



PENNSYLVANIA PATIENT SAFETY ADVISORY

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Patient Safety Authority

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About the Pennsylvania Patient Safety Advisory

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 those in which urgent communication of information could have a significant impact on patient outcomes.

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The Authority also works with the Pennsylvania State Nurses Association to offer nursing continuing education credits for selected portions of the *Advisory*. Go to <http://www.panurses.org/new/cc/listCourses.cfm> to view the course catalog.

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Leveraging Healthcare Policy Changes to Decrease Hospital 30-Day Readmission Rates

ABSTRACT

Hospitalizations account for nearly one-third of the \$2 trillion spent on healthcare in the United States annually. Nearly 20% of these hospitalizations are rehospitalizations occurring within 30 days of discharge. In 2008, there were 57,852 readmissions in Pennsylvania, amounting to approximately \$2.5 billion in charges. Thirty-eight percent of these readmissions were related to complications or infections. From June 2004 through August 2009, 1,791 events of readmission to the emergency department within 48 hours were reported to the Pennsylvania Patient Safety Authority, 8% of which were Serious Events (indicating harm to the patient). In June 2008, the Medicare Payment Advisory Commission calculated the annual cost of readmissions to the Medicare program at \$15 billion. The Obama administration's 2010 budget aims to reduce Medicare readmissions in order to fund healthcare reform. The Centers for Medicare & Medicaid Services posts hospital readmission rates for three conditions on its Web site. National readmission rates show a wide variance across states as well as variance between facilities within the same state. This high variance rate suggests that significant financial savings could be realized if best practices for preventing unnecessary readmissions were adopted. This article reviews both national policy related to readmissions and best practices that could help hospitals reduce readmission rates while simultaneously improving patient-centered care and patient safety. (*Pa Patient Saf Advis* 2010 Mar;7(1):1-8.)

Background Policy

Hospitalizations account for nearly one-third of the \$2 trillion annual cost of healthcare in the United States.^{1,2} In the majority of cases, hospitalization is necessary and appropriate. However, experts estimate that as many as 20% of hospitalizations are rehospitalizations within 30 days of discharge.^{1,2} These rehospitalizations are costly, potentially harmful, and often preventable. The Pennsylvania Patient Safety Authority received more than 3,500 reports of hospital readmissions from June 2004 through August 2009. According to data from the Agency for Healthcare Research and Quality's (AHRQ) Healthcare Cost and Utilization Project (HCUP), in 2006, nearly 4.4 million hospital admissions, totaling nearly \$30.8 billion, could have been potentially preventable with timely and effective ambulatory care or adequate patient self-management of the condition.³ Additionally, nearly one in five Medicare admissions (18%) was for a potentially preventable condition.³ More recently, in June 2008, the Medicare Payment Advisory Committee (MedPAC) calculated the annual cost of readmissions to the Medicare program at

\$15 billion.⁴ In response to rising healthcare costs, the Obama administration's 2010 budget proposes a combination of incentives and penalties to reduce hospital readmission rates, thereby saving approximately \$26 billion over 10 years to help pay for healthcare reform.⁵

On a national level, the Centers for Medicare & Medicaid Services (CMS) posts 30-day, all-cause, risk-adjusted readmission rates for three conditions on its Web site: (1) heart failure, (2) acute myocardial infarction, and (3) pneumonia. Participating hospitals are classified as "better than U.S. national rate," "no different than U.S. national rate," or "worse than U.S. national rate." Exclusionary criteria include patients readmitted for the purpose of planned cardiac treatment, patients who leave the hospital against medical advice, and hospitals with fewer than 25 cases. These measures are updated quarterly.⁶ Historically, hospitals could only track readmissions back to their own facilities; collecting and sharing multihospital aggregate data may shed new light on the readmission issue. MedPAC has recommended that CMS confidentially report readmission rates and resource use around hospitalization episodes (30-day periods) to hospitals and physicians for two years. Beginning in the third year, providers' relative resource use should be publicly disclosed. To encourage providers to collaborate and better coordinate care, MedPAC believes that payments should be reduced for those hospitals with relatively high readmission rates for select conditions and favors shared financial accountability (gain sharing) between physicians and hospitals.⁴

