for decreasing the potential for distraction and harm. These risk reduction strategies include developing systems and processes that reduce or eliminate distractions and teaching effective techniques for handling distractions. (Pa Patient Saf Advis 2013 Mar;10[1]:1-10.)

INTRODUCTION

The definition of "distract" is "to draw or direct (as one's attention) to a different object or in different directions at the same time."[1] Distraction is especially detrimental to human functioning in situations requiring cognitive processing of large amounts of complex and rapidly changing information. Such situations occur almost constantly in healthcare settings. When presented with new information, the mind of the healthcare worker must be able to focus attention and encode information to be retrieved at a later time. Diverting attention during these key points of information encoding or retrieval may result in human error.[2]

DISTRACTIONS IN PENNSYLVANIA

A query of the Pennsylvania Patient Safety Authority's Pennsylvania Patient Safety Reporting System (PA-PSRS) database for events reported in 2010 or 2011 containing the terms "distract," "interrupt," or "forgot" produced 1,202 reports, of which analysts identified 1,015 reports describing events that could be attributed to distraction. The majority of these events were reported as medication errors or errors related to procedures, treatments, or tests (see Figure). Nearly all events were reported as Incidents (i.e., events resulting in no harm to patients). However, it is important to note that even in cases of no harm, additional costs may be incurred during follow-up. For example, nearly one in five events (17.7%, n = 180) were reported with a harm score of D, which is defined as an event that requires monitoring to confirm that it results in no harm and/or requires intervention to prevent harm.[3]

Of the 13 Serious Events (i.e., events resulting in harm to patients) reported, the majority were split equally between medication errors and errors related to procedures, treatments, or tests. See Table 1 for events reported according to event type and harm score.

Figure. Event Reports to the Pennsylvania Patient Safety Authority Attributed to Distraction, by Event Type, 2010 through 2011

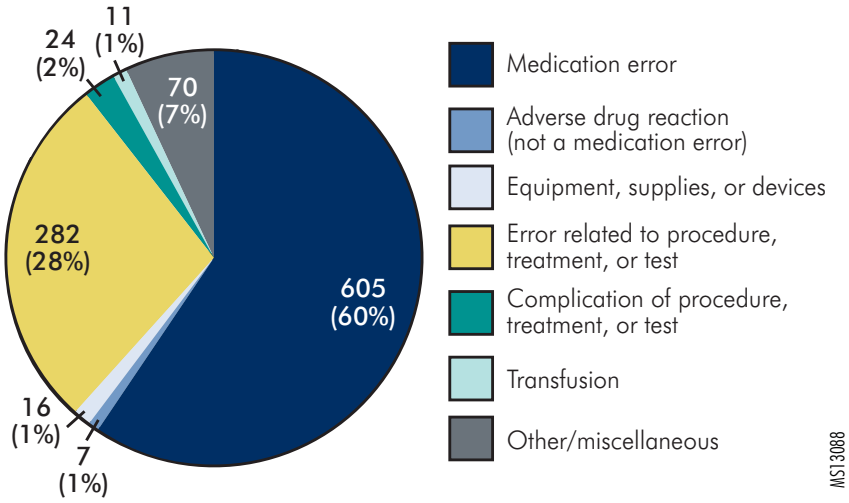

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Table 1. Serious Event Reports to the Pennsylvania Patient Safety Authority Attributed to Distraction, by Event Type and Harm Score, 2010 through 2011

EVENT TYPE BY HARM SCORE	NO. OF REPORTS
Harm score E: An event occurred that contributed to or resulted in temporary harm and required treatment or intervention	**12**
Medication error	**5**
Extra dose	1
Wrong dose (overdosage)	2
Wrong rate (intravenous)	2
Adverse drug reaction (not a medication error)	1
Error related to procedure/treatment/test	**4**
Surgery/invasive procedure problem—other	1
Radiology/imaging test problem—wrong site	1
Radiology/imaging test problem—other	1
Other	1
Complication of procedure/treatment/test	**2**
Complication following surgery or invasive procedure—other	1
Other	1
Harm score G: An event occurred that contributed to or resulted in permanent harm	**1**
Error related to procedure/treatment/test	**1**
Laboratory test ordered, not performed	1
Total events with harm	**13**

Sixty-six percent (n = 672) of reports describe distraction of nurses as directly contributing to the events. Fewer reports identify the following individuals as the distracted parties: laboratory technician/phlebotomist (7.9%, n = 80), patient (6.7%, n = 68), pharmacist (6.7%, n = 68), physician (5.3%, n = 54), radiology technician (2.3%, n = 23), secretary (1.4%, n = 14), respiratory therapist (1.2%, n = 12), nursing assistant (0.9%, n = 9), nurse practitioner/nurse anesthetist/physician's assistant (0.6%, n = 6), and "other" (4.0%, n = 41). Caution must be taken in interpreting these percentages, as nearly all events appear to have been reported by nurses. The role of the reporter is not identified within PA-PSRS, but analysis revealed the majority of narratives were written in the first- or third-person perspective of nurses.

The majority of events do not directly identify the source of distraction; however, the following key search terms appeared in the event reports (with their frequency provided in parentheses): forgot (80.8%, n = 820), distract (14.1%, n = 143), and interrupt (7.3%, n = 74). Together, these percentages total greater than 100% because, in a small number of reports, more than one of the key search terms was identified. In general, the narratives describe some element of patient care being forgotten without identification of the reason for the lapse in memory or attribute the reason for the memory lapse to a general cause, such as being "busy" (5.4%, n = 55). Use of this term may reflect multitasking. In fact, many of the report narratives describe this phenomenon using a variety of terms. Of note, 40 event reports (3.9%) specifically identify distractions from phones, computers, or other technologic devices as contributing to errors.

Event Reports

The following examples from PA-PSRS reports illustrate the variety of events attributed to distraction and the resulting influence on various clinicians.

Pharmacy

> *I saw that unusual custom traces were ordered. I informed the technician to make the special dilutions (which was done without incident). When I entered the prescription into the compounding computer, I forgot to "zero-out" the neonatal trace mix, which provides the standard traces. Because of other unusual events in the area, I did not catch my error that day, and the double-dose was dispensed. (Persons were talking to me while I was entering and while I was checking, and I was stressed due to a drug shortage and multiple new procedures required, and I was striving to meet delivery deadlines despite late-received adult orders.) I am very sorry. In the future, if someone is talking to me while I am entering or checking a prescription, I will stop until I can fully concentrate. I caught my mistake when I entered the new prescription for today.*

Anesthesia

> *Patient had PCA [patient-controlled analgesia] and nerve block. Pumps were side by side. The anesthesiologist identified the nerve block pump and tubing to administer a bolus via*

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the route. He was distracted and, upon returning to give bolus, did not reidentify the pump. He programmed the wrong pump for the bolus. The patient received HYDROmorphone PCA bolus, requiring naloxone rescue.

Laboratory

While logged into this patient's report screen, I inadvertently viewed the slide of another patient and reported the results from that slide. I immediately realized my error and notified the nurse taking care of the patient. I was distracted and trying to do too much at the same time.

Nursing

[The night before, the] patient was ordered to have a potassium level drawn, with the results to be called to the attending [physician's attention]. It was learned the following morning that the test had not been ordered. The nurse had gotten distracted with seven admissions in eight hours and missed the order.

Surgeon

The assisting surgeon was placing a central venous catheter. The procedure was interrupted . . . prior to getting started by a nurse asking when the doctor would be coming to the OR [operating room]. She informed him she would be there in 30 minutes. After closing the door and placing the "Do Not Enter" sign up, the anesthesiologist came into the room and again asked when she would be coming to the OR. She told him that she would be there as soon as she found a vein. I turned to get something and heard the doctor yell "ouch." When I turned back around, I saw that she was pulling the scalpel out of her finger.

Radiology

Patient was ordered a stat chest x-ray. I began to run the x-ray and was distracted by a fellow technologist's question regarding another patient. I returned to the workstation to identify the image. I glanced at the highlighted first name of the patient I had pulled up and assumed that I had the correct patient information. I sent the image across. The next day it was brought to my attention that the image was not in the computer system. When looking for the exam on the workstation, the patient was not listed. I thought through what I might have done and looked for a patient with a similar first or last name close to my patient and discovered that I had entered the results for the wrong patient and misidentified the results as an abdominal x-ray.

Medication Errors

More than half of the events reported (59.6%, n = 605) describe distractions during the medication administration process that were associated with medication errors (see Table 2). Within this category, the largest percentage of events involved dose omissions (46.8%, n = 283), followed by errors with some aspect of medication administration labeled as "wrong" (33.9%, n = 205). The two most frequently reported errors of this type were wrong time (n = 49) and wrong dose/overdosage (n = 47). Examples of distraction can be found impacting all disciplines and at every step involved in the medication administration process.

Prescribing

Physician entered midazolam order incorrectly. Physician intended to write for 10 mg but scrolled to the bottom of the electronic list, ordering 15 mg. Child's weight would indicate maximum standard dose of 10 mg. Physician was distracted during entry by another clinical question.

Transcribing

Orders were written for patient A, faxed to satellite pharmacy, and processed. The pharmacist began entering the orders and was then interrupted by nurse taking care of patient B. The pharmacist pulled up the profile of patient B to answer questions. At that time, he finished processing orders but entered them on patient B instead of patient A. The error was found within one hour, and the orders were corrected. Unfortunately, the nurse taking care of patient B confirmed, charted, and gave the medications to patient B.

Preparation and Dispensing

The patient was ordered 1100 mg of a chemotherapy agent. The pharmacist pulled two 1 gram vials to prepare the dose, then realized that we carry 500 mg vials and pulled a 500 mg vial also. He forgot to put one of the 1 gram vials back and used all three vials to prepare the dose. The patient ended up receiving 2100 mg of the drug. The pharmacist performing the double check confirmed the calculation and verified that there was a 1 gram vial and a 500 mg vial used to prepare the dose. He did not notice the other vial and assumed that the other vials were sterile water vials for reconstitution. The next day, the pharmacist who prepared the dose went to reorder the drug and realized his error.

Administration

The patient had a heart rate in the 170s. The physician ordered metoprolol 2.5 mg IV [intravenous] x 1 dose. The nurse pulled the dose from the automated dispensing cabinet and scanned it. Before he had a chance to draw up the medicine, he was distracted by another patient. When he came back to his workstation, he ended up drawing up 2.5 mL from an insulin vial and giving it to the

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patient. He realized the error, and the doctor was notified; dextrose was given and fingerstick blood glucose testing was ordered. The blood sugar dropped as low as 52 but returned to normal by 2 p.m.

Errors Related to Procedures, Treatments, or Tests

The next most frequently reported event type associated with distraction was error related to procedures, treatments, or tests (see Table 2), with 27.8% (n = 282) of reports falling into this category. Within this category, laboratory test problems accounted for the largest percentage of events (45.0%, n = 127). The two most commonly reported laboratory test problems were test ordered and not performed (n = 36) and result missing or delayed (n = 30).

Following laboratory test problems, the subcategory of "other" contained the second-highest number of reports in this category (22.7%, n = 64). Close examination revealed that most reports labeled "other" refer to errors surrounding procedures, treatments, or tests performed by nursing staff that were not medication-related, nor did they fit clearly into the existing subcategories. Examples are as follows:

Nurse prepared infant's 17:00 feeding in syringe, then was interrupted to provide care to another infant. Nurse overlooked feeding and noted omission at 20:00 feeding. Doctor notified; no adverse outcome.

Patient with a known history of SVT [supraventricular tachycardia] called and left a message on our clinic voice mail that she had to download her EKG [electrocardiogram] tracings. The pacemaker technologist recorded the tracings into the database and printed the tracings when he noted that the patient was in rapid SVT. He then placed the tracings in a folder to show the provider; however, he got distracted with other things and charts got placed on top of the folder. The folder was found two days later and the provider was notified. The patient is to be scheduled for an ablation procedure.

Following laboratory test problems and "other," the remaining subcategories represented in the reports consisted of problems relating to surgery or invasive procedures (15.6%, n = 44), radiology or imaging tests (11.0%, n = 31), respiratory care (3.5%, n = 10), referrals or consults (1.4%, n = 4), and dietary issues (0.7%, n = 2).

DISCUSSION

Distraction and Memory

Memory loss is common to all humans. A certain amount of information is expected to be lost over time (a phenomenon labeled "transience") with the rate of forgetting being highest immediately following the initial encoding of information. However, with more elaborate encoding of information, less information is lost over time. "Working memory" is a specific form of memory that holds on to small pieces of information, for a few seconds at a time, as people cognitively process them for encoding. Divided attention at the time new information is being encoded directly interferes with "working memory" and is the first point at which distraction interferes with memory.[2]

Distraction also creates problems during information retrieval. Divided attention at this point results in a failure to remember information that was either never encoded properly or is available in memory but overlooked.[2]

Distraction is of particular concern to "prospective memory," or remembering to do things in the future. This form of memory can be event-based (i.e., when X happens, do Y) or time-based (i.e., do Y at a specific time in the future). Event-based

Table 2. Reports to the Pennsylvania Patient Safety Authority Attributed to Distraction for the Two Most Frequently Reported Event Types, 2010 through 2011

EVENT TYPE	NO. OF REPORTS
Medication error	**605**
Dose omission	283
Wrong (e.g., wrong drug, wrong rate, wrong route)	206
Extra dose	54
Monitoring error (includes contraindicated drugs)	23
Other	18
Prescription/refill delayed	11
Medication list incorrect	7
Unauthorized drug	3
Error related to procedure/treatment/test	**282**
Laboratory test problem	127
Other	64
Surgery/invasive procedure problem	44
Radiology/imaging test problem—wrong site	31
Respiratory care	10
Referral/consult problem	4
Dietary	2

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cues are less likely to be forgotten, but problems occur when attention is diverted at the time of the event. Time-based cues require self-initiated recall and are more likely to be forgotten without converting them to events (e.g., setting an alarm on a watch converts a time-based cue to an event-based cue—"turn off the Heparin infusion at 5 p.m." becomes "when the alarm sounds, turn off the Heparin infusion"). Of note, the event-based cue must contain sufficient information about what is to be done, and must be available at the time necessary, in order to be effective. Ideally, these events should also be distinct (e.g., infusion pump alarms are set with different tones to indicate the completion of an infusion versus indicating the battery charge is low and the pump needs to be plugged into a wall outlet).

Multitasking and Interruption

Balancing multiple tasks, also known as multitasking, is a universal and constant challenge in healthcare settings. Being able to continually process incoming information while balancing and responding to competing priorities and completing necessary tasks is an essential skill for healthcare workers. Multitasking creates a stream of interruptions that may in fact be necessary and may increase efficiency. However, more research is needed on the optimal level of interruptions that minimize error and maximize efficiency.[4,5]

Unfortunately, there is a very real limit to the ability of the human brain to multitask. Cognitive neuroscientists have identified a specific region of the brain responsible for encoding and retrieving information, particularly in relation to working memory. This region of the brain is unable to process more than one task simultaneously, severely limiting human capacity for perception and decision making in multitasking situations.[6]

Observational studies of nurses and physicians have been conducted that have found multitasking to be highly prevalent—with interruptions occurring anywhere from 1.4 times per minute[7] to once every 14 minutes[8]—and observable multitasking occurring more often than perceived by the clinicians themselves.[9] Differences in frequency of interruptions and prevalence of multitasking found in the clinical literature are due to variation in study designs and definitions for these variables. The psychological literature on interruption as it correlates to patient safety is more consistent in this respect. The six experimental variables most often studied are working memory load, interruption similarity, interruption position, interruption modality, practice/experience, and interruption-handling strategies.[5] The implications for clinicians related to each of these experimental variables are shown in Table 3.