Jencks et al. conducted a retrospective review of Medicare fee-for-service claims data from October 2003 to September 2004 to analyze Medicare 30-day readmission rates in an effort to describe patterns of readmissions and the relation of rehospitalizations to demographic characteristics of the patients and of the hospitals. Their findings revealed that nearly 20% of hospitalized Medicare beneficiaries were readmitted to the hospital within 30 days and 34% were readmitted within 90 days. Additionally, they found that nearly 69% of patients who had been admitted with a medical diagnosis and 53% of patients who had been admitted with a surgical diagnosis were either readmitted or had died within one year following the initial hospitalization. Surprisingly, *less than half of the Medicare patients who had been readmitted to the hospital within 30 days had visited an outpatient physician before the readmission.* It was estimated that only 10% of the readmissions were likely to have been planned, leaving 90% of the readmissions potentially preventable, at a cost of \$17.4 billion to the Medicare program in 2004.⁷

The Table illustrates the high variability of readmission rates across states. This high variance rate suggests that significant financial savings could be

realized if best practices for preventing unnecessary readmissions were adopted.

In 2007, the Commonwealth Fund studied key indicators of health system performance, including Medicare 30-day readmissions in 2003, and found a two-fold variation in rates of hospital readmission within 30 days among Medicare beneficiaries, from 24% in Louisiana and Nevada to 13% in Vermont and Wyoming. Pennsylvania’s Medicare 30-day readmission rate in 2003 was 20.1%, ranking 43rd of 50 states. If Pennsylvania’s performance improved to the level of the best performing state on this indicator, 13,866 fewer readmissions would occur, saving the Medicare program nearly \$164 million annually.⁸

More recently, Friedman et al. conducted a retrospective review of nearly 1.5 million adult surgery patients initially treated in 1,088 short-stay hospitals in 2004, all at risk for one of nine patient safety events (see the box “Nine Patient Safety Events”).* Their findings showed that patients who experienced one of the nine patient safety events had a higher incidence of hospital 30-day readmissions than those who did not experience a patient safety event (11% versus 16%; risk adjusted result for readmission within one month 1.20 [p < 0.01]).⁹ The connection between patient safety events and hospital readmissions, while not surprising, further complicates the preventable 30-day hospital readmission scenario. Furthermore, 30-day readmission rates have been considered a marker of low quality care and suboptimal patient safety.¹⁰

These recent studies have helped land 30-day readmissions on Medicare’s program-integrity radar screen. In fact, CMS’ program integrity contractors (recovery audit contractors) will continue postpayment audits to identify hospital readmissions within 30 days of a hospital discharge.¹⁰ According to MedPAC’s plan,⁴ once 30-day readmission rates are systematically calculated and analyzed, financial penalties and incentives to reduce 30-day readmissions will follow.

The Pennsylvania Environment

In 2007, Governor Rendell introduced “Prescription for Pennsylvania,” a statewide healthcare reform agenda focused on reducing costs, providing access to universal coverage, improving quality, and decreasing inefficiencies in the Pennsylvania healthcare system. His plan identified avoidable readmissions as an area ripe for both quality improvement and financial savings.¹¹

In Pennsylvania, rates of hospital readmission (i.e., an acute care hospitalization for any reason which occurs within 30 days of the original hospitalization) are calculated for 21 medical and surgical conditions and are published by the Pennsylvania Health Care Cost

* Patient safety events, as specified in software in the public domain by AHRQ. The main data sources are seven state-wide databases of hospitalizations in 2004, maintained by HCUP. (Cited 2009 Sep 21; available from Internet: <http://www.qualityindicators.ahrq.gov/>.)

Table. Rates of Rehospitalization within 30 Days after Hospital Discharge*

| PERCENTAGE RANGE | NUMBER OF STATES IN RANGE |
|------------------|-------------------------------------|
| 13.3% to 17.5% | 13 |
| 17.6% to 19.1 % | 14 |
| 19.2% to 20.1% | 13, including Pennsylvania at 19.7% |
| 20.2% to 23.2% | 10 |

*The rates include all patients in fee-for-service Medicare programs who were discharged between October 1, 2003, and September 30, 2004.

Source: Jencks SF, Williams MV, Coleman EA, et al. Rehospitalizations among patients in the Medicare fee-for-service program. *N Eng J Med* 2009 Apr 2;360(14):1418-28.

Containment Council (PHC4).¹² Rates are calculated for all-cause readmissions and readmissions for complications or infections. They are categorized by condition into “significantly higher than the expected rate,” “not significantly different than the expected rate,” and “significantly lower than the expected rate.” Exclusionary criteria include hospitals with less than five cases, nonadult cases, and missing or invalid discharge status, as well as patients who leave against medical advice.

In 2008, there were 57,852 readmissions for any reason in the categories covered by the report. These readmissions resulted in nearly \$2.5 billion in charges and 350,000 additional hospital days. Thirty-eight percent (22,094) of the readmissions were for complication or infection, amounting to approximately \$1.1 billion in charges and 157,000 additional hospital days.¹³ For the 21 conditions for which readmissions are calculated, the overall Pennsylvania readmission rate was 18.9%; respiratory failure with mechanical ventilation was the highest at 27.6%, and vaginal hysterectomy was the lowest at 3%. (For a visual summary of the background information, see “Timeline of 30-day Avoidable Readmission Information,” available on the Authority’s Web site.)

Authority Data

The Authority received more than 3,500 reports related to readmissions from June 2004 through August 2009. However, this is just the “tip of the iceberg,” as only readmissions associated with Incidents or Serious Events are reported in the Authority’s database. For example, 1,791 events of “unplanned return to emergency department (ED) in 48 hours requiring admission” were reported between June 2004 and August 2009.

The Authority reviewed 392 events related to hospital readmissions reported from January through August 2009, 120 of which were reported as Serious Events (those events which harm patients) (31%) and 272 of which were reported as Incidents (near-misses) (69%). Common themes among the hospital readmission reports included ineffective communication

Nine Patient Safety Events

1. Iatrogenic pneumothorax
2. Selected infections due to medical care
3. Postoperative hemorrhage or hematoma
4. Postoperative physiologic and metabolic derangements
5. Postoperative respiratory failure
6. Postoperative pulmonary embolism or deep vein thrombosis
7. Postoperative sepsis
8. Postoperative wound dehiscence after abdominopelvic surgery
9. Accidental puncture or laceration

Source: Friedman B, Encinosa W, Jiang HJ, et al. Do patient safety events increase readmissions? *Med Care* 2009 May;47(5):583-90.

among providers, between providers and patients, and between providers across healthcare settings and inadequate transitions of care, both within hospitals and between hospitals and community settings. The report narratives reveal the breadth of reasons why patients experience potentially preventable readmissions.

Ineffective Communication

Examples of ineffective communication among providers include the following:

A patient was admitted from a nursing home with a four-page list of medications. The admitting diagnosis was dehydration and vomiting. The triage nurse listed all medications on the ED triage form. The admitting nurse completing the medication reconciliation missed one page of the patient's nursing home medications. The admitting physician listed all of the medications in the [history and physical] but did not add to the ED physician orders to include any cardiac medications. At discharge, a covering physician who was sending the patient back to the nursing home reviewed the medication reconciliation list and did not order any cardiac medications. The nursing home considered the medications discontinued. The patient was [subsequently] readmitted to the hospital in congestive heart failure.

Amylase/lipase [levels were] highly elevated, and the patient was discharged. The patient had to return to the ED; no phone call for critical value was received while the patient was registered in the ED.

Examples of ineffective communication between providers and patients include the following:

The patient was admitted to the ED for an animal bite. Rabies prophylaxis was initiated in the ED. The patient was admitted. Later, the patient was discharged home without plan to continue rabies booster . . .

Patient discharged; readmitted one week later. During the admission assessment, it was discovered that patient had [had] no anticoagulant education [during previous admission].

The patient had a transurethral resection of the prostate and was ordered an antibiotic postoperatively. The patient never took the ordered medication, which contributed to a readmission due to back pain. The patient was found to have an UTI [urinary tract infection].

An example of ineffective communication between providers across healthcare settings is as follows:

The patient met discharge criteria and was discharged to a personal care home after leg surgery. He fell at the personal care home and was sent back to the hospital [the next day]. The physician from the personal care home stated he did not think a return to the home should have occurred on a Saturday because the home did not have licensed staff on the weekend.

Ineffective Transitions of Care

Examples of ineffective transitions of care within hospitals include the following:

A patient was transferred from the medical surgical unit to the inpatient rehab center in the mid-afternoon. The patient was sent to the ED that evening with shortness of breath and hypoxia. The patient was readmitted to facility secondary to the respiratory condition. The event was reviewed, and staff confirmed that the patient was receiving oxygen at 4L/min via nasal cannula prior to discharge. Oxygen was omitted on the transfer orders to the rehab facility.