Sources of Distraction

Interruptions or distractions can be defined as self-initiated or other-initiated. Research has shown the prevalence of self-initiated distraction ranges from 28%[10] to 38%,[7] while other-initiated distraction ranges from 34% to 69%.[10] In studies of distractions and medication errors, the majority of interruptions were found to be self-initiated by nurses or other members of

Table 3. Top Six Experimental Variables Identified in the Psychological Literature Investigating Interruptions and Their Implications for Clinicians

EXPERIMENTAL VARIABLE	IMPLICATIONS FOR CLINICIANS
Working memory load	Interruption during times of high working memory load is associated with decreased performance of the primary task.
Interruption similarity	Interruption that is similar to the primary task is more disruptive than a dissimilar interruption.
Interruption position	Interruption occurring during task performance is more detrimental to performance than interruption occurring between tasks.
Interruption modality	Interruption presenting through a modality different from the primary task (e.g., auditory versus visual) is less disruptive to performance than interruption presenting through the same modality.
Practice/experience	Practice of the primary task is important to procedural tasks because it increases association between steps in the primary task process, freeing up cognitive resources to be able to handle interruption.
	Practice of interruption-handling strategies is important to decision-making tasks because it improves performance of the primary task.
Interruption-handling strategies	Being able to control when to deal with interruption is less disruptive than having no control. Task performance and effective response to interruption are improved when clinicians have a repertoire of strategies for handling interruption.

Source: Li SY, Magrabi F, Coiera E. A systematic review of the psychological literature on interruption and its patient safety implications. *J Am Med Inform Assoc* 2012 Jan-Feb;19(1):6-12.

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the nursing team, through face-to-face interaction, occurring for purposes of patient management, and of short duration.[11]

Self-initiated distraction may also be the by-product of increased intrinsic cognitive load, which is determined by the complexity of information being processed. In other words, the internal processing of complex information creates a distraction that interferes with processing other information. Other-initiated distractions may be a source of increased extraneous cognitive load, determined by the kind and amount of new information being perceived and encoded. Decreasing the cognitive load required for either has been shown to free up cognitive resources necessary for the other[12] (i.e., decreasing the difficulty level of the primary task increases one's ability to handle interruptions or distractions without impairing performance, while decreasing interruptions and distractions increases one's ability to complete tasks that require more complex cognitive processing).

A common source of self- or other-initiated distraction is communication of information irrelevant to the primary task at hand. In an observational study of distracting communications in the OR, psychologists observed for case-irrelevant communications (CICs). Half of all CICs consisted of "small talk." Although surgeons initiated and received the majority of CICs, visitors to the OR initiated CICs with the highest levels of distraction. Also, communications directed to nurses and anesthetists provided higher levels of distraction than communications directed to surgeons.[13]

Distraction Due to Technology

Anything that diverts attention away from the primary task is a source of distraction. Sources of distraction can be broadly attributed to individuals (e.g., clinicians, patients, family members) or to technology (e.g., medical equipment, computers, communication devices). "Distracted doctoring" is a term recently coined in the media to describe the interruptions to workflow caused by the introduction of new technological devices in the clinical setting. This has been elevated to new levels of concern within the healthcare community and the general public due to the widespread implementation of computerized provider order entry (CPOE) systems and electronic medical records, along with the growing use of cell phones and smartphones.[14-16] In fact, distractions from smartphones and other mobile devices have been identified for the first time as one of the top 10 health technology hazards for 2013 by ECRI Institute.[17]

A case study published in December 2011 by the Agency for Healthcare Research and Quality (AHRQ) highlights just how serious the impact of these distractions can be in the healthcare setting:

> *During rounds with the attending, a medical resident was using a smartphone to access the CPOE to discontinue an order for warfarin. The resident was distracted by an incoming personal text message and failed to complete her primary task—discontinuing the warfarin order. The patient continued to receive warfarin for the next three days. As a result, the patient developed hemopericardium requiring emergency open heart surgery.*[18]

In a large study of computer-related patient safety incidents, 55% of incidents were attributed to technical problems (i.e., hardware, software, or networking infrastructure problems), while 45% were due to human-computer interaction. The majority of technical problems resulted in delays or failures to complete clinical tasks. As described in the AHRQ case study, the majority of human-computer interaction problems were related to data entry (e.g., incorrect or missing data, failure to update data). High cognitive workload and multitasking were highlighted as contributing factors.[19]

Studies examining the impact of cell phone use on driving may inform research on the impact of cell phone and smartphone use in the clinical setting. These studies have shown cell phone use to be as detrimental to driving performance as operating a vehicle while intoxicated. This impact on driving ability appears to be due to the diversion of attention away from the primary task of driving, regardless of whether or not a hands-free device is used.[20]

Investigation of this phenomenon is just beginning in healthcare. Surveys of clinicians are being published that show that cell phone and smartphone use is prevalent, with the majority of clinicians voicing concern over the significant potential safety risks they introduce. There is a generational difference found across surveys, with older clinicians reporting less trust of the new technology. Interestingly, clinicians report witnessing others being distracted or committing errors related to cell phone or smartphone use at rates higher than they report for themselves.[21,22] This mirrors the findings in studies of cell phone use and driving showing that drivers did not perceive the detrimental impact that cell phone use was observed to have on their driving performance.[23]

Lack of insight into the impact technology is having on performance and patient safety may explain the low number of reports in PA-PSRS that specifically mention these sources of distraction. Out of the 1,015 reports involving distractions, 10 identify phones as the source of distraction, 15 identify computers, and 15 identify other technologies (e.g., automated medication dispensing cabinets, infusion pumps).

RISK REDUCTION STRATEGIES

Effort should be made to limit distractions in healthcare settings whenever possible. However, total elimination of distractions is not an achievable goal.

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Dr. Atul Gawande, author of *The Checklist Manifesto*, summarized the challenge facing modern healthcare as follows: "Medicine has become the art of managing extreme complexity—and a test of whether such complexity can, in fact, be humanly mastered. . . . Substantial parts of what hospitals do . . . are now too complex for clinicians to carry them out reliably from memory alone."[24] Checklists are just one of the strategies suggested to ameliorate the impact of distraction in healthcare settings. Mindfulness meditation training is another such strategy, one that has been found to improve focused attention and working memory while effectively managing distractions—particularly in multitasking situations.[25,26] These and other risk reduction strategies are suggested to avoid the detrimental effects of variables shown in Table 3 that contribute to increased distraction and decreased performance:

— Educate clinicians about distraction and its potential detrimental effect on patient safety.[10,27]

— Raise awareness of the potential for distraction, and promote vigilance through sharing deidentified narratives of patient safety events and near misses that occurred due to distraction.[28,29]

— Teach clinical staff interruption-handling strategies[5] (e.g., teach staff how to forward calls to a colleague or voice mail when they are performing a procedure, show staff how to save documentation in the computer system so that it can be resumed after the distraction is addressed).

— Consider offering a course in mindfulness meditation for clinical staff.[25,26]

— Avoid communication of irrelevant information whenever possible, but especially when performing tasks with high cognitive loads[13,27,30] (e.g., avoid small talk when performing safety-critical tasks such as the preoperative time-out or programming an infusion pump to deliver an intravenous anticoagulant).

— Designate routinely encountered tasks that are not to be interrupted, and develop a system to communicate when staff are engaged in these tasks[10,27,30,31] (e.g., close the door to the patient's room and post a sign instructing other staff to avoid interruptions when performing an invasive procedure at the bedside).

— Minimize interruptions during performance of any tasks that place high demands on working memory[5,27] (e.g., close the door to the patient's room and silence or forward any calls when performing an unfamiliar procedure for the first time, select and prepare medications in a dedicated medication room instead of at busy nurses' stations or in high-traffic hallways).

— Practice tasks, particularly those that are complicated or known to be distraction-prone[5] (e.g., encourage preceptors to seek out opportunities during the orientation period for novice staff to perform tasks that are encountered infrequently in their clinical area, provide opportunities to role-play distraction-prone clinical scenarios in simulation training).

— Develop and utilize checklists for complex tasks that require multiple steps or are known to be distraction-prone[24] (e.g., central-line insertion, ventilator-associated pneumonia prevention measures, continuous renal replacement therapy).

— Implement communication strategies that do not involve oral communication,[10] especially in busy clinical areas with high noise levels (e.g., outline a protocol for sending and responding to text messages in facilities that provide text-pagers or smartphones to clinical staff).

— Use written reminders as event-based cues to complete future tasks. Ensure that written reminders contain sufficient information about what is to be done and that they are placed in a location that will be visible at the time the task needs to be completed[2] (e.g., write a note to call for more bags of bladder irrigation fluid and attach it to the second-to-last bag in the case that is currently being used).

— Batch communications to minimize distraction to the recipient[10,27] (e.g., use a report sheet to communicate missing medications for a nursing unit to pharmacy rather than having each nurse call the pharmacist individually).

— Do not batch tasks for multiple patients concurrently[5] (e.g., do not prepare medication for more than one patient at a time, avoid switching back and forth between patient electronic records when entering new orders in a CPOE system).

— Provide environmental cues to assist in recovery from distraction in order to complete the primary task[5,24,30,31] (e.g., using checklists, building CPOE systems that alert prescribers when an order has been partially entered but abandoned after a period of inactivity).

— Use concepts from human factors engineering when evaluating and redesigning care processes and workspaces in order to decrease the potential for distraction[7,32] (e.g., conduct observations of processes known to be distraction-prone in order to identify sources of distraction and develop a plan to minimize them, redesign medication preparation areas to limit outside distractions).

CONCLUSION

Distractions are encountered in healthcare settings on a nearly continuous basis. These distractions originate internally and externally to clinicians. There are many

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and varied stimuli that divert attention away from primary tasks. With each new technology introduced to the healthcare setting, new sources of distraction are recognized. The relatively recent addition of computerized health information systems, cell phones, and smartphones has brought new attention to the study of distraction and its impact on patient safety.

The work of clinicians places high demands on working memory. This is due to the high complexity and large amounts of continuously changing information that must be processed, resulting in high intrinsic and extraneous cognitive loads. Under these circumstances, distraction can be particularly detrimental to performance.

Most of the patient safety event reports to the Authority that were attributed to distraction by reporters involved medication errors or errors related to procedures, treatments, or tests. Multitasking is frequently the culprit in these patient safety events. In some cases, multitasking increases efficiency by eliminating downtime. But in many more cases, efficiency is decreased because of the limited ability of the human brain to process more than one task at the same time.

Clinicians can take steps to reduce the impact of distraction by recognizing common sources of distraction and situations that are distraction-prone, identifying clinical tasks or procedures that are most likely to result in medical error and patient harm as a result of distraction, and applying specific risk reduction strategies.

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LEARNING OBJECTIVES

— Assess sources of distraction present in healthcare settings and the means by which they can lead to error.

— Recall the predominant safety event types associated with distraction, according to reports submitted to the Pennsylvania Patient Safety Authority.

— Distinguish between interruptions that convey greater potential to disrupt performance of the primary task and those that convey less potential to disrupt performance of the primary task.

— Identify strategies for decreasing the potential for distraction and harm.

SELF-ASSESSMENT QUESTIONS

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

1. Assess the following scenarios and determine which one describes an interruption during *information encoding*?
   a. A physician is completing placement of a nasoduodenal feeding tube in a patient and is interrupted by a medical student asking a question about a prescription missing from the discharge instructions for another patient who is leaving the hospital. The physician forgets to order the x-ray to confirm placement of the feeding tube.
   b. A nurse is receiving critical blood gas results over the phone from the laboratory during a patient emergency situation. While writing down the results, the anesthesiologist asks the nurse to bring the respiratory emergency equipment box with her when she comes back to the room. When reading the blood gas results to the emergency response team, she discovers she did not write down the bicarbonate level.
   c. A pharmacy technician is about to restock an automated dispensing cabinet with HYDROcodone. A nurse interrupts to ask if the technician has brought the HYDROmorphone that had been ordered from the pharmacy 30 minutes ago for a patient in severe pain. The technician checks the stock of HYDROmorphone, finds the drawer empty, and tells the nurse to call back down to the main pharmacy. The technician proceeds to place the HYDROcodone tablets in the HYDROmorphone drawer.
   d. A patient asks the nutrition hostess for extra sugar and ketchup. On the way to the kitchenette, another patient stops the hostess and asks for their lunch to be reheated. The hostess takes the tray to the kitchenette, and when she arrives, she grabs some salt and pepper and ketchup packets to take back to the first patient.
2. Which of the following event types associated with distraction were reported most frequently to the Authority from 2010 through 2011?
   a. Medication error: dose omission
   b. Medication error: overdosage
   c. Medication error: wrong patient
   d. Medication error: unauthorized drug

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SELF-ASSESSMENT QUESTIONS (CONTINUED)

A nursing assistant set an alarm on her watch to remind her to return to a patient's room to perform a repeat fingerstick blood sugar test. When the alarm sounded half an hour later, she was unable to recall which patient needed the fingerstick.

3. The nursing assistant was using the alarm to support prospective memory, or remembering to do something in the future. The alarm failed to achieve its desired result in this instance because of which of the following?
   a. The alarm provided a time-based cue that did not offer information about what was to be done.
   b. The use of alarms to aid prospective memory has been found ineffective in multitasking environments, such as hospitals.
   c. The alarm provided an event-based cue that did not offer information about what was to be done.
   d. The nursing assistant was suffering from alarm fatigue.

4. Each of the following statements regarding interruptions are true *except:*
   a. Interruptions similar to the primary task are more disruptive than interruptions that are dissimilar.
   b. Interruptions during task performance by novice practitioners are more disruptive than interruptions during task performance by experienced practitioners.
   c. Interruptions occurring during performance of tasks requiring high working memory load are more disruptive than interruptions occurring during tasks requiring low working memory load.
   d. Interruptions presenting through a different modality than the primary task (e.g., auditory versus visual) are more disruptive than interruptions presenting through the same modality.
5. All of the following statements regarding multitasking are false *except*:
   a. Multitasking can increase efficiency for healthcare professionals by eliminating downtime.
   b. Multitasking is not a highly valued skill for healthcare professionals.
   c. Multitasking is only a contributor to errors in high-acuity care areas, such as critical care areas and the operating room.
   d. There is no limit to the human brain's ability to multitask, given enough simulation training.
6. All of the following are risk reduction strategies that a hospital can use to decrease the potential for distraction and harm *except*:
   a. Move the automated medication dispensing cabinet and medication carts to an area away from high traffic flow and clinical alarms, preferably behind closed doors.
   b. Implement a strict no "small talk" policy for all staff working in clinical areas, except during meal breaks.
   c. Have novice staff practice clinical tasks in a simulation lab setting using scenarios designed to include multiple interruptions.
   d. Require staff to forward all calls to another staff member when entering a patient room to perform an invasive procedure.

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Class III Obese Patients: Is Your Hospital Equipped to Address Their Needs?

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ABSTRACT

Safely caring for class III obese patients brings a unique set of demands to healthcare facilities and their staff. Class III obese patients require special equipment that is big enough and strong enough to support them safely while in the care of others. A review of five years of events reported to the Pennsylvania Patient Safety Authority identified 180 equipment-use event reports involving class III obese patients. In July 2012, a statewide survey was sent to Pennsylvania hospitals to determine how prepared they were to care for this patient population. The survey identified that 36.5% (n = 23 of 63) of respondents indicated that their hospital does not have an evacuation plan in place for moving class III obese patients to a safe location in an emergency. An additional finding was that more hospitals rent versus own bariatric equipment, which may provide insight into why, in some of the Authority event reports, bariatric equipment was not available or why patients had delays in care. Addressing equipment challenges can include tracking the number of class III obese patients at the facility, educating staff about the acquisition and use of bariatric equipment, providing sensitivity training, and updating policies and procedures for class III obese patients. (Pa Patient Saf Advis 2013 Mar;10(1):11-8.)

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INTRODUCTION

More than one-third (35.7%) of US adults were obese as of 2010, as well as approximately 17% of children and adolescents.[1] In 2011, 28.6% of Pennsylvania's population was obese.[2] Obesity is an increasingly prevalent problem that affects the healthcare system as well as patients. In 2006, medical spending was $1,429 greater for an obese person than spending for a healthy-weight person, and the medical cost of obesity was estimated to have risen to $147 billion per year by 2008.[3] Some of the expenditures are related to medical equipment, which can cost as much as $47,808 for an operating room table or $330 for an evacuation sled.[4] Providing clinical care for obese patients in the hospital setting can require extra staff, new policies and procedures, and special equipment.[5]

Not all obese patients require special care and equipment, but class III obese patients have different needs. Class III obese patients are identified as having a body mass index (BMI) greater than or equal to 40 or weighing 100 pounds or more than their ideal body weight.[6] From 2000 to 2005, the prevalence of individuals reporting a BMI greater than 40 increased by 52% and the prevalence of individuals reporting a BMI greater than 50 increased by 75%.[6] Healthcare facilities need to be prepared to provide safe general medical care to class III obese patients whose size surpasses the capacity of present equipment. Some hospitals are addressing these challenges by preparing their facilities to better accommodate these patients.[7] Evaluating patient care needs from admission to discharge for class III obese patients can lead to the development of specific patient care pathways and protocols and the establishment of staffing considerations for delivering safe patient care.[5,8,9]

ANALYSIS OF REPORTS ASSOCIATED WITH MORBID OBESITY

A review of the Pennsylvania Patient Safety Authority's Pennsylvania Patient Safety Reporting System (PA-PSRS) database was conducted to determine the extent of adverse events that class III obese patients experience in Pennsylvania healthcare facilities. With the exception of a few event-specific requests for details about medication errors, PA-PSRS event reports do not capture weight information. To identify this patient population, PA-PSRS event narratives were searched using the words "obese," "morbidly obese," and "bariatric." To capture a representative sample, a five-year time period from January 1, 2007, through December 31, 2011, was selected, and 1,774 adverse event reports that involved class III obese patients were identified. A comparison of the number and percentage of Incidents (i.e., near-miss events) and Serious Events (i.e., events with harm) between PA-PSRS class III obese patient population event reports identified and PA-PSRS general patient population event reports was performed for this five-year time period. An analysis of event reports identified that the Serious Event reports accounted for 24% of the adverse events, whereas in the PA-PSRS general event report population for the same five-year time period, Serious Event reports accounted for less than 4% of the adverse events.[10]

Next, an examination of the event types of the class III obese patient reports compared with the PA-PSRS general population reports revealed a higher-than-expected number of equipment-related reports. This article will address the topics of providing safe general medical care for class III obese patients and the use of bariatric equipment.

Facility-Level Issues

Of the 1,774 adverse event reports, 10% (n =180) were associated with the use of equipment or devices or facility-level limitations when caring for class III obese patients. In

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comparison, the PA-PSRS general population equipment-related reports accounted for 0.8% of all adverse event reports in 2011.[10] Only one equipment-related event occurred in an ambulatory surgical facility; the remaining events occurred in hospitals. Seven common issues were identified in the reports: (1) class III obese patient hospital policies and procedures not followed, insufficient, or absent; (2) bariatric equipment availability; (3) bariatric equipment access; (4) bariatric equipment limitations; (5) bariatric equipment failure; (6) inadequate staffing for safe patient transfers or direct patient care; and (7) hospital not completely retrofitted. The following are a few examples of equipment-related event reports.

> *The patient was scheduled for a MRI [magnetic resonance imaging] scan [but the exam was refused] after two attempts because of the size of the patient. The patient was too large and [could] not breathe when in the scanner.*

> *While transferring a bariatric patient from the chair to the bed using the appropriate rental patient transfer mat, one of the canisters supplying air to the mat malfunctioned, causing a loss of air. Once the mat started to lose air, the patient's weight shifted to that side and the patient with the mat fell to the floor between the chair and the bed. The patient was assisted back to bed using the Hoyer lift. The patient complained of pain in his right shoulder and did sustain a small skin tear on their right forearm. The patient did sustain a large hematoma on the right shoulder and left chest area.*

Class III obese patient hospital policy and protocol issues were present in a majority of the event reports (69.4%, n = 125 of 180). These event reports also included issues with the availability and maintenance of bariatric equipment, the selection of regular versus bariatric equipment, the transfer of a patient to another hospital, inadequate staffing for safe patient transfers and care delivery, the use of radiologic equipment, and lack of communication among staff about patient size and needs. Table 1 provides a summary of the event reports.

SURVEY OF THE READINESS OF PENNSYLVANIA HOSPITALS TO ACCOMMODATE CLASS III OBESE PATIENTS

The information uncovered in the event reports analysis raised questions about how prepared Pennsylvania hospitals are to provide general medical care safely to class III obese patients. A 31-question survey was developed based on information obtained from the PA-PSRS event reports analysis, a literature search, and conversations with Pennsylvania hospitals that engage in bariatric surgery. The survey concentrated on facility-level issues, equipment-related issues, and policies and protocols that can affect the delivery of safe care for class III obese patients. For purposes of the survey, class III obese patients were identified as patients who weighed more than 450 pounds. The survey was administered to all hospitals in Pennsylvania in July 2012 and had a 35.3% response rate (n = 85 of 241); 11.9% (n = 8 of 67) of hospitals responding are designated as Bariatric Surgery Centers for Excellence by the American Society for Metabolic and Bariatric Surgery.[11] The number of responses for each question varied because not every respondent answered every survey question. Behavioral health hospitals and children's hospitals did not participate in the study.

The Figure shows the percentage of hospital survey participants.

DEMOGRAPHIC REALITIES VERSUS FACILITY PERCEPTIONS

In the survey, respondents were asked if their hospital limits care of obese patients to the emergency department because of safety concerns. Only 1.6% (n = 1 of 61) of respondents indicated yes, yet 23.5% (n = 12 of 51) of hospital respondents indicated that their emergency department had to transfer a patient to another hospital because of safety concerns related to the patient's weight.

Table 1. Pennsylvania Patient Safety Reporting System Morbidly Obese Patient Event Report Issues (N = 180)

CATEGORY*	NO. OF REPORTS†	% OF REPORTS
Morbidly obese patient hospital policies and procedures not followed, insufficient, or absent	125	69.4
Hospital does not have bariatric equipment	78	43.3
Needed to wait for equipment (lack of access)	51	28.3
Inadequate staffing for safe patient transfers or direct patient care	43	23.9
Bariatric equipment failed	32	17.8
Facility not completely retrofitted	10	5.6
Equipment limitations	5	2.8

* Twenty-nine reports identified the appropriate use of bariatric equipment.

† Event report narratives could have indicated more than one issue.

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Respondents were then asked if they have a policy in place for obtaining a baseline height and weight for every patient; 97.0% (n = 64 of 66) of respondents said yes, though only 66.7% (n = 42 of 63) of respondents that own bariatric equipment have bariatric scales. Some of the respondents that indicated that their hospitals own bariatric scales also indicated that they use rental equipment, too. Tables 2 and 3 show breakdowns of the type of bariatric equipment owned and rented, respectively.

The analysts conclude that perceptions about the ability to provide safe patient care for extremely obese patients can differ from actual circumstances.

Knowing the patient population demographics helps hospital leaders make informed decisions about which patients they can safely care for, as well as the types of equipment, building limitations, and staff required to meet the needs of every patient.[12] Conducting a needs assessment by weighing every patient in a sampling cohort upon admission will identify the number and percentage of class III obese patients that frequent a hospital.[13] Weighing every patient upon admission also assists in determining whether a hospital has the capacity (i.e., necessary equipment, space, and personnel available) to provide safe care to this patient population.[13]

Figure. Percentage of Hospital Survey Participants (N = 85)

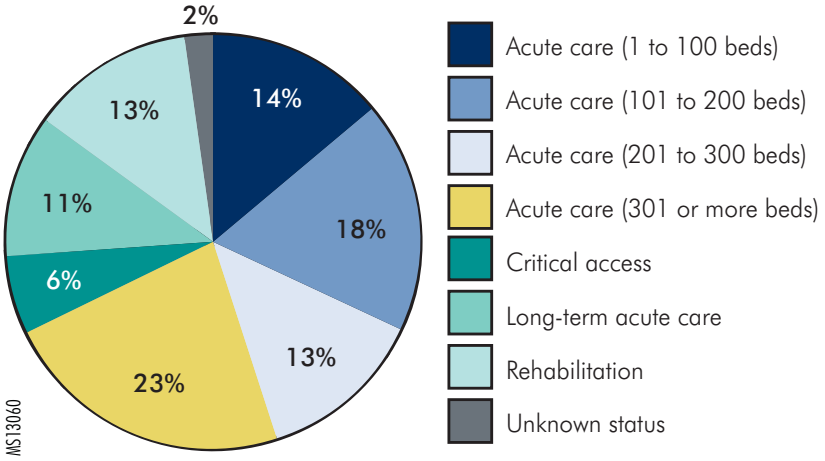

Table 2. Survey Response: Bariatric Equipment Owned by Hospitals (N = 63)

EQUIPMENT	NO. OF FACILITIES	% OF FACILITIES
Wheelchairs	59	93.7
Blood pressure cuffs	58	92.6
Scales	42	66.7
Beds	41	65.1
Stretchers	38	60.3
Lifts (including Hoyer, sit-to-stand, air bag system, portable, or ceiling-mounted lifts)	11	17.5
Bedside commodes	7	11.1
Chairs	3	4.8
Operating room tables	2	3.2
Hover mats	2	3.2
Bedside furniture	1	1.6
Procedure tables	1	1.6
Walkers	1	1.6
Shower chairs	1	1.6

CHALLENGES ASSOCIATED WITH CLASS III OBESE PATIENTS

Before addressing specific patient needs, a discussion about how much respect class III obese patients receive is essential, as this can impact their seeking care and reporting health concerns.[9] Weight stigma and discrimination is pervasive and not limited to healthcare settings.[14,15] The stigmatization of obese patients exists and has been shown to negatively impact their care.[16] Sensitization to the plight of all obese patients, not just class III obese patients, is essential to understanding their circumstances and needs and can help in addressing their healthcare issues sooner.

In the Authority survey, slightly less than half of respondents (47.1%, n = 33 of 70) stated that their hospital provides different types of staff education programs regarding the care of obese patients. The majority of respondents (69.7%, n = 23 of 33) whose hospitals have training programs in place provide sensitivity training. Nonjudgmental attitudes and addressing privacy concerns toward class III obese patients are essential to providing safe patient care. For example, healthy-weight patients do not want outsiders knowing what their weight

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Table 3. Survey Response: Bariatric Equipment Rented by Hospitals (N = 72)

EQUIPMENT	NO. OF FACILITIES	% OF FACILITIES
Beds	56	77.7
Wheelchairs	16	22.2
Lifts	6	8.3
Scales	5	6.9
Stretchers	4	5.5
Bedside commodes	4	5.5
Shower chairs	3	4.2
Unspecified (e.g., rent equipment when need exceeds equipment owned by facility, dependent on patient needs)	3	4.2
Bariatric recliners	1	1.4
Chairs	1	1.4
Hover mats	1	1.4
Specialty bariatric beds	1	1.4
Walkers	1	1.4

Table 4. ECRI Institute SELECTPlus Average Prices for Bariatric Equipment, 2011

EQUIPMENT TYPE	PRICE PER ITEM
Operating room tables	$47,808
Beds	$18,555
Treadmills	$9,828
Laparoscopes	$8,857
Ceiling lifts	$7,743
Mobile lifts	$7,065
Wheelchair mover*	$6,895
Stretchers	$6,550
Cadaver cart	$5,715
Commode (600-pound weight capacity)	$5,220
Stretcher ramp (for ambulance)	$4,600
Exam tables and chairs	$4,589
Patient scales	$2,406
Patient seating/recliners	$2,154
Wheelchairs	$1,571
Traction frames (overbed trapeze)	$992
Shower chair	$771
Evacuation sled	$330
Adult thigh blood pressure cuffs†	$16.47
Adult large blood pressure cuffs†	$15.64

* Motor attached to the back of a wheelchair
† Prices from ECRI Institute PriceGuide 2012

is, just like a class III obese patient would not want that information disseminated. Obtaining sensitive information such as the patient's weight in a dignified, respectful, nonjudgmental manner is vital to securing the proper information and the appropriate type of equipment.[17,18]

EQUIPMENT DECISIONS

A study by Drake et al. (2008) revealed that the most significant barrier for nurses to providing "excellent" patient care to class III obese patients was special equipment needs.[19] Owning and renting bariatric equipment are not mutually exclusive. Some of the respondents indicated that their hospital does both. Fewer respondents acknowledge owning bariatric equipment (n = 63) compared with the number who rent (n = 72). A major consideration with renting bariatric equipment is the time needed to secure bariatric rental equipment. The majority of survey respondents (75%, n = 45 of 60) said that it takes one to six hours to receive rented bariatric equipment. Another 11.7% (n = 7) indicated that it takes more than six hours to receive rented equipment, and 8.3% (n = 5) of respondents indicated that it takes more than 12 hours. Time to receive specialized equipment can impact the care class III obese patients receive and the staff caring for them. Knowing the costs associated with owning versus renting bariatric equipment helps inform decisions about whether to purchase or rent equipment. Table 4 provides prices for a variety of bariatric equipment.

Equipment for Vital Signs

Obtaining accurate vital signs is basic and essential to excellent, high-quality patient care. Medications, activity orders, diet, and other aspects of treatment rely heavily on accurate vital signs, including blood pressure measurement. If a blood pressure cuff is too small for a patient, an inaccurate reading will result.[20] In the survey, 92.1% (n = 58 of 63) of respondents

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reported owning bariatric blood pressure cuffs. When asked if every location in the hospital where blood pressure is measured has cuffs of all size for obese patients, 73.6% (n = 53 of 72) of respondents said yes, and 74.7% (n = 56 of 75) of respondents reported that their nurses were trained to properly obtain blood pressures in obese patients of different sizes. See "Blood Pressure Cuff Sizes" for suggested sizes based on arm circumference.[20]

BLOOD PRESSURE CUFF SIZES

Arm circumference 22 to 26 cm—the cuff should be "small adult" size: 12 x 22 cm

Arm circumference 27 to 34 cm—the cuff should be "adult" size: 16 x 30 cm

Arm circumference 35 to 44 cm—the cuff should be "large adult" size: 16 x 36 cm

Arm circumference 45 to 52 cm—the cuff should be "adult thigh" size: 16 x 42 cm

Source: Pickering TG, Hall JE, Appel LJ, et al. Recommendations for blood pressure measurement in humans and experimental animals. Part 1: blood pressure measurement in humans: a statement for professionals from the subcommittee of professional and public education of the American Heart Association council on high blood pressure research. *Circulation* 2005 Feb 8; 111(5):697-716.

Lift Equipment

Lifts and transfer devices are necessary to prevent the friction and shear that occurs when repositioning a patient to prevent pressure ulcer development, to help move patients who have limited mobility to prevent falls, and to protect the staff members assisting the patient. Out of 63 respondents who own equipment, 15.9% (n = 10) reported owning lifts, and 10.0% (n = 1 of 10) of respondents who own lifts also rent them. Only 8.3% (n = 6 of 72) of respondents who rent equipment rent lifts. Without mechanical lifts, multiple staff members are often recruited to assist in moving obese patients. This situation puts both the patient and staff members at risk for injury, as illustrated in the following event report:

> *Patient given [diuretic] and did not use [bedside commode but] went to the bathroom instead. [The patient] voided on the floor and slipped in urine. [The patient was] unable to get up because [the patient was] obese. Security was called, and several guards assisted [the patient] from the floor to the chair, and then to the bed.*

The National Institute for Occupational Safety and Health's recommendation is that an assistive device should be used if a care provider needs to lift more than 35 pounds of another individual's body weight.[21] One leg of a 350-pound patient can weigh as much as 62 pounds.[22] This is an important point to consider when thinking about completing a dressing change, repositioning, or assisting a patient back to bed. Staff safety also needs consideration. Staff injuries* can create staffing shortages, which can compromise patient safety.[23]

Daily-Use Equipment

Larger-size equipment such as bariatric bedside commodes, wheelchairs, and beds are essential for daily use by class III obese patients. Even in hospitals that own bariatric equipment, renting additional equipment for daily use may be necessary if demand increases. More survey respondents own bedside commodes and wheelchairs than rent this type of equipment; only 9.5% (n = 6 of 63) of respondents own bedside commodes and 5.6% (n = 4 of 72) rent them, while 93.7% (n = 59 of 63) of respondents own bariatric wheelchairs and 22.2% (n = 16 of 72) rent them. The opposite trend was found with bariatric beds; 65.1% (n = 41 of 63) of survey respondents own bariatric beds, while 77.8% (n = 56 of 72) rent them.