A patient was admitted to the ED with an overdose. The patient was treated and admitted to the intensive care unit (ICU). When stable, the patient was transferred to the inpatient mental health unit. The patient was in a gown at the time of transfer. The patient's belongings were searched. Later, the patient was found unresponsive on the floor of her room, with shallow respirations. 911 was called, and the patient was given Narcan® and transferred to the ED. The patient was treated and readmitted to the ICU.

Examples of ineffective transitions of care between hospitals and community settings include the following:

A patient was transferred to long-term care from acute care without oxygen; oxygen saturation was 46% on room air. The patient had been on oxygen at the acute care facility. Rebreather mask and respiratory treatments were given; oxygen saturation was 87% after one hour. The patient became confused. The physician determined that the patient was medically unstable and gave orders to transfer the patient back to acute care. The patient was readmitted there. The patient was transferred to us [long-term care] again without oxygen and only partial medical records . . .

A patient was seen in the ED for evaluation of syncope. Labs revealed blood urea nitrogen of 85 and creatinine of 5.2. . . CT [computed tomography] scan of the head was negative. Patient sent home alone [emphasis added]. The patient returned to

the ED [one day later] in acute renal failure with rhabdomyolysis following a fall at home. The patient was unable to get up and was found by family on the floor. A large surface pressure ulcer was noted.

A patient was seen in the ED after a fall. The patient complained of knee pain and had x-rays done of the right knee and lower leg. The x-rays were normal. The patient was in pain and unable to ambulate. The patient was discharged and sent home by ambulance. The patient returned to the ED two days later with continued right leg pain and was x-rayed and found to have a fractured hip that required surgical care.

Of the 392 events related to hospital readmissions reported from January through August 2009, four root-cause analyses (RCAs) were completed and forwarded to the Authority, three of which indicated that “communication among staff members” was the root cause of the failure. If more RCA information related to readmissions were routinely submitted by facilities, the Authority would be better able to provide analysis of the causes of some of these events.

Barriers to Successfully Reducing Hospital Readmissions

Clearly, hospital readmissions are costly, and both federal and state agencies are interested in reducing 30-day readmission rates in an effort to save health-care dollars. With policy makers focused on reducing healthcare costs and improving patient safety, 30-day readmission rates are an area of improvement that no Pennsylvania facility can afford to ignore.

One major barrier to reducing hospital readmissions is misalignment of financial incentives. While reducing readmissions saves money for insurers and payers, there is no financial incentive for hospitals to decrease utilization. The current fee-for-service payment system not only encourages patient admissions, it also encourages silos among healthcare providers, creating barriers to effective communication and care coordination across care settings.

An anecdotal example from Pennsylvania follows:

An elderly patient fell going up some outdoor concrete steps with his wife, hitting his head. He complained of dizziness. He was taken to his local hospital, where he was given a CT scan and admitted on the service of his primary care physician, a cardiologist. The wife understood that he had “blood in his brain.” His primary physician discontinued his Coumadin® and started aspirin. His wife did not know why he had been on Coumadin. He continued to complain of dizziness. He was discharged back to the skilled nursing facility in his retirement community.

After discharge from the skilled nursing facility, he got dizzy and fell again. He was readmitted to the hospital on the service of his cardiologist with a “fracture of the pelvis,” according to his wife. She was unaware of the treatment recommended

by the orthopedic consultant. He was discharged back to the skilled nursing facility. A nursing assistant helped him out of bed, and he complained of pain in his groin. She called the geriatrician, who sent him back to the ED of the hospital.

The emergency physician confirmed that the pain was from the fracture, which remained stable, and sent him back to the skilled nursing facility with confirmation that weight bearing as tolerated was appropriate. Later, he was found to have a high blood sugar (about 500 mg/dl) and was sent back to the ED, where he was noted to also be dehydrated. He was readmitted to the service of his cardiologist, who changed his diabetes medications. He was sent back to the skilled nursing facility but returned to the hospital the next day, again with high blood sugar. The cardiologist had dictated a note to the geriatrician, but the note had not arrived, and the patient had been put on the same diabetes medication regime that he had been on previously. The patient went on to develop decubiti that took months to heal. He eventually became a permanent resident of the skilled nursing facility within the retirement community.

In the above example, each facility appropriately cared for the patient and treated his medical condition, yet the over-arching care plan failed. Because there is no payment structure to absorb the cost of care plan management across care settings, this important task is frequently missed or poorly performed.^{4,7} In the U.S. healthcare environment, few built-in safeguards identify and rectify failures spanning more than one healthcare setting. In Pennsylvania, the Authority is unlikely to receive reports referencing fragmented care, because no mechanism exists to track readmissions across facilities. Nonetheless, poorly executed transitions in care, whether interhospital transfers or transfers between healthcare settings, can negatively affect patients’ health and well-being and often result in avoidable readmissions to the hospital.