In-Service Training

The availability of specialized bariatric equipment when caring for class III obese patients is only as good as how well staff know how to access and use it appropriately, including knowing the equipment weight capacities and how to obtain the equipment. The survey results showed that 65.5% (n = 36 of 55) of respondents mark their equipment with the weight capacity, 63.6% (n = 35 of 55) said equipment manuals are available to identify weight capacity, 21.8% (n = 12 of 55) said the weight capacity is not identified, and 20.0% (n = 11 of 55) replied in the "other" category. Some of the methods in the other category included posting lists, making information available on the system-wide intranet and log books, making information available in departmental policies and procedures, and developing systematic plans to label all equipment using symbols to identify weight limits. Creating a systematic plan using symbols or other indicators (e.g., colored tape) rather than printing weight limits directly on equipment to identify weight capacities on bariatric equipment provides a way to inform staff of the weight restrictions of the equipment while maintaining patient dignity. Hospitals have established multiple approaches to identifying weight capacities; however, 3.6% (n = 2 of 55) of respondents did not know if their staff were knowledgeable about the weight capacity of available equipment. Development of policies and procedures for education and training of all staff is necessary to ensure the appropriate acquisition and use of bariatric equipment.

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* The average direct cost of a back injury in healthcare is $37,000, and indirect costs can range from $147,000 to $300,000.[22] The one-time expense of a lift ranges from $7,000 to $7,700.[4]

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STRUCTURAL CONSIDERATIONS

Class III obese patients require larger spaces and equipment that supports weight loads two to three times as heavy as the weight loads of equipment for healthy-weight patients. Structural considerations for using bariatric equipment include not only patient amenities but cumulative patient weight load, patient transport, and emergency evacuation considerations.

Older hospital buildings need to take into account the cumulative load. The increase in the number of class III obese patients has resulted in some hospitals choosing to make structural changes to buildings to accommodate these patients. Hospital bariatric care unit building guideline specifications address issues such as the size of the room, shower stall, doorway, and waiting areas.[24] These guidelines also address issues of toilet placement (i.e., toilets need to be floor-mounted, with a specific amount of distance from the wall in order to allow the patient room to sit comfortably and to accommodate a wheelchair).[24] Another structural issue that hospitals need to consider is the building's floor capacity and whether the floors can support these heavier cumulative weight loads when there are multiple class III obese patients on the same floor. When respondents were asked if their hospital has an elevator that can accommodate the obese patient, the equipment used in their care, and the staff, 78.9% (n = 60 of 76) of respondents said yes, 17.1% (n = 13) said no, and 3.9% (n = 3) did not know.

While many hospitals may not be in a financial position to make structural changes, there are some actions that can be adopted in the hospital that would have an immediate effect in ensuring safe care for class III obese patients. For example, deciding where these patients should be admitted affects the day-to-day care of the patient. Utilizing strategically placed nursing units such as those near the ground level or those near radiological departments may ease transports for testing and admission and discharge. Some units may also have larger hallways and patient rooms that may be more appropriate for the patient and their needed equipment. The PA-PSRS event reports analysis revealed that hospitals do not always check that the bariatric equipment will fit the existing facility structure and allow enough room for safe patient care; that the bariatric bed and other equipment fit safely through the door to the patient room; and that there is enough space for the patient, the equipment, and the staff. Protecting not only the class III obese patient but also all the patients and staff can be done with good planning and little cost using these action steps. The following is an event report that illustrates the need to address hospital building constraints:

> *A rapid response team [was] called on a patient. The patient was in a bariatric bed, which, upon attempting to transfer the patient to the ICU [intensive care unit], would not fit [through] the door. All expandable parts of the bed were returned to their normal position (not expanded) and all siderails were lowered in order to attempt to fit the bed out of the room, thus compromising patient safety. The bed repeatedly got stuck in the doorframe and was only able to be dislodged with extreme force by multiple personnel. When the bed was finally dislodged, it was noted that there was damage to the doorframe and the metal strip on the door.*

Most important when considering the hospital's structure is an evacuation plan. Patient safety is the top priority in healthcare. It is imperative to address class III obese patients in emergency evacuation plans. More than one-third (36.5%, n = 23 of 63) of the respondents did not have an evacuation plan in place for moving class III obese patients to a safe location in the event of an emergency. Class III obese patients who have severe mobility issues will depend on staff to help them in the event of an evacuation. For example, as one paper noted, "During Hurricane Katrina, 12 staff members at a New Orleans area hospital took nearly two hours to carry a single obese patient down an emergency stairwell. As a result, many staff members were unable to assist with other aspects of the hurricane evacuation."[25] More recently, there was the evacuation of hundreds of patients from New York University's Bellevue Hospital Center during Hurricane Sandy, as well as some of the city's surrounding hospitals prior to Hurricane Sandy. The chief executive of Maimonides Medical Center in Brooklyn, Pamela Brier, told the *New York Times*, "As prepared as we think we are we've never had a mock disaster drill where we carried patients downstairs. I'm shocked that we didn't do that. Now we're going to."[26]

Being in the midst of a disaster is not the time to figure out how to safely and effectively evacuate patients. Class III obese patients with BMIs greater than 60 might benefit most if admitted, when possible, to units that are easily accessible to exits without having to travel down elevators or stairs. In addition to the physical location of these patients, having the appropriate equipment available to move these patients will help staff evacuate them safely and efficiently. Developing a thorough evacuation plan and having the appropriate resources will make evacuation safer and more efficient, thus protecting the safety of all the patients.

ADDRESSING CLASS III OBESE PATIENT EQUIPMENT NEEDS

Providing safe care for class III obese patients can be accomplished whether or not bariatric equipment is purchased.

The following strategies address equipment-related issues for class III obese patients:

— Provide sensitivity training to all healthcare staff.[13,22,27,28]

— Assess whether the hospital has policies addressing the needs of obese

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patients (e.g., lifting policies, rental equipment policies).[12,13,22]

- Weigh every patient upon admission to the hospital, including patients in the emergency room.[13,27,29]
- Measure every patient's height upon admission to calculate their BMI, including patients in the emergency room.[13,27,29]
- Measure patients' abdominal girth to determine equipment of the appropriate size.[13,27,29]
- Assess patients' mobility needs to determine if special equipment is required.[22]
- Trend the hospital's obese patient population to help determine the level of demand and develop a business case for purchasing equipment.[22,27]
- Evaluate the average daily census of obese patients compared with the bariatric equipment.[22,27]
- Take inventory of bariatric equipment, noting weight capacities.[13,27]
- Evaluate the type and number of equipment owned.[13,27,28]
- Consider a phased-in approach to equipment acquisition.[27]
- If considering purchasing equipment, evaluate storage capacity and a system to track the equipment.[27]
- Develop and make accessible to staff a system to identify the weight capacity of the equipment.[12,27]
- Evaluate the availability of smaller bariatric-related equipment (e.g., blood pressure cuffs, longer tourniquets, larger gowns, longer wrist identification bands, longer needles, extra-long tracheostomy tubes for the emergency room).[13,22,27]
- Evaluate elevator size and weight capacity.[22,27,28]
- Evaluate floor weight capacity and doorway and hall size.[12,22,27]
- Develop and test an evacuation plan.[12,28]
- If emergency transport vehicles are owned by a hospital, evaluate whether class III obese patients can be accommodated safely.[27]
- Ensure that staff know who to contact when equipment (owned or rented) will be needed or require repair.[22]
- Evaluate staffing needs based on the number of class III obese patients on a unit.[13,22]
- Educate staff on the proper use of equipment.[22]

LIMITATIONS

The 180 PA-PSRS event reports identified for this analysis related to class III obese patients underrepresent the actual number of class III obese patients who experienced adverse events during hospitalization. Identification of class III obese patients in PA-PSRS was accomplished through a search of the PA-PSRS event report narrative descriptions, which rely on the subjective assessments provided by the individuals filling out the event reports rather than the identification of patients by their weight or BMI. Limitations associated with the statewide survey include (1) a potential response bias toward hospitals that care for class III obese patients, (2) a potential nonresponse bias due to an underestimation of the number of and issues associated with class III obese patients, and (3) a low response rate potentially resulting from the time the survey was administered.

CONCLUSION

As the prevalence of class III obese patients increases, the issue of delivering safe care will impact many more hospitals than those identified in the statewide survey. This article identified some of the problems that class III obese patients encounter when different types of equipment (bariatric and nonbariatric) are unavailable, malfunction, or are improperly used or when hospital policies and procedures are not followed, insufficient, or absent. This article also provides a wide range of solutions that all hospitals can institute. If priorities were assigned to the strategies, the strategies at the top of the list would be sensitivity training; measuring height, weight, and abdominal girth of all patients; and developing an evacuation plan for class III obese patients.

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Results of the Opioid Knowledge Assessment from the PA Hospital Engagement Network Adverse Drug Event Collaboration

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ABSTRACT

There are many published studies and reported events that demonstrate potential gaps in the knowledge regarding the use of opioids. As a part of the Pennsylvania Hospital Engagement Network adverse drug event collaboration sponsored by the Centers for Medicare and Medicaid Services, an 11-question opioid knowledge assessment tool for participating hospitals was developed to assess their practitioners' current knowledge about the use of opioids. The questions covered a variety of issues associated with the use of opioids, including differences between opioid-naïve and opioid-tolerant patients, indications for long-acting opioids, and patient-specific conditions that require a lower starting dose of opioids. More than 1,700 individual practitioners completed the assessment. The lowest-scoring questions encompassed topics identifying the predictors of respiratory depression in patients receiving intravenous opioids, defining what constitutes an opioid-tolerant patient, and choosing medications that could potentiate the effects of an opioid with respect to a patient's ventilation. Strategies that organizations may consider include assessing the organization's need for training based on the analysis of reported adverse events, near misses, outcome measures, staff observations, and knowledge assessments. This type of analysis may be helpful in identifying knowledge gaps and in developing improvement strategies to reduce medication errors associated with opioid use. (Pa Patient Saf Advis 2013 Mar;10[1]:19-26.)

Scan this code with your mobile device's QR reader to access the Authority's toolkit on this topic.

INTRODUCTION

There are several published studies that have looked into errors related to knowledge deficiencies regarding the use of opioids. For example, analyzed data from the MEDMARX national medication error reporting database revealed 644 harmful opioid errors from 222 facilities.[1] Of these, 21% were opioid prescribing errors. Another study looked at opioid errors specifically in cancer pain patients.[2] The authors found that 70% of those with cancer pain had at least one incorrect opioid prescription—and in some cases, there were up to seven errors per patient. One of the common errors was the use of incorrect dosing intervals.

To describe the epidemiology of medication prescribing errors averted by pharmacists, the clinical staff pharmacists in a 700-bed academic medical center saved all orders that contained a prescribing error for a week in early 2002.[3] Anti-infective agents, cardiovascular agents, and opioid analgesics accounted for 57% of the clinically significant prescribing errors.

In a pilot study to evaluate the hypotheses that there are differences in pediatric pain management knowledge across resident specialties and that questions in the form of multiple-choice items could detect such differences, fewer than 50% of respondents were able to correctly convert from one opioid to another (defined as opioid equianalgesia).[4] In addition, 46% of residents who correctly converted from one opioid to another were anesthesiology residents. The authors concluded that this revealed a real knowledge deficit among pediatric and orthopedic residents in opioid equianalgesia.

Based on these findings, and as a part of the Centers for Medicare and Medicaid Services (CMS) Partnership for Patients, the Pennsylvania Hospital Engagement Network's (HEN) adverse drug event collaboration focuses on problems with the use of opioids. As part of the opioid collaboration, the analysts decided to develop an opioid knowledge assessment tool for participating hospitals to assess their practitioners' current baseline knowledge on problematic issues with the use of opioids.

Medication Errors

Opioid drugs are a necessary component of pain management for many patients. When used inappropriately, or in error, they present serious risks that can lead to patient harm. An opioid, morphine, was one of six medications or medication classes on the first Institute for Safe Medication Practices (ISMP) list of high-alert medications published in 1989.[5] High-alert medications are defined as drugs that bear a heightened risk of causing significant patient harm when they are used in error.[6] The current *ISMP's List of High-Alert Medications* for acute care hospitals includes opioids as one of 22 high-alert drugs or drug classes.

Errors with opioids have led to serious adverse events, ranging from allergic reactions, failure to control pain, oversedation, respiratory depression, seizures, and death. According to data from the United States Pharmacopeia MEDMARX program, opioids, particularly morphine and HYDROmorphone, are still among the most frequent high-alert medications to cause patient harm.[7] In 2004, among medication error events reported to the Pennsylvania Patient Safety Authority's Pennsylvania Patient Safety Reporting System (PA-PSRS), approximately one out of four reports involved high-alert medications. Of those reports, 44% involved opioids, including morphine, HYDROmorphone (Dilaudid®), meperidine (Demerol®), and fentaNYL.[8]

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Additional analysis of medication error and adverse drug reaction events involving HYDROmorphone reported to the Authority also revealed the following:[9]

- The most common medication error event types associated with HYDROmorphone were wrong dose/overdosage (16.9%) and wrong drug (10.9%).
- A majority of the HYDROmorphone overdoses that occurred during the prescribing node involved orders for a wrong dose (79.6%), followed by an incorrect frequency (18.5%).
- Of the reported central nervous system (CNS) and respiratory adverse drug reaction reports, 65% appear to have been preventable adverse drug events (ADEs) (i.e., medication errors) in which patients received a dose in excess of what would be needed to resolve pain symptoms (e.g., greater than a 1 mg dose for an opioid-naïve adult patient) or in which HYDROmorphone was prescribed and administered with other medications that would lead to additive sedative effects (e.g., orders for both morphine and HYDROmorphone).

Additional examples of factors associated with medication errors involving opioids that have been published by ISMP or learned from root-cause analyses of actual errors include the following:[10]

- Dosing errors in opioid-naïve patients:
  - Prescribing initial doses too high for opioid-naïve patients, especially with HYDROmorphone and fentaNYL transdermal systems
  - Unfamiliarity with proper oral (PO)-to-intravenous (IV) dose conversions for some opioids
  - Prescribing short-acting opioids without knowledge that long-acting morphine (DepoDur®) had been administered
  - Prescribing opioids without knowledge that an epidural opioid had been administered
  - Prescribing doses of opioids too high for patients with a history of respiratory conditions (e.g., sleep apnea), for patients on concomitant medications with sedative properties, or for elderly patients
- Patient monitoring problems:
  - Failure to notice respiratory depression due to insufficient, improper, or untimely monitoring of patients receiving opiates

Proposed Intervention

On December 14, 2011, CMS announced the award of $218 million to 26 state, regional, and national hospital system organizations to serve as HENs. The Department of Health and Human Services sponsored the contract, which is part of the public-private Partnership for Patients. This initiative was started to help keep patients from being harmed while in the hospital and heal without complications once they are discharged.[11]

The Hospital and Healthsystem Association of Pennsylvania (HAP) is the only Pennsylvania-based organization that serves as a HEN as part of the Partnership for Patients initiative.[12] According to HAP, it will be under a two-year contract with its partners (the Authority, the Health Care Improvement Foundation, Quality Insights of Pennsylvania, and the Pennsylvania Health Care Quality Alliance) to implement strategies to support Pennsylvania hospitals in achieving Partnership for Patients' goals of reducing preventable hospital-acquired conditions, readmissions, and complications during hospitalization. There are 10 core areas of focus that are a part of the overall project, including ADEs. In Pennsylvania, the ADE collaboration specifically addresses the safe use of opioids.

The purpose of the ADE opioid collaboration is to explore the current trends of opioid therapy within organizations, barriers to optimal therapy and safety, common types of errors that occur with opioids, and contributing factors that lead to patient harm from opioid use. This collaboration includes all care and procedural areas, as well as practitioners who prescribe, dispense, administer, or monitor patients on opioids. The goal of the collaboration is to decrease the number of harmful events with opioids for participating hospitals (compared with the participating hospitals' baseline using historical controls).

Hospitals that signed up to participate in this collaboration were asked to be involved in

- developing a multidisciplinary task force team;
- asking staff to complete baseline and follow-up opioid knowledge assessments;
- completing baseline and follow-up opioid organizational assessments;
- collecting outcome measures, specifically naloxone use for patients on opioids and rapid response team calls primarily due to opioids;
- gathering and reviewing documents related to established process measures with the use of opioids;
- submitting program feedback; and
- participating in webinars and conference calls.

METHODS

As a part of the collaboration, the Authority partnered with the Pennsylvania Medical Society to develop a clinician knowledge assessment tool for opioids for prescribers, pharmacists, and nurses. The assessment consisted of two demographic questions, the practitioner's position and how long he or she has worked in the facility, followed by 11 multiple-choice assessment questions. The questions

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covered a variety of problematic issues associated with the use of opioids, including the following:

— Differences between "opioid naïve" and "opioid tolerant," and what constitutes or makes a patient "opioid tolerant"
— Indications for long-acting opioids (who and/or when they should be prescribed)
— Comparative dosing between two different opioids, particularly morphine and HYDROmorphone
— Patient-specific conditions that require a lower starting dose of opioids
— The impact of concomitant medications in combination with opioids
— Monitoring the effects of opioids

The multiple-choice assessment was built and conducted in a web-based survey tool, which was distributed by e-mail. Users were required to enter an organization-specific four-digit code to associate results with specific facilities. A paper version was also used by organizations to capture responses from practitioners who were unable to respond by e-mail. This tool was released on June 5, 2012, and the last day of data submission was August 26, 2012. (The tool will be available for use at http://patientsafetyauthority.org/EducationalTools/PatientSafetyTools/Pages/home.aspx.)

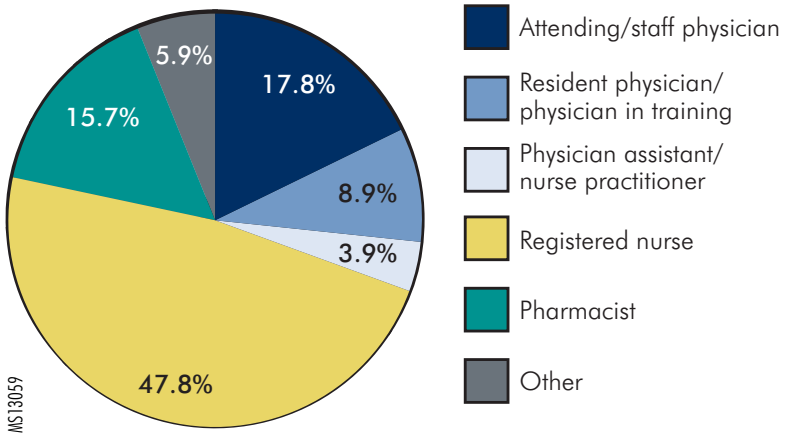
RESULTS

Practitioner Characteristics

Practitioners from 24 of the 29 (83%) hospitals that signed up for the collaboration participated in the assessment. More than 2,000 practitioners started the assessment, of which 1,758 individuals (79%) completed the assessment (see Figure).

Overall, more registered nurses (47.8%, n = 840) completed the opioid knowledge assessment than any other type of practitioner. Other practitioners included (in decreasing order of participation): attending/staff physicians (17.8%, n = 313); pharmacists (15.7%, n = 276); resident physicians/physicians in training (8.9%, n = 157); practitioners who selected "other" (5.9%, n = 104); and physician assistants/nurse practitioners (3.9%, n = 68). Practitioners who selected "other" were predominantly certified registered nurse anesthetists (46.1%, n = 48).

Figure. Percentage of Completed Knowledge Assessments by Type of Practitioner (N = 1,758)



The lowest-scoring questions in the assessment included topics addressing the following:

— Identifying the most important predictor of respiratory depression in patients receiving IV opioids
— Defining what constitutes an opioid-tolerant patient
— Choosing which medication could potentiate the effects of HYDROmorphone on ventilation

Predictor of Opioid-Induced Respiratory Depression

Sedation is a common and expected adverse effect of opioids, particularly at the start of therapy and generally during the first 24 hours of opioid therapy, as well as with increases in opioid dose.[13] Although respiratory depression is less common than sedation, it is frequently the most serious of the opioid-induced adverse effects.

Opioid-induced respiratory depression can be defined as a decrease in the effectiveness of an individual's ventilatory function after opioid administration.[14] Sedation generally precedes significant respiratory depression.[15,16] Opioid-induced sedation occurs on a continuum ranging from full consciousness to complete loss of consciousness and respiratory arrest. Unintended advancing sedation occurs at increasingly higher levels along the continuum of sedation, impairing both arousal mechanisms and content processing.

Acute pain appears to stimulate respiration and antagonize the respiratory depressant effects of opioids.[17] While pain can antagonize opioid-induced respiratory depression, sleep can intensify the depressant effects of opioids. In addition, as carbon dioxide levels increase due to respiratory depression, patients exhibit a reduction in overall level of consciousness that is additive to the direct sedative effects of opioids. Critical incidents from opioid-induced respiratory depression appear to be more common in the hours from midnight to 6 a.m.[17] Depression of level of consciousness is an extremely useful guide to observing clinical effect

(continued on page 25)

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Table. Results of the Opioid Knowledge Assessment by Individual Question and Practitioner Type

QUESTION	OVERALL NO. OF RESPONSES	ANSWER	OVERALL (%)	ATTENDING/STAFF PHYSICIAN (%)	RESIDENT PHYSICIAN/PHYSICIAN IN TRAINING (%)	PHYSICIAN ASSISTANT/NURSE PRACTITIONER (%)	REGISTERED NURSE (%)	PHARMACIST (%)	OTHER (%)
Patients who are considered opioid tolerant are those who have been:	2,024	Taking acetaminophen 300 mg with codeine 30 mg, up to 5 doses a week	6.4	6.3	6.3	3.9	7.5	3.7	5.8
		Taking oxyCODONE 10 mg with acetaminophen 325 mg 4 times daily for 5 days	1.4	1.4	3.4	0.0	1.1	1.7	1.7
		Taking oxyCODONE 10 mg with acetaminophen 325 mg 4 times daily for 14 days	29.1	34.2	24.0	32.5	25.5	40.5	20.7
		Taking extended-release morphine 15 mg twice daily for 1 week	10.2	8.8	11.4	14.3	8.5	16.3	9.1
		All of the above	52.9	49.3	54.9	49.4	57.4	37.8	62.8
The most important predictor of respiratory depression in patients receiving intravenous (IV) opioid analgesics in the hospital setting is:	2,023	Respiratory rate	49.1	36.8	45.7	50.6	49.0	62.9	56.2
		Patient-reported pain intensity	0.6	1.1	0.6	1.3	0.3	0.7	0.8
		Sedation level	22.4	33.0	30.9	19.5	20.1	16.0	15.7
		Blood pressure	0.3	0.0	0.0	1.3	0.2	1.0	0.0
		All of the above	27.6	29.1	22.9	27.3	30.4	19.4	27.3
Which of the following statements about long-acting opioids is true?	2,024	They are intended for use for pain on an as-needed basis.	6.6	4.0	4.0	3.9	10.1	0.0	6.6
		They are indicated for pain in the immediate postoperative period (12 to 24 hours following surgery).	10.3	4.5	17.1	7.8	11.3	6.5	20.5
		They are indicated for pain during the postoperative period, if the pain is not expected to persist for an extended period of time.	13.5	11.6	10.3	13.0	14.5	12.6	18.0
		They are only indicated if the patient is opioid tolerant and has already been receiving the drug prior to surgery.	56.5	71.6	58.3	71.4	46.4	78.6	31.1
		All of the above	13.0	8.2	10.3	3.9	17.7	2.4	23.8
Which of the following best represents the equianalgesic dose of IV HYDROmorphone to IV morphine 2 mg?	1,898	0.4 mg	67.2	70.1	80.6	73.2	55.8	92.6	66.7
		0.8 mg	8.6	12.7	6.7	9.9	9.1	2.8	9.0
		1 mg	19.2	14.2	10.3	14.1	28.0	3.5	17.1
		2 mg	5.0	3.0	2.4	2.8	7.2	1.1	7.2

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Table. Results of the Opioid Knowledge Assessment by Individual Question and Practitioner Type *(continued)*

QUESTION	OVERALL NO. OF RESPONSES	ANSWER	OVERALL (%)	ATTENDING/STAFF PHYSICIAN (%)	RESIDENT PHYSICIAN/PHYSICIAN IN TRAINING (%)	PHYSICIAN ASSISTANT/NURSE PRACTITIONER (%)	REGISTERED NURSE (%)	PHARMACIST (%)	OTHER (%)
Which patient-specific parameters might cause you to consider reducing the initial dose of HYDROmorphone?	1,899	Hypertension	0.2	0.3	0.0	0.0	0.0	0.0	1.8
		Sedation following administration of morphine	6.6	7.3	10.9	5.6	5.7	7.7	4.5
		A history of obstructive sleep apnea	10.4	4.5	6.1	2.8	11.2	19.0	9.9
		Hypertension and a history of obstructive sleep apnea	1.9	3.0	1.8	1.4	1.4	2.1	3.6
		Sedation following administration of morphine and a history of obstructive sleep apnea	65.9	71.9	70.9	66.2	66.8	54.9	61.3
		Hypertension, sedation following administration of morphine, and a history of obstructive sleep apnea	15.0	13.0	10.3	23.9	14.9	16.2	18.9
The best choice to manage this patient's pain and restlessness is to:	1,832	Ask the nurse to provide reassurance to the patient and continue to monitor him for signs of increased sedation and respiratory depression	63.0	71.7	64.4	58.0	63.0	49.1	73.6
		Administer diphenhydrAMINE 25 mg proper oral (PO)	29.4	20.2	28.8	34.8	29.7	42.3	19.1
		Administer diazepam 10 mg PO	4.1	3.4	4.4	4.3	4.8	2.2	4.5
		Administer midazolam 2 mg IV	3.5	4.7	2.5	2.9	2.5	6.5	2.7
Which of the following patient-specific parameters is/are the most important to monitor in patients receiving IV HYDROmorphone?	1,831	Patient-reported pain intensity	0.5	0.9	0.6	0.0	0.2	0.7	1.8
		Level of sedation	2.6	5.0	3.8	1.4	2.5	0.4	1.8
		Adequacy of ventilation	2.7	3.1	3.8	2.9	2.5	0.4	7.3
		Respiratory rate	6.2	4.3	5.6	1.4	7.9	4.7	6.4
		Patient-reported pain intensity and respiratory rate	11.7	9.3	11.3	4.3	10.7	19.0	13.6
		Patient-reported pain intensity, level of sedation, and adequacy of ventilation	76.2	77.3	75.0	89.9	76.3	74.9	69.1

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Table. Results of the Opioid Knowledge Assessment by Individual Question and Practitioner Type *(continued)*

QUESTION	OVERALL NO. OF RESPONSES	ANSWER	OVERALL (%)	ATTENDING/STAFF PHYSICIAN (%)	RESIDENT PHYSICIAN/PHYSICIAN IN TRAINING (%)	PHYSICIAN ASSISTANT/NURSE PRACTITIONER (%)	REGISTERED NURSE (%)	PHARMACIST (%)	OTHER (%)
Which of the following statements is correct in regard to the HYDROmorphone 1 mg order?	1,789	The dose is appropriate since the patient has an insignificant past medical history.	11.6	7.3	9.4	7.2	15.2	7.6	11.3
		The dose is too high because the patient is opioid naïve and over 80 years old.	77.4	85.2	79.9	85.5	70.5	87.8	74.5
		The dose is too low because the patient's chronic medications will lead to rapid metabolism of HYDROmorphone.	4.7	4.4	5.0	2.9	5.8	1.4	5.7
		The dose is too low based on her elevated body mass index.	6.3	3.2	5.7	4.3	8.5	3.2	8.5
Which of the following agent(s) can potentiate the effects of HYDROmorphone on ventilation?	1,788	Atorvastatin	0.9	0.3	0.6	1.4	1.0	0.7	1.9
		FLUoxetine	2.6	2.5	3.8	1.4	2.7	2.9	0.9
		ALPRAZolam	51.5	47.6	54.1	58.0	49.9	59.6	45.8
		Atorvastatin and ALPRAZolam	5.2	6.0	6.9	2.9	5.1	1.8	11.2
		FLUoxetine and ALPRAZolam	39.8	43.5	34.6	36.2	41.2	35.0	40.2
What would be the best option to control this patient's pain?	1,759	Order a second dose of IV HYDROmorphone 1 mg	3.5	3.2	5.1	7.4	3.7	1.8	2.9
		Assess sedation level, then continue titration of IV HYDROmorphone 0.2 mg to 0.4 mg every 10 minutes	60.4	72.2	61.8	60.3	54.0	68.8	52.9
		Order a nonopioid pain reliever until the initial dose HYDROmorphone starts to have an effect	34.8	24.3	31.8	32.4	41.0	28.3	40.4
		Order a dose of meperidine 25 mg IV	1.2	0.3	1.3	0.0	1.3	1.1	3.8
Which patient-specific parameter(s) might cause you to consider reducing the subsequent dose of opioid?	1,758	Hypertension	0.6	0.0	1.3	0.0	0.6	1.1	1.0
		Patient's age	10.1	7.3	8.3	7.4	8.9	17.4	13.5
		Coronary artery disease	0.8	0.3	0.0	0.0	1.1	0.7	1.9
		Sedation following the initial dose of HYDROmorphone	70.6	78.9	79.6	72.1	70.7	60.5	56.7
		Patient's age and coronary artery disease	17.9	13.4	10.8	20.6	18.7	20.3	26.9

Note: Percentages for individual questions are added vertically and reflect each practitioner type's responses for each answer choice; correct answer choices are shaded gray. Case examples were included for some questions in the original assessment but are not provided in this table.

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(continued from page 21)

in patients receiving opioids. Respiratory depression is almost always preceded by sedation or clouded sensorium.[18]

The second question posed on the assessment (see Table) asked practitioners to select the most important predictor of respiratory depression in patients receiving IV opioids. Participants could select respiratory rate, patient-reported pain intensity, sedation level, blood pressure, or all of the above. Overall, 22.4% of all respondents answered the question correctly; 33.0% of physicians, 20.1% of nurses, and 16.0% of pharmacists answered correctly.

Opioid Tolerance

Although opioids are often titrated to the effective dose to avoid dose-dependent adverse effects, the appropriate starting doses or the use of potent and/or long-acting dosage forms for chronic pain depend on whether patients are opioid tolerant or opioid naïve.[19]

"Opioid naïve" implies patients are not chronically receiving opioids on a routine basis. "Opioid tolerant" implies patients are chronically receiving opioids on a daily basis. Opioid-tolerant patients, as defined in the fentaNYL transdermal patch official labeling, are those who have been taking, for a week or longer, at least 60 mg of oral morphine daily, at least 30 mg of oral oxyCODONE daily, at least 8 mg of oral HYDROmorphone daily, or an equianalgesic dose of another opioid.[20] This is the lowest daily dose of opioid taken over a week that a patient must be receiving in order to be prescribed the lowest dose of fentaNYL transdermal systems. Therefore, fentaNYL transdermal systems should only be used in patients who are already receiving opioid therapy and who have demonstrated tolerance.[19]

Giving potent, long-acting opioids like a fentaNYL transdermal system to opioid-naïve patients has resulted in deaths.[21] Thus, most long-acting opioids such as fentaNYL transdermal system should *not* be used for acute pain.

This definition of opioid tolerance that is endorsed by the Food and Drug Administration (FDA) is also found in many of the new Risk Evaluation and Mitigation Strategy documents and FDA-approved Medication Guides for new opioids.[22]

The first question posed on the assessment (see Table) asked practitioners to identify the order(s) that would make a patient tolerant to opioids. Only one of the four proposed orders was correct. Overall, 29.1% of all respondents answered the question correctly; 34.2% of physicians, 25.5% of nurses, and 40.5% of pharmacists answered correctly. In addition, almost 53% of all respondents answered "all of the above"; 49.3% of physicians, 57.4% of nurses, and 37.8% of pharmacists thought that all of the listed orders would render a patient to be opioid tolerant.