Success Stories

National Success: Reducing Readmissions by Improving Transitions in Care Collaborative

In fall 2009, the Institute for Healthcare Improvement began a four-year multistate initiative to measurably reduce hospital readmissions. The Reducing Readmissions by Improving Transitions in Care Collaborative focuses on creating an ideal transition for patients from hospital to home. The aim of this collaborative is to reduce 30-day readmission rates by 30% and increase patient and family satisfaction with optimal transitions and coordination of care. This collaborative focuses on four major areas of risk reduction: (1) performing enhanced admission assessments, (2) providing effective teaching and enhanced learning, (3) conducting real-time patient- and family-centered handover communication, and (4) ensuring posthospital care follow-up.¹⁴ This initiative is one of

several successful care models designed to reduce hospital 30-day readmission rates.

National Success: Project Reengineered Discharge (RED)

A randomized controlled trial in a general medical service at an urban, academic, safety-net hospital to test the effects of interventions designed to minimize hospital utilization after discharge showed that participants in the discharge intervention group (n = 370) had a lower rate of hospital utilization than those receiving usual care (n = 368) (0.314 versus 0.451 visit per person per month; IRR 0.695 [95% CI, 0.515 to 0.937]; p = 0.009).¹⁵ Interventions included a nurse discharge advocate (DA) who worked with patients in the hospital to arrange follow-up appointments, confirm medication reconciliation, and conduct patient education using “teach-back” methodology for patient-centered education. The nurse DAs also used an individualized instruction booklet (an after hospital care plan), a copy of which was sent directly to the primary care provider at discharge. A clinical pharmacist was an integral part of the discharge team, as well, and called the patient two to four days after discharge to reinforce the discharge plan and to review medications with the patient. Key success factors in the handoff between hospital and home were (1) using a plan that the patient understood, (2) putting it in writing, and (3) bridging gaps between the hospital doctors and the patient’s doctor in the community. Project RED showed that bundled interventions including patient-centered education, comprehensive discharge planning, and postdischarge reinforcement worked to decrease postdischarge hospital utilization (combination emergency room admissions and hospital readmissions) within 30 days of discharge by approximately 30%.¹⁵

Local Success: Geisinger Health System

Geisinger Health System (Danville, Pennsylvania) has realigned financial incentives for care, thereby minimizing variance and reducing costs by implementing a medical home concept. The medical home concept focuses on personal care coordination by shifting from episodic acute care to a continuous, comprehensive team approach to care, called ProvenHealth Navigator, which uses financial incentives to alter the care model. Payments are made to physicians for a variety of actions that contribute to a more cohesive treatment process, including seeing patients more often, seeing them during off-hours, and playing a more direct role in coordinating care throughout the system. Internists, surgeons, and specialists are paid for adherence to evidence-based medical guidelines in the treatment of chronic diseases and other illnesses. Additionally, physicians are rewarded for collecting and managing patient data, which allows trends to be identified and analyzed. Simultaneously, Geisinger has changed the way it charges payers. For example, for a number of surgeries, costs are bundled into a single flat fee. If the patient experiences complications or needs additional treatment within 90 days, the system covers the costs. This innovative financial architecture has resulted in

a decrease in the system’s readmission rate by 44% as well as the decline of overall treatment costs.^{16,17}

Planning for the Future

A 2009 Cochrane systematic review to determine the effectiveness of in-hospital discharge planning of patients moving from hospitals to outpatient settings failed to show an associated reduction in readmission rates. Specifically, the review pooled data from seven randomized controlled trials that recruited elderly patients with a medical condition and reported readmission rates at up to three months of discharge from the hospital. The review failed to detect a difference between those allocated to discharge planning and the control group, with respect to hospital readmission rates (OR 0.91, 95% CI to 0.67 to 1.23).¹⁸ However, as the above examples illustrate, other studies have shown significant reductions in 30-day readmission rates, as well as cost savings, associated with a variety of enhanced discharge processes, most of which used a combination of enhanced in-hospital communication plus improved discharge processes, postdischarge care coordination, and restructured financial incentives.

The State Action on Avoidable Rehospitalizations (STAAR)* Initiative identified several potential reasons for high hospital readmission rates, including the following: quality of care issues in the initial hospitalization, lack of access to physicians to receive follow-up care following the initial hospitalization, hospital admission norms that discourage treatment in other care settings, home healthcare access and quality, effective discharge planning, breakdowns in transitions of care between settings, and nursing home access and quality.¹⁹ Hospitals can assess the characteristics of their readmission population to determine which of these factors may be influencing their readmission rate and to determine how many of their readmissions are potentially preventable.

Strategies to Reduce 30-Day Hospital Readmission Rates

The STAAR Initiative reviewed the medical literature and identified five promising, evidence-based strategies to reduce readmissions:¹⁹

1. **Comprehensive discharge planning with timely communication.** Thorough preparation of the patient and family for discharge is important. Having a strong transition plan, prompt postdischarge communication, and follow-up care can significantly reduce rehospitalizations.²⁰
2. **Postdischarge support.** Early, post-acute follow-up care by transition coordinators, coaches, telephone nurses, or clinicians has been shown to reduce readmissions.²¹⁻²³
3. **Multidisciplinary, team-based management.** Multidisciplinary heart failure management programs have shown a decrease in hospital

* An initiative of the Commonwealth Fund and the Institute for Healthcare Improvement, launched May 1, 2009.

admissions.²⁴ For example, the Program for All-Inclusive Care for the Elderly (PACE) provides comprehensive, interdisciplinary care through an adult day-care center coupled with PACE teams that provide care in the hospital, nursing home, or home, as needed.²⁵

4. **Patient education and self-management support.** Developing a commonly understood care plan that contains instructions for medications, diet, activity level, and identification of signs of disease progression is a critical part of the discharge process. Providing the patient with a nurse educator for one hour as an adjunct to the normal discharge process can reduce the risk of rehospitalizations or death.²⁶
5. **Remote monitoring.** Remote monitoring uses a variety of modalities to track patients' health and well-being in order to identify early signs of clinical deterioration. Used in conjunction with other support systems, remote monitoring can help patients remain in their homes and avoid rehospitalizations.¹⁹

In light of impending national- and state-level policy changes, Pennsylvania hospitals can and should evaluate their 30-day readmission rates and formulate both short- and long-term plans to reduce these rates while simultaneously working toward improving integrated, patient-centered care. Following is a list of potential strategies that hospitals can implement now, and into the future, depending upon available financial and human resources.

Immediate

Environmental Scan^{4,10,14,18}

- Collect monthly data related to readmission rates to track organizational performance, and compare performance data with national and state benchmarks available online from <http://www.hospitalcompare.hhs.gov> and <http://www.phc4.org>.
- Develop a plan related to the proposed or potential financial impact of the alternatives being discussed for Medicare readmissions (e.g., financial incentives, disincentives, bundling).
- Survey community healthcare resources including primary care physicians, home healthcare services, assisted living, and nursing home or long-term care facilities. Does each of these facilities send patients to the hospital? Are they associated with a portion of the readmissions? Is there a way to collaborate with these entities to improve care transitions across healthcare settings?

In-Hospital Assessment: Enhanced Admission Assessments^{10,14,20}

- Ask patients about previous admissions; document any admission occurring within 30 days of a previous hospital discharge (from your facility or from another facility). If the patient was previously admitted within

the past 30 days, ask questions to determine the reason for the readmission. Did the patient:

- Understand discharge instructions?
- Take medications correctly?
- Have adequate home resources?
- Follow self-care instructions?
- Understand the signs of clinical deterioration to report to the primary physician?
- Seek medical follow-up after discharge from the hospital?
- Consider a dedicated transitional coach to perform enhanced admission assessments, focusing on post-discharge needs as soon as possible.¹⁵
- Include the patient and family in the discharge process, and be vigilant in assessment of the support systems available in the postacute care setting.
- Perform a thorough physical and cognitive functional health status assessment to identify the appropriate postacute care setting for the patient.
- Refer the patient to appropriate community resources (e.g., home care, assisted living, long-term care).
- Provide evidence-based and error-free care for the patient in the hospital.

In-Hospital Assessment: Effective Teaching and Enhanced Learning¹⁴

- Identify the “learners” on admission by asking, “Who will be helping you when you leave the hospital?” Realize that the patient’s visitors may not be the designated “learners.”
- Use customized, individualized discharge instructions that incorporate health literacy principles, written at a literacy level that does not exceed patient comprehension.^{10,14} Health literacy principles include using simple one-to-two syllable words written in a font size of 14 points, short four-to-six word sentences, and short two-to-three sentence paragraphs without medical jargon and with abundant white space.
- Use a “teach-back” method to ensure patient understanding of discharge and follow-up care instructions. Ask patients in a nonjudgmental way to discuss what they have learned, identify gaps in understanding, and offer additional instruction as needed.
- Develop a plan of care that follows the patient home and/or to the next care setting.