Medications That Potentiate the Effects of Opioids on Ventilation

Various patients are at higher risk for adverse events from opioid use, including patients with sleep apnea, patients who are morbidly obese, and patients who concurrently receive other drugs that are CNS and respiratory depressants. This includes patients receiving other sedating drugs, such as benzodiazepines, antihistamines, diphenhydrAMINE, sedatives, or other CNS depressants.[23] One study found that most ADEs were due to drug-drug interactions, most commonly involving opioids, benzodiazepines, or cardiac medications.[24]

The ninth question posed on the assessment (see Table) asked practitioners to identify which medications could potentiate the effects of HYDROmorphone on ventilation. Overall, only 51.5% of all respondents answered the question correctly; 47.6% of physicians, 49.9% of nurses, and 59.6% of pharmacists answered correctly.

NEXT STEPS

Facility representatives from participating organizations were provided with facility-specific assessment results on the Authority's password-protected Patient Safety Knowledge Exchange (PassKey) site. In addition, the results of the knowledge self-assessment tool have helped identify statewide knowledge gaps that need to be addressed through education or other technical assistance. The Authority will work with the Pennsylvania Medical Society to develop tools on opioids to address these gaps. Collaboration will also continue with the Pennsylvania Society of Anesthesiologists to continue to enhance the role of the anesthesia department in pain management overall in participating facilities.

The Authority intends to repeat this opioid knowledge assessment to determine if improvements have been made within organizations in regard to use of opioids.

CONCLUSION

The results of the knowledge assessment supported the Authority's perception that Pennsylvania hospitals may have underestimated or were unaware of the degree of opioid knowledge deficit among practitioners. The knowledge assessment has identified basic knowledge gaps by practitioners, which will hopefully spur organizations to address these gaps and possibly assess staff knowledge about other high-alert medications. Based on the results of the opioid knowledge assessment, organizations should consider both educating and assessing the understanding of staff that care for patients receiving opioids about the following:[14,24]

- Potential effect of opioid therapy on sedation and respiratory depression
- Differences between opioid-naïve and opioid-tolerant patients, and what constitutes or makes a patient opioid tolerant
- Indications for long-acting opioids (who and/or when should they be prescribed)
- Equianalgesic dosing between opioids, IV to PO as well as between two different opioids
- Patient-specific conditions that require a lower starting dose of opioids

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— The impact of concomitant medications in combination with opioids
— Technological and clinical monitoring

Staff training can emphasize how to assess patients for adverse drug reactions, how to recognize advancing sedation, and the importance of making timely adjustments to the plan of care based on the patient's risk.

In addition, it is important to assess the organization's need for training based on the analysis of reported adverse events, near misses, outcome measures, staff observations, and knowledge assessments. This analysis may be helpful in identifying knowledge gaps and in developing improvement strategies to reduce recurrences.

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Healthcare Outbreaks—Risk Assessment and Mitigation Based on Pathogen, Population, and Environmental Factors: The P²E Concept

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ABSTRACT

Beginning in 2009, Pennsylvania experienced one of the largest and most prolonged outbreaks of invasive group A streptococcus (GAS) within a nursing facility to date. The only known reservoirs for GAS in nature are the skin and mucous membranes of the human host. Therefore, one of the highest-risk patient populations is those who have nonintact skin. In the case example from Pennsylvania, the patient population, at any given time, had several known GAS risk factors (including nonintact skin). Such an observation may indicate that outbreak risk can be assessed, and initiation of proactive intervention may provide opportunities to mitigate risk in order to decrease the probability of an outbreak. Presented herein is a novel framework describing proactive outbreak prevention based on pathogen, population, and environment (P2E) risk assessment. Pennsylvania GAS outbreak facts are used as an example, and the framework is expanded to include carbapenem-resistant Enterobacteriaceae, demonstrating the framework's applicability to a multitude of outbreak scenarios. (Pa Patient Saf Advis 2013 Mar;10[1]:27-33.)

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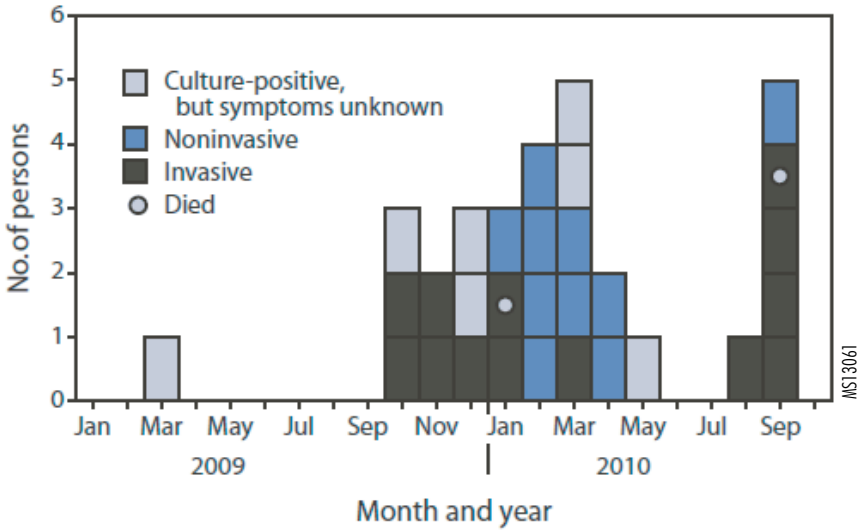
INTRODUCTION

Often, the published literature concerning outbreaks in healthcare settings highlights the event, subsequent investigation, and results. The publication of the outbreak investigation serves to educate healthcare workers and facility management on preventing and controlling these unfortunate events. Investigation of an outbreak is traditionally triggered through surveillance of case reports through a state-specific reporting system such as the Pennsylvania National Electronic Disease Surveillance System (PA-NEDSS). Once an outbreak is identified, investigation focuses on case finding, interventions, and source control. Outbreaks may remain elusive, and mitigation of associated risks to the patient may prove difficult due to the inability to predict those patient populations within a facility that would likely be affected. Herein, the authors use an outbreak of invasive group A streptococcus (GAS) in Pennsylvania as an example for risk assessment. A *Morbidity and Mortality Weekly Report* (MMWR) article[1] relevant to this event will be used as the primary document for the presentation of the facts for this risk assessment. A novel conceptual model for risk assessment and mitigation will be presented in order to provide an example of proactive outbreak prevention, as opposed to the traditional approach of reaction and control.

BACKGROUND

GAS is defined as "a facultative, gram-positive coccus that grows in chains and causes numerous infections in humans including pharyngitis, tonsillitis, scarlet fever, cellulitis, erysipelas, rheumatic fever, poststreptococcal glomerulonephritis, necrotizing

Figure. Number of Persons with Culture-Confirmed Group A Streptococcus Infection (N = 30), by Infection Type and Month of Positive Culture—Nursing Facility, Pennsylvania, 2009-2010



Reprinted from the following: Centers for Disease Control and Prevention. Invasive group A streptococcus in a skilled nursing facility—Pennsylvania, 2009-2010. MMWR Morb Mortal Wkly Rep *2011 Oct 28;60(42):1445-9.*

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Table 1. Example Factor-Based Risk Assessment, with Selected Interventions and Rationale for Group A Streptococcus (GAS)

P²E* CATEGORY	INCLUSION CRITERIA (TRANSMISSION-BASED)	INCLUSION RATIONALE	AT RISK?	MITIGATION STRATEGY†
Pathogen: GAS	How is the pathogen transmitted?	GAS is commonplace on skin and in mucous membranes[1] • Contact (direct and indirect) and droplet transmission[2]	Yes	A hand hygiene program, including surveillance, should be in place. Personal protective equipment should be readily available. Isolation precautions and treatment for known patient cases may be used. Infected healthcare providers may be excluded from clinical care and treated. Sick contacts may receive prophylaxes. Ongoing targeted screening of patients and healthcare workers may be needed to establish prevalence for the purpose of situational awareness related to potential risk.[3]
Patient	Do the majority of patients in this facility or unit exhibit at least one risk factor for the development of invasive disease?	Population-based patient demographics (per the *Morbidity and Mortality Weekly Report* article):[4] • Diabetes • One or more wounds • Physical and/or occupational therapy • Resides in a pulmonary unit • Tracheostomy	Yes	Group risk factors of similar clinical implication, then assign appropriate evidence-based prevention and control measures. (For example: The majority of the patients involved in this outbreak had breaks in skin integrity and/or were dependent of respiratory care. Therefore, interventions could be designed that focus on hand hygiene compliance, with particular attention paid toward decreasing the chance of bacterial translocation.)
	Do any of the patient-specific risk factors that are exhibited provide a vehicle for transmission from one person to another?	• Urinary catheter • Gastrostomy or jejunostomy • At least two underlying conditions	Yes	Methods to decrease bacterial load both on the patient and immediate environment could be explored. Systems that encourage sharing supplies between patients could be discouraged.

fasciitis, toxic shock syndrome, myonecrosis, and lymphangitis."[2] The pathogenic mechanisms underlying these infections are poorly understood.[2] The only known reservoirs for GAS in nature are the skin and mucous membranes of the human host. In order for GAS to become invasive and not solely an established reservoir on human mucous membranes or skin, there needs to be (1) a mode of transmission, (2) a portal of entry into the body, and (3) a host who is susceptible to infection.[3] The Centers for Disease Control and Prevention's (CDC) 2010 Active Bacterial Core surveillance (ABCs) report on GAS-related syndromes in the Emerging Infections Program Network stated that the syndromes that accounted for invasive disease included cellulitis (37%), primary bacteremia (22.5%), pneumonia (15.5%), necrotizing fasciitis (5.7%), and toxic shock (3.3%).[4] The 2010 percentages of syndromes presented in the ABCs report were comparable to those reported in 2009.[5]

In Pennsylvania, healthcare-associated infection outbreak investigations usually begin with the Pennsylvania Department of Health being notified through PA-NEDSS, by a local health department, or by an individual facility because of an increased incidence of patient cases related to a pathogen of interest. Following notification, the local and state departments coordinate investigation and control activities in conjunction with varying levels of support from CDC as warranted by the severity and controllability of the event. Other state agencies may be involved as needed. Once appropriate control measures are in place and case finding is engaged, results of the investigation then yield suggestions for control, as well as interventions to further mitigate risks of continued disease spread.

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Table 1. Example Factor-Based Risk Assessment, with Selected Interventions and Rationale for Group A Streptococcus (GAS) *(continued)*

P²E* CATEGORY	INCLUSION CRITERIA (TRANSMISSION-BASED)	INCLUSION RATIONALE	AT RISK?	MITIGATION STRATEGY†
Patient ***(continued)***		• Congestive heart failure or myocardial infarction • Male • Length of stay less than or equal to 10 months		
Environment	Do the majority of patients routinely have skin or mucous membrane contact with common surfaces?	Indirect transmission happens when pathogens are transferred through a contaminated intermediate object or person.[2]	Yes	Surfaces, equipment, and devices that are in contact with skin should be disinfected in between patients.
	Does the potential for introduction of this pathogen from external sources exist?	Direct transmission occurs when pathogens are transferred from one person to another without a contaminated intermediate object or person.[2]	Yes	Visitation by those who exhibit signs and symptoms of infection may be limited.

Sources:

[1] Stevens DL, Bryant A. Group A streptococcus: virulence factors and pathogenic mechanisms [online]. UpToDate 2012 Aug 1 [cited 2012 Oct 6]. http://www.uptodate.com/contents/group-a-streptococcus-virulence-factors-and-pathogenic-mechanisms.

[2] Siegel JD, Rhinehart E, Jackson M, et al. 2007 guideline for isolation precautions: preventing transmission of infectious agents in healthcare settings [online]. [cited 2012 Oct 7]. http://www.cdc.gov/ncidod/dhqp/pdf/isolation2007.pdf.

[3] Girou E, Azar J, Wolkenstein P, et al. Comparison of systemic versus selective screening for methicillin-resistant *Staphylococcus aureus* carriage in a high-risk dermatology ward. *Infect Control Hosp Epidemiol* 2000 Sep;21(9):583-7.

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* P²E = pathogen, population, and environment

† Refer to the appendix for Pennsylvania Department of Health recommendations specific to invasive GAS outbreak intervention.

Beginning in 2009, Pennsylvania experienced one of the largest and most prolonged outbreaks of invasive GAS within a nursing facility to date.[1] The Figure, which is reprinted from the *MMWR* article, depicts the extent of illness in individuals fitting the case definition and the timeline related to this event.[1] Furthermore, since the *MMWR* article was published, there were two additional cases of invasive GAS associated with the described outbreak.

As a result of the prolonged and evolving nature of the outbreak, the investigators decided to conduct a matched case-control study as part of the investigation. The purpose of this approach was to identify associations between potential risk factors and GAS infection, therefore providing clues that may help stop the outbreak.

The case-patient majority (n = 23) in the *MMWR* report, as compared with control subjects (n = 69), were male (52%); had a length of stay less than or equal to 10 months (83%); resided in a pulmonary unit (83%); received physical therapy (74%) or occupational therapy (61%); had a tracheostomy tube (74%); had an indwelling urinary catheter (83%); had a gastrostomy or jejunostomy (65%); and had at least two underlying conditions (56%), congestive heart failure or myocardial infarction (57%), diabetes (52%), at least one wound (87%), and finally, two or more wounds (70%).[1] Of the 23 potential GAS risk factors assessed during the outbreak investigation, the case-patients represented a majority in 13 of those factors. Having a patient population that, at any given time, can express a majority of the known GAS risk factors and having potential at-risk patient demographics like expressed by the *MMWR* article strongly suggests that this population might be at an increased risk for outbreaks. Therefore, if a facility has

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Table 2. Example Factor-Based Risk Assessment, with Selected Interventions and Rationale for Carbapenem-Resistant Enterobacteriaceae (CRE) Organisms

P²E* CATEGORY	INCLUSION CRITERIA (TRANSMISSION-BASED)	INCLUSION RATIONALE	AT RISK?	MITIGATION STRATEGY
Pathogen: **CRE**	How is the pathogen transmitted?	Contact	Yes	A hand hygiene program, including surveillance, should be in place. Personal protective equipment (PPE) should be readily available. Isolation precautions and treatment for known patient cases may be used. If organism is prevalent in the facility, the facility may consider surveillance, screening cultures, and preemptive isolation of transfers and admissions of high-risk patients or patients from high-risk areas.[1]
Patient	Do the majority of patients in this facility or unit exhibit at least one risk factor for the development of invasive disease?	Selected CRE patient-related risk factors:[2-4] • Length of stay prior to positive culture • Admission to the intensive care unit • Foreign material in the body • Tracheostomy • Chronic obstructive pulmonary disease • Age 65 or older • Mechanical ventilation • Nasogastric tube • Prior antibiotic use • Immunosuppression • Central venous catheter • Foley catheter • Dialysis	Yes	Group risk factors of similar clinical implication, then assign appropriate evidence-based prevention and control measures. For example, grouped risks may include intensive care admission, the use of ventilation equipment (tracheostomy and endotracheal tubes), and antibiotic use.[2-4]
	Do any of the patient-specific risk factors that are exhibited provide a vehicle for transmission from one person to another?		Yes	Refer to Centers for Disease Control and Prevention's *Guidance for Control of Carbapenem-resistant Enterobacteriaceae (CRE)*[5]

residents who are at risk for GAS infection and susceptible to infection, and if mechanisms of transmission are present, those responsible for infection prevention may need to have greater vigilance in enforcing infection prevention measures in order to prevent an outbreak.

DISCUSSION

Using the aforementioned GAS outbreak event as a working example, comprehending the very high risk to the population represented, and knowing that to date there is no commercially available GAS vaccine,[6] an approach for describing proactive outbreak prevention based on assessment of the pathogen, population, and environment (P²E) may be the best method to prevent outbreaks. Factor et al. noted that a large proportion of cases with invasive GAS disease had a cutaneous form and that a large proportion of those cases reported some type of wound prior to the infection, suggesting that nonintact skin is a primary portal of entry into the body.[7] As previously mentioned, human skin and mucous membranes are also implicated as the only known reservoirs for GAS in nature.[2] Therefore, the highest-risk patient population includes those most likely to have nonintact skin, for example, patients who have a tracheostomy tube, a feeding tube, a urinary catheter, or one or more wounds (likely related to malnutrition and/or the presence of diabetes). Pathogen factors are

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Table 2. Example Factor-Based Risk Assessment, with Selected Interventions and Rationale for Carbapenem-Resistant Enterobacteriaceae (CRE) Organisms *(continued)*

P²E* CATEGORY	INCLUSION CRITERIA (TRANSMISSION-BASED)	INCLUSION RATIONALE	AT RISK?	MITIGATION STRATEGY
Patient ***(continued)***		• Nonsurgical invasive procedure • Malignancy		
Environment	Do the majority of patients routinely have skin or mucous membrane contact with common surfaces?	Indirect transmission happens when pathogens are transferred through a contaminated intermediate object or person.[6]	Yes	Surfaces, equipment, and devices that are in contact with skin should be disinfected in between patients.
	Does the potential for introduction of this pathogen from common sources exist?	Direct transmission occurs when pathogens are transferred from one person to another without a contaminated intermediate object or person (for example, healthcare workers moving from high-risk areas to low-risk areas).[6]	Yes	PPE should be used properly, and effective hand hygiene practices and policies should be in place.
	Is the pathogen present in the environment?	Positive patient cultures	Yes	Ensure situational awareness related to communication with laboratory personnel and facility epidemiologist.

Sources:

[1] Ben-David D, Maor Y, Keller N, et al. Potential role of active surveillance in the control of a hospital-wide outbreak of carbapenem-resistant *Klebsiella pneumoniae* infection. *Infect Control Hosp Epidemiol* 2010 Jun;31(6):620-6.

[2] Bratu S, Landman D, Haag R, et al. Rapid spread of carbapenem-resistant *Klebsiella pneumoniae* in New York City: a new threat to our antibiotic armamentarium. *Arch Intern Med* 2005 Jun 27;165(12):1430-5.

[3] Falagas ME, Rafailidis PI, Kofteridis D, et al. Risk factors of carbapenem-resistant *Klebsiella pneumoniae* infections: a matched case-control study. *J Antimicrob Chemother* 2007 Nov;60(5):1124-30.

[4] Schwaber MJ, Klarfeld-Lidji S, Navon-Venezia S, et al. Predictors of carbapenem-resistant *Klebsiella pneumoniae* acquisition among hospitalized adults and effect of acquisition on mortality. *Antimicrob Agents Chemother* 2008 Mar;52(3):1028-33.

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[6] Siegel JD, Rhinehart E, Jackson M, et al. 2007 guideline for isolation precautions: preventing transmission of infectious agents in healthcare settings [online]. [cited 2012 Oct 7]. http://www.cdc.gov/ncidod/dhqp/pdf/isolation2007.pdf.

* P²E = pathogen, population, and environment

related to the affinity of GAS to reside in sufficient quantity on human skin and mucous membranes, establishing a reservoir of significant virulence. Environmental factors in this population include patient exposures to the pathogen by way of sick or colonized contacts, through translocation, or possibly (but less likely) from contaminated environmental surfaces (such as therapy mats).

A realistic, population-based, proactive risk mitigation strategy for outbreak prevention may consider a combination of basic infection control interventions,[8] a P²E-based risk assessment, situational awareness related to at-risk patients and infected individuals,[9] an ongoing educational plan targeting pathogen-specific transmission prevention,[10,11] and identification (through the P²E risk assessment) of a related patient population. Table 1 represents an example of a P²E-based risk assessment, with rationale using the facts presented by the *MMWR* report relevant to the described GAS outbreak event in Pennsylvania.[1]

Once P²E risk assessment is performed, it is then possible to review specific recommendations for the prevention of organism-specific outbreaks. Included in the online-only appendix to this article is a list of staged recommendations specific to GAS. The recommendations presented in the appendix were developed during the

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Pennsylvania GAS outbreak in coordination with participating state and federal agencies. (The appendix is available online at http://patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2013/Mar;10(1)/Pages/home.aspx.)

In order to perform a P^2E risk assessment, the patient population needs to be assessed comprehensively for the pathogens it is likely to be susceptible to. This novel P^2E risk assessment approach as presented herein may help guide the infection preventionist as to which pathogens, and in which patient populations, targeted infection prevention measures may be indicated in order to establish an appropriate outbreak prevention strategy. Knowing whether a population is at risk will dictate which prevention strategies to use and how they are applied.

For pathogens that are difficult to eradicate (i.e., hard to kill, unlike GAS), P^2E assessment may be a useful strategy for obtaining actionable data for the mitigation of environmental invasion and associated outbreaks of pathogens. Carbapenem-resistant Enterobacteriaceae (CRE), which includes carbapenem-resistant *Klebsiella pneumoniae* (CRKP), is a grouping of organisms that were rarely encountered in the United States before the 1990s.[12] CRE is endemic in certain healthcare patient populations, adding to the likelihood of outbreaks related to inappropriate use of antibiotics.[13] Bratu et al. note that "most patients [affected] had been heavily treated with antibiotics before the culture that revealed imipenem-resistant *K* [*Klebsiella*] *pneumoniae*. Although case-cohort studies are necessary to accurately identify risk factors, only 20% of the patients had recent previous therapy with a carbapenem. In contrast, virtually all patients had received previous therapy with a β-lactam or a fluoroquinolone."[14] Looking at Bratu et al.'s observations as a starting point, one may conduct a P^2E risk assessment on the patient population at risk for developing an infection with a particular type of resistant organism.

Information like what has been modeled in Table 1 related to GAS can be reproduced for other organisms of interest in order to determine (1) whether a facility and its patients are at risk for an outbreak and (2) if the organism is found to be endemic, how risks should be grouped in order for resources to be assigned to mitigate continued risk. Table 2 represents an example P^2E approach using clinical knowledge of risk factors for disease and death, as well as transmission control related to CRE.[15-17]

Risk assessments that target a pathogen, an at-risk population, and a particular environment can proactively guide mitigation strategies related to outbreaks. The three factors—pathogen, population, and environment—can synergistically combine to produce the circumstances for infection and pathogen transmission. Provided herein is a glimpse into how P^2E risk assessment can be conducted and applied to the clinical arena. Solely assessing for the risk of an outbreak for a particular organism in and of itself will not prevent an outbreak. The results of the risk assessment should educate and provide for situational awareness in terms of how ripe a situation is for an outbreak. Information gathered in regard to risk may be used to develop individual and shared situational awareness among staff.

"Individual situational awareness" refers to how the world is seen in individual terms, based on cultural background, education, experiences, and the strengths and limitations of our senses. The mindset that evolves is a result of these inputs and is essentially self-centered.[18] "Shared situational awareness obviously differs from individual SA [situational awareness] because it involves a number of persons trying to form a common picture. In any given 'situation' these people each have their own 'individual SA,' a unique dynamic picture of the situation, which exists in their minds."[18]

Schofield and Tauber note the following: [19]

> *A common ground does not mean strong unification; it does not imply that everyone has the same goals, shares the same view of the world, and acts the same way. A common ground allows for certain diversity and individuality, enables shared views and vocabularies, and tolerates sub-communities, sub-disciplines, and the like. However, there is always a core of common concepts and views.*
>
> *The common ground is dynamic in nature and therefore is often a matter of explicit negotiation and communication. A common ground can fall apart and eventually can get lost; hence, it needs constant maintenance in order to keep the community, culture, and discipline alive.*

CONCLUSION

The P^2E risk assessments presented in this article are meant to be examples of how to start developing situational awareness of a facility's risk given the characteristics of the patients it cares for in combination with the pathogens in its environment. These assessments are meant to be communicated to staff in order for them to further develop individual awareness of risk and adopt behaviors that can mitigate risk to the patient. The lessons gleaned from conducting specialized risk assessment can be incorporated into the education and training of all staff in order to achieve a group situational awareness and common ground related to outbreak prevention. The P^2E risk assessment also provides an opportunity to review the effectiveness of the facility's policies and procedures from the standpoint of how well the policies and procedures address the needs of the population the facility serves.

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As one paper notes, "To get the members of the group to develop a shared awareness of the situation requires that they build individual situational awareness within the framework of the mission to be accomplished; share their individual situational awareness, which requires being 'aware' of relevant actions and functions of other team members; [and] develop the group 'shared situational awareness.'"[18] A critical element in building a shared situational awareness is establishing common ground, which must be achieved through training and experience.[18]

The authors believe that focused training and development of relevant clinical experience is only obtainable through P^2E exercises that serve to provide risk prediction and mitigation interventions that can be used as a basis for staff education, situational awareness, and appropriate policy and procedure development in order to prevent probable outbreaks.

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Quarterly Update: What Body Parts and Procedures Are Associated with Wrong-Site Surgery?

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The six wrong-site procedures in Pennsylvania operating suites this quarter were *an all-time low* since reporting of patient safety events began in mid-2004 (see Figure). Two of the procedures were wrong-side anesthesia blocks. Two were wrong-side pain blocks. One was a wrong-side needle localization of a breast lesion for a breast biopsy. One was the removal of a wrong skin lesion. Going into 2013, 88 days passed since a surgeon had operated on the wrong site in the operating room (OR) and 20 days passed since an anesthesiologist had blocked the wrong site.

Some near-miss reports from this quarter illustrate the importance of using the time-out as a final check for information errors:

> *The CRNA [certified registered nurse anesthetist] gave the report to the circulator stating consents were signed and the patient was marked. The patient stated right ear surgery when asked upon entering the OR, and the right ear was marked. The history and physical noted right ear surgery. When reading the OR consent [during the] time-out, the RN [registered nurse] noticed no right or left ear was noted in the surgery description. The time-out stopped until [the ear was] clarified. The surgeon agreed it was the right ear.*

> *The patient was on the OR schedule for a left inguinal hernia. The circulating nurse opened the electronic patient record in preparation for the procedure and used the information for this patient to complete the information on the time-out board. The circulating nurse retrieved the patient from the preoperative area, confirming the patient's identity with the parents, the chart, and the patient bracelet. The circulating nurse entered the OR with the patient and proceeded to perform a time-out, identifying the patient, birth date, weight, allergies, and procedure. During the time-out procedure, the nurse anesthetist asked why the patient's first name on the time-out board was different from the patient bracelet and patient chart. The surgeon stated the patient was a twin and the twin had been scheduled instead incorrectly.*

Another report illustrates the struggle facilities have ensuring compliance with best practices to prevent wrong-site surgery with the time-out:

> *The doctor inserted the cystoscope prior to the time-out. When reminded, he continued the procedure while doing the time-out. [He was] reminded again of the need to wait to start the procedure until after the time-out, and the doctor continued talking.*

Recently, Mehtsun et al.[1] reviewed surgical "never events" in the National Practitioners Data Bank from September 1, 1990, through September 30, 2010. For wrong-site, wrong-procedure, and wrong-patient events, they identified an average payment of $179,575, in 2010 US dollars, for each of an average of 250 events with payments per year. They extrapolated a total of 2,058 wrong-site, wrong-procedure, or wrong-patient occurrences per year in the United States. When outcomes were described for events resulting in payments, 8% resulted in deaths, 48% in permanent injury, 42% in temporary injury, and 2% in emotional injury.

Scan this code with your mobile device's QR reader to access the Authority's wrong-site surgery prevention toolkit.

AN ANALYSIS OF 500 WRONG-SITE SURGERIES

The first 500 wrong-site surgery events reported to the Pennsylvania Patient Safety Authority between July 2004 and August 2012 were reviewed for the relationship between the type of wrong-site event, the procedure intended, and the location of the intended incision. The primary intent was to answer the question: What sites benefit from marking and having the mark referenced during the time-out?

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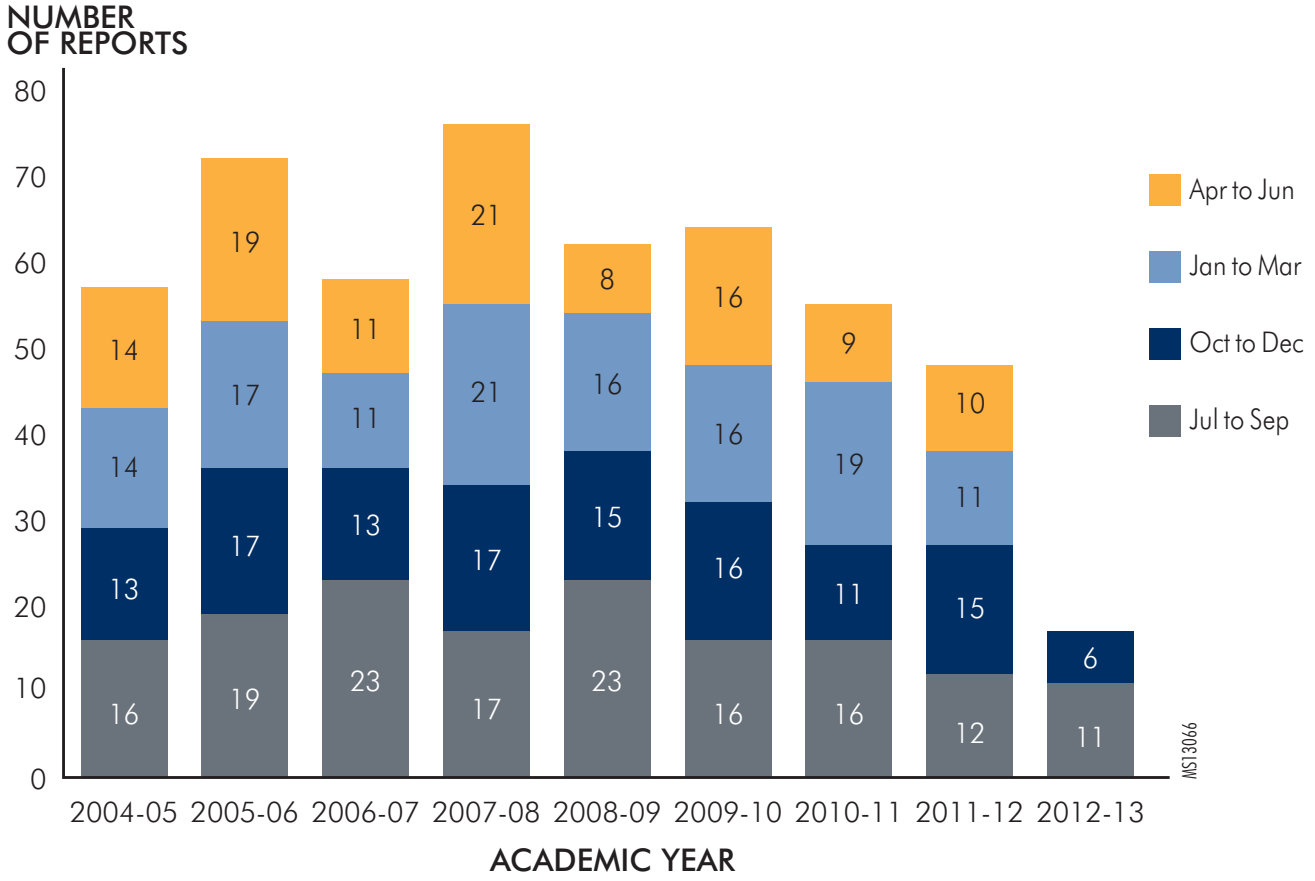
Figure. Pennsylvania Patient Safety Authority Wrong-Site Surgery Reports by Academic Year



Wrong-Patient Events

Of the 500 events, 9 (1.8%) were OR procedures done on the wrong patient, approximately 1 per year. However, 32 months passed since the last report of an OR procedure on the wrong patient in Pennsylvania.

Of the 9, 8 involved the use of incorrect information, as follows:

— 4 involved patients with the same or similar names

— 2 involved another patient's information entered in the chart

— 1 involved using another patient's chart

— 1 involved operating on patients out of the scheduled order

Two reports documented suboptimal patient identification practices:

> *The physician entered and identified the patient by first and last name. The patient responded affirmatively. . . . The RN entered and identified the patient by name, and the patient responded affirmatively. . . . The RN spelled the patient's last name, and the patient responded affirmatively.*

> *The patients were coming back to the OR out of order. . . . His name bracelet was not checked, and he was not asked to identify himself.*

However, the rarity of wrong-patient events in the OR is consistent with good compliance with verification using the patient's statements of two identifiers. This "active voice" verification of the patient's identity has been observed during site visits at multiple facilities involved in collaborations to prevent wrong-site surgery.