In-Hospital Assessment: Real-Time Patient and Family Centered Handover Communication^{4,10,14,15,23}

- Reconcile the patient’s medication on admission to the hospital and at each transition of care (in-hospital and across care settings).
 - If the patient’s prescription medications have changed, clearly document and instruct the patient about the changes, identifying those medications and doses that the patient should take now.

- If the patient’s medications have been held during the hospital admission, clarify if and when those medications should be continued.
- Assess whether a home care nurse or transitional care nurse or coach should reconcile the medications during a home visit with the patient after discharge.
- Send the patient home with a copy of the plan of care, and share the care plan with the primary physician, home healthcare agency, or long-term care facility that will be accepting the patient into care.
- For dialysis patients, send a copy of the plan of care, including the reconciled medication list, to the nephrologist at the dialysis center.
- Improve coordination of care between hospitals and primary care physician offices, home health-care agencies, assisted-living facilities, or other outpatient settings by faxing or e-mailing discharge summaries directly to primary care offices, mailing discharge packets, or using a community discharge planner to facilitate the timely transfer of discharge information.
- Make the initial outpatient appointment for the patient before he or she leaves the hospital. A primary care physician should see patients with a significant chronic disease within one week of discharge.
- Speak with the “emergency contact” listed in the patient record, and give an accurate, up-to-date report of the patient’s condition.

Posthospital Care Follow-Up^{4,14-16,19}

- Consider implementing a follow-up telephone call from a pharmacist, nurse, or transitional care staff member one to three days after discharge from the hospital to confirm understanding of all discharge instructions and prescribed medications.
- Establish an emergency call number at the hospital to help patients until their primary care physicians take over.
- Assess the patient’s home environment to evaluate self-reported ability to manage healthcare needs independently, and refer supplemental services as needed.

Future

- Investigate relationships with primary care physicians, home care agencies, or other community service providers to establish collaboration across the care continuum.^{4,14,16}
- Work toward establishing an integrated system of care across multiple care settings with shared accountability for patient-centered care and the ability to communicate, review each other’s work, and collaborate to deliver consistently high-quality, patient-centered care.
- Establish data collection criteria and share readmission information within the community of providers.
- Consider establishing a common care plan used across care settings, and shared patient educational materials, as well as a nurse who travels to outpatient

physician settings to facilitate transfers of care and information.

- Investigate integrated electronic health records and remote monitoring technology to share real-time clinically relevant patient medical information across the care continuum.

(A recently released guide from the Health Research and Educational Trust provides an overview of strategies and interventions hospitals can implement during hospitalization, at discharge, and postdischarge. The guide is available online at http://www.hret.org/hret/programs/content/Readmission_Guide.pdf.)

Conclusion

All-cause readmission rates highlight the importance of understanding factors that influence rehospitalization. There is extensive literature on rehospitalization related to medical conditions; less so for studies analyzing the multiple diseases and processes that contribute to hospital readmissions.⁷ A review of the literature and success stories points toward two major processes that, if improved, can help decrease 30-day readmission rates: (1) improved communication among providers within and across care settings and (2) enhanced transitional care processes including postdischarge intervention. Additionally, financial incentives and disincentives have proven effective in decreasing avoidable readmissions, and both federal and state policymakers have focused on restructuring hospital payments as one way to reduce avoidable readmissions. Geisinger Health System is one example of a Pennsylvania healthcare system that has reduced hospital readmissions by restructuring both its payment and clinical care models.

Improving healthcare delivery means eliminating barriers between silos of service and information that have dominated healthcare to create a seamless, human-centered, and more cost-effective delivery system.¹⁶ The risk reduction strategies in this article allow facilities to begin gradually reducing readmissions with simple, cost-effective strategies and move to more fiscally challenging strategies as the financial incentives to do so evolve.