Wrong-Procedure Events

Physicians initiated a wrong procedure during 58 of the 500 events (11.6%), with 42 of the 58 wrong procedures (72.4%) being completed. The types of procedures were as follows:

— 14 hand procedures

— 12 insertions of an incorrect device, including 1 incorrect type of ear tubes

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— 10 ear, nose, and throat (ENT) procedures, including the previously noted event involving ear tubes
— 5 eye procedures
— 4 gynecological procedures
— 3 breast procedures
— 3 orthopedic procedures
— 3 urological procedures
— 2 pain management procedures
— Plus a bariatric procedure, a hernia repair, and a wrong endoscopy

The wrong-hand procedures exhibited an interesting pattern: 12 of the 14 were incisions for unintended carpal tunnel release. For 9 of the 12, the intended procedure was a trigger finger release, not a carpal tunnel release, exactly the same situation described in a case report in the *New England Journal of Medicine*.[2]

Of the 58 wrong procedures, 9 were additional procedures to those that were intended. Of those, 3 were unintended tonsillectomies in addition to planned adenoidectomies, 2 were unintended bilateral salpingo-oophorectomies in addition to planned hysterectomies, and 1 was a bilateral myringotomy instead of a unilateral myringotomy.

The tendency to do carpal tunnel releases instead of trigger finger releases, tonsillectomies with adenoidectomies, and salpingo-oophorectomies with hysterectomies suggests problems of automatic thinking by the surgeons and the need for OR staff to maintain situational awareness of the intended procedures throughout all operations:

> *The patient was in the OR for bilateral myringotomy with insertion of PE [pressure equalization] tubes and adenoidectomy. The patient was draped, and a time-out was performed prior to beginning the myringotomy. When the bilateral myringotomy was completed, the surgeon placed the mouth gag. The scrub nurse set up the coblator, and, when she looked inside the mouth, she saw the surgeon was removing the right tonsil. [The scrub nurse and surgeon] both noted at that time the patient was for adenoidectomy.*

> *The patient was scheduled for a right trigger thumb release. The surgeon made the incision for carpal tunnel release. The surgical tech questioned the procedure.*

> *The patient was scheduled for left trigger thumb release. . . . The patient held up her marked thumb, which was initialed by [the doctor]. . . . The patient was prepped and draped. The time-out was announced—the patient name and proper procedure [were verified]. [The doctor] began injecting the palm as though he was doing a carpal tunnel instead of a trigger thumb release. The CRNA asked [the doctor] if he was injecting for a carpal tunnel instead of a trigger thumb. [The doctor] stopped.*

Some of the unintended carpal tunnel releases were facilitated by the absence of a site mark or time-out:

> *Scheduled for release of trigger finger; consent indicated same; site marked by surgeon; . . . during prep, site mark washed off with alcohol; MD proceeded to do carpal tunnel, then realized he was to do trigger finger; . . . MD told staff he was thinking about a patient he had done previous day; MD said the time-out was done.*

> *Time-out was not performed. Incision made for left carpal tunnel. Surgeon realized patient was to have release of trigger finger.*

> *Patient was scheduled for a trigger finger release. . . . No time-out process was completed. The surgeon started the procedure and made an incision as if the patient were undergoing a carpel tunnel release. The surgeon immediately realized his error.*

Wrong-Location Events

Physicians initiated an intended procedure at an incorrect site on the correct patient according to 433 of the 500 event reports (86.6%). The errors in the location of the incisions or punctures were subdivided as follows:

— 1 procedure started on the wrong side and at the wrong spinal level (counted as half for each).
— 306 other procedures started on the wrong side.
— 64 other procedures started at the wrong level of the spine (63) or rib cage (1).
— 59 procedures started at a wrong location near the correct location.

In three reports, the information was insufficient to make such a determination.

Wrong-Side Events

Counting the report of a procedure started both on the wrong side and at the wrong level, 307 OR procedures were initiated on the wrong side of body. Wrong-side procedures constituted the vast majority (61.3%) of all 500 wrong-site surgery reports. They represented 71.3% of all intended procedures done on the correct patient but initiated at the wrong location on the body among the 430 patients for whom the location could be determined.

The exact anatomic location of the surgery was described for 283 of the 307 wrong-side procedures and is presented in Table 1. For some of the events, the wrong-side error did not occur during the primary procedure but during the anesthesia block or the tissue donor site procedure. Wrong-side anesthesia blocks done by anesthesiologists accounted for 104 of the 307 wrong-side procedures in the OR (33.8%), and wrong-side pain procedures accounted for another 41 (13.4%). Surgical procedures accounted for slightly more than half (52.6%).

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Table 1. Areas with Wrong-Side Operating Room Procedures

ANATOMIC LOCATION	NO. OF WRONG-SIDE PROCEDURES
Knees	52
Spine	43
Eyes	33
Legs	26
Ureters	25
Feet	16
Shoulders	10
Neck	8
Ankles	7
Chest or lungs	7
Skull (craniotomies)*	7
Colon	6
Hips†	6
Inguinal hernias	6
Breasts	5
Ears	4
Jaw	2
Kidneys	2
Nose	2
Ovaries	2
Sinuses	2
Testes	2
Abdominal wall	1
Buttocks	1
Device implantations	1
Forehead (temples)	1
Hands	1
Parathyroid glands	1
Thyroid gland	1
Tongue	1
Vocal cords	1
Vulva	1
Total	**283**

* 5 of 7 craniotomies were emergencies for brain injuries
† 1 of 6 hip procedures was for a hip fracture

Of the 43 wrong-side spinal procedures, 29 (67.4%) were injections to control pain.

The need for intraoperative verification of ureteral stent placement with imaging studies has been discussed in a previous issue of the *Pennsylvania Patient Safety Advisory*.[3]

The only wrong-site emergency trauma procedures done in the OR were wrong-side craniotomies, as illustrated by the following:

> *There was no consent obtained for this emergent case. The patient arrived intubated in the OR. The OR staff was set up for a right craniotomy, but the surgeon was positioning the patient for a left craniotomy. The OR staff assumed amongst the rush of the case that the case was booked wrong and that it was a left-side craniotomy. [After making the incision, the surgeon] recognized the operation was on the wrong side. The procedure was immediately stopped. The dura was not opened. The incision was closed and dressed, and the patient was repositioned for a right craniotomy. . . . No time-out [had been] done.*

A fracture by itself is not always adequate to indicate the correct site for surgery, as illustrated by the following:

> *Surgery was scheduled and consent obtained for repair of a right hip fracture. The patient marked the site, and team verification "pause" occurred. However, the patient was positioned with the left hip draped and prepped, and the surgery proceeded. After the incision, the error was realized. The incision was sutured and the patient repositioned, and surgery resumed on the right hip.*

Wrong-Level Events

Counting the report of the procedure started both on the wrong side and at the wrong level, 65 OR procedures were initiated on the level of a multitiered skeletal

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structure. Wrong-level procedures constituted 12.9% of all 500 wrong-site surgery reports. They represented 15.0% of all intended procedures done on the correct patient but initiated at the wrong location on the body among the 430 patients for whom the location could be determined.

All but one of the wrong-level events was a procedure done at the wrong spinal level. One event of the 500 was the resection of the second rib, instead of the first rib, on the correct side. For events requiring intraoperative verification of the correct level of a skeletal structure by imaging studies, the event is not considered a wrong-level event if a correct adjustment is made in the location in response to the intraoperative verification before the definitive part of the procedure is initiated.

Of the 64 wrong-level spinal procedures, one event described a patient who had a lumbar procedure instead of a cervical procedure:

> *The patient was scheduled for an epidural steroid injection. . . . The time-out was done using the consent. However, the site had not been marked in the preoperative area and the consent did not specify a site. The patient stated only that he was having an epidural steroid injection. The doctor stated during the time-out that the lumbar area was the correct area. After the lumbar procedure, the CRNA discovered "cervical" on the medical record and informed the physician.*

Of the 64 reports of wrong-level spinal procedures, 57 (89.1%) were open procedures and 7 (10.9%) were pain procedures. Open spinal procedures were more likely to be done at the wrong level (56) than on the wrong side (13), not considering the procedure done at both the wrong level and on the wrong side.

Of the 64, 6 might have been due to preoperative information errors and 56 were most likely due to intraoperative misperceptions; the sources of error were ambiguous for 2. The intended and erroneous vertebral bodies used to verify the location of the procedure were mentioned in 53 reports. Most of the vertebrae intended to be used for intraoperative verification of the spinal procedure were in the lumbosacral region of the spine (55.7%), followed by the cervical region (30.2%) and the thoracic region (14.2%). For cervical and upper thoracic spine procedures, there was a tendency to erroneously identify vertebrae that were more caudad (closer to the coccyx). For lower thoracic and lumbosacral spine procedures, there was a tendency to erroneously identify vertebrae that were more cephalad (closer to the head) (see Table 2).

Table 2. Errors in Verification of Vertebral Bodies

VERT.*	NO.†	ERRORS CAUDAD‡	ERRORS CEPHALAD§	TENDENCY
C1	0			
C2	0			
C3	5	4	1	Caudad
C4	6	5	1	Caudad
C5	9	6	3	Caudad
C6	8	4	4	Even
C7	4	2	2	Even
T1	0			
T2	0			
T3	0			
T4	0			
T5	1	1	0	Caudad
T6	1	1	0	Caudad
T7	2	1	1	Even
T8	2	0	2	Cephalad
T9	2	0	2	Cephalad
T10	2	0	2	Cephalad
T11	3	0	3	Cephalad
T12	2	1	1	Even
L1	2	0	2	Cephalad
L2	7	3	4	Cephalad
L3	9	3	6	Cephalad
L4	19	7	12	Cephalad
L5	18	7	11	Cephalad
S1	4	1	3	Cephalad
S2	0			

* Vert. = Intended vertebral body

† No. = Number of misidentifications involving the intended vertebral body

‡ Errors Caudad = Wrong level is closer to the coccyx

§ Errors Cephalad = Wrong level is closer to the head

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The importance of specifying the exact location of a spinal procedure on documents used for verification is illustrated by the following report:

> *The patient was brought into OR. . . . Left side was verified with the physician. The physician announced Left 4. Surgical consent stated lumbar epidural injection with no level or side specified. Left 4 lumbar epidural injection was completed. The physician returned in the afternoon to perform other procedures and realized he had an incorrect schedule from his office, which led to the realization that he had done the wrong level on the morning patient.*

The value of following the North American Spine Society (NASS) suggestion of using an intraoperative imaging study—after surgical exposure of the operative site, using markers that do not move—to confirm the vertebral level to be operated[4] upon is illustrated by the following report:

> *Spinal procedure completed at unintended level. Discectomy was planned for L2-3 but performed at L3-4. This error was detected intraoperatively, and the surgery was extended to include the intended procedure. . . . Surgical site verification was performed according to our policy and did not include intraoperative imaging to confirm the level.*

The importance of using stable markers to verify, rather than estimate, the intended vertebra is illustrated by this report:

> *An intraoperative fluoroscopy was used to localize the incision over C5-6. Fluoroscopy revealed that needle was at C4-5, so dissection was carried further distally to the presumed C5-6 level. The procedure was completed. However, a follow-up x-ray revealed that the site was C6-7.*

The value of the NASS suggestion of an additional reading of the verification image by a radiologist, as well as the surgeon,[4] is illustrated by another report:

> *The patient has a transitional lumbar vertebra. The surgeon performed surgery at the L3-4. The patient remained symptomatic. Review of the films with the radiologist determined that the radiologist and the surgeon were counting differently (one included the transition vertebra and one did not), resulting in confusion of the level for surgery. The patient was taken back to the OR, and surgery at L2-3 [was done] with good results.*

Reasons for misreading the landmark vertebra included transitional vertebrae, lumbarization of the sacrum, prior fusions, osteoporosis, kyphosis, and obesity, among many other pathologies that could lead to confusion.

Other Wrong-Location Events

There were 59 intended procedures done on the correct patient but initiated at the wrong location other than the wrong side or wrong level. They constituted 11.8% of all 500 wrong-site surgery reports and represented 13.7% of all intended procedures done on the correct patient but initiated at wrong location on the body among the 430 patients for whom the location could be determined.

These procedures were initiated at locations near the correct locations:

- 14 procedures that started on the wrong part of the correct hand or fingers
- 11 procedures involving the removal of the wrong skin or subcutaneous lesion
- 9 procedures that started on the wrong part of the correct breast
- 7 procedures that started on the wrong part of the correct foot or toes
- 3 procedures that started on the wrong side of the correct elbow
- 3 vascular access procedures that started at other than the intended location
- 2 device implantations that started at other than the intended location

Unique events among the 500 reports involved the wrong tooth, the wrong cardiac vessel, the wrong part of the correct lung, the wrong midline hernia, the wrong part of the perineum, the wrong end of the femur, the wrong side of the internal knee, the wrong muscle, and an incorrectly placed incision over the lower spine. One event was described only as medial instead of lateral.

These events illustrate the importance of the following:

- Locations of procedures should be documented as specifically as possible (e.g., medial or lateral, proximal or distal).
- Marks referencing the location of the surgery on hands, fingers, feet, and toes should be placed as close as possible to the intended incision site.
- The exact location of skin and subcutaneous lesions should be marked.

Localizing breast lesions is more complex and may be discussed in a future issue of the *Advisory*.

SUMMARY

Analysis of 500 consecutive wrong-site surgery reports identified the following themes:

- The process of having the patient state two identifiers to verify their identity appears to be effective in preventing wrong-patient errors.
- Preoperative documentation of the site of surgery should be specific enough for all OR team members to anticipate the correct location of the mark.
- Marks should be made as close to the intended incisions as possible. The

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exact location of skin and subcutaneous lesions should be marked.

— The most likely wrong-site error, by far, is a wrong-side error. Bilateral structures, especially extremities and eyes, are most likely to experience wrong-side surgery. The most common wrong-side error is the anesthetic block, accounting for 34% of all wrong-side errors and 21% of all wrong-site errors in the OR area.

— Some wrong procedures may result from surgeons becoming distracted during the operation. The OR team should maintain situational awareness of the intended procedures throughout the case, not just at the start of the case.

— Wrong-level spinal procedures represent 13% of all wrong-site procedures. Intraoperative misperceptions were reported nine times as often as errors based on misunderstandings of information available preoperatively. The prevention of wrong-level spinal procedures requires intraoperative verification of the correct spinal level.

NOTES

1. Mehtsun WT, Ibrahim AM, Diener-West M, et al. Surgical never events in the United States [online]. Surgery 2012 Dec 17 [cited 2013 Jan 29; epub ahead of print]. http://www.sciencedirect.com/science/article/pii/S003960601200623X.
2. Ring DC, Herndon JH, Meyer GS. Case records of the Massachusetts General Hospital: case 34-2010: a 65-year-old woman with an incorrect operation on the left hand. *N Engl J Med* 2010 Nov;363(20):1950-7.
3. Quarterly update on the preventing wrong-site surgery project: digging deeper. Pa Patient Saf Advis [online] 2010 Mar [cited 2013 Jan 29]. http://www.patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2010/Mar7(1)/Pages/26.aspx.
4. North American Spine Society. Sign, mark & x-ray (SMaX): a checklist for safety [online]. 2001 [cited 2013 Jan 29]. http://www.spine.org/Documents/SMaXchecklist.pdf.

Correction

Carson SL, Gaunt MJ. Events associated with the prescribing, dispensing, and administering of medication loading doses. Pa Patient Saf Advis [online] 2012 Sep [cited 2013 Jan 14]. http://patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2012/Sep;9(3)/Pages/82.aspx. *This article contained a statement in error. The statement should read "Six high-alert medications, drugs that bear a heightened risk of causing significant patient harm when used in error,[9,10] appear in the top 20." This statement has been corrected in the online article. The editors regret the error.*

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