Notes

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Medication Errors with the Dosing of Insulin: Problems across the Continuum

ABSTRACT

Controlling blood sugars with insulin is essential in the management of hyperglycemia in both diabetic and nondiabetic patients. However, studies have shown that the use of insulin has been associated with more medication errors than any other type or class of drug. From January 2008 to June 6, 2009, Pennsylvania healthcare facilities submitted 2,685 event reports to the Authority that mentioned medication errors involving the use of insulin products. The most common types of medication error associated with insulin were drug omission (24.7%) followed by wrong-drug errors (13.9%). More than 52% of the reported events led to situations in which a patient may have or actually received the wrong dose or no dose of insulin (e.g., dose omissions, wrong dose/overdosage, wrong dose/underdosage, extra dose, wrong rate errors), which could lead to difficulties in glycemic control. Strategies to address these problems include limiting the variety of insulin products on the organization's formularies, developing standardized protocols and a standard format for prescribing insulin, avoiding the use of abbreviations or other shortcuts when communicating orders for insulin, and requiring an independent double check of all doses before dispensing and administering intravenous insulin. (Pa Patient Saf Advis 2010 Mar;7[1]:9-17.)

Introduction

An estimated 23.6 million Americans (nearly 8% of the U.S. population) have diabetes mellitus. In 2007, approximately 17.9 million people have been diagnosed with the disease, and 5.7 million remain undiagnosed.¹ Among adults diagnosed with type 1 or type 2 diabetes, 14% take insulin only, 13% take both insulin and oral medication, 57% take oral medication only, and 16% do not take either insulin or oral medication.²

Glycemic control is fundamental to the management of diabetes. Insulin is used to control blood sugars in both diabetic and nondiabetic patients. For example, it is used to manage hyperglycemia in intensive care unit (ICU) patients, a common finding caused by insulin resistance in the liver and muscle tissue. Some have considered insulin resistance to be an adaptive response, providing glucose for the brain, red blood cells, and wound healing.³

Due to a number of conflicting published studies, there has been an increased effort to determine the benefit of tightly controlled blood glucose levels, both in diabetic and nondiabetic patients. For example, in a large, single-center study of postoperative surgical patients, an initial investigation by van den Berghe et al. suggested that controlling blood glucose levels by intensive insulin therapy decreased mortality and

morbidity in critically ill surgical patients.⁴ The study design employed a continuous infusion of insulin to maintain blood glucose between 80 mg/dL and 110 mg/dL. Patients receiving intensive insulin therapy were found to be less likely to require prolonged mechanical ventilation and intensive care. Also, rigorous insulin treatment reduced the number of deaths from multiple-organ failure with sepsis, regardless of whether there was a history of diabetes or hyperglycemia.

The NICE-SUGAR study evaluated whether there was a difference in mortality between subjects randomly assigned to either intensive glucose control (target blood glucose range of 81 mg/dL to 108 mg/dL) or conventional glucose control (target of 180 mg/dL or less).⁵ The study showed that the odds of dying with intensive control were 1.14 times greater than with conventional control. In addition, severe hypoglycemia (blood glucose level of 40 mg/dL) occurred in 6.8% of the intensive-control group and 0.5% in the conventional-control group. The NICE-SUGAR study also demonstrated that there was no significant difference between the two treatment groups in the median number of days in the ICU or hospital or in the median number of days of mechanical ventilation or renal-replacement therapy.

In a meta-analysis of randomized controlled trials of tight glucose control versus usual care in critically ill adults, the authors found no significant difference in hospital mortality or new need for dialysis. Although tight glucose control was associated with a significant reduction in septicemia overall, subgroup analysis suggested this benefit was limited to surgical ICU patients. Conversely, they found clear evidence that hypoglycemia increased roughly fivefold, regardless of the ICU setting, and was more common with patients receiving very, rather than moderately, tight glucose control.⁶

For many years, literature has shown that the use of insulin has been associated with more medication errors than any other type or class of drug. Cohen et al. reported in 1998 that 11% of harmful medication errors result from insulin misadministration.⁷ The U.S. Pharmacopeia MEDMARX 2008 data report showed that insulin was the leading product involved in harmful medication errors (i.e., National Coordinating Council for Medication Error Reporting and Prevention [NCC MERP] harm index⁸ E to I), representing 16.2% of all harmful medication error reports.⁹ In 2004, the Pennsylvania Patient Safety Authority established that 25% of all medications errors reported involve high-alert medications, and 16.3% involved insulin products.¹⁰ This article presents analysis of events involving insulin products reported to the Authority during an approximately 17-month period and describes the most common types of errors

involving the use of insulin, as well as those events that could contribute to uncontrolled blood sugars.

A Look at the Numbers

Pennsylvania healthcare facilities submitted 2,685 event reports to the Authority from January 2008 to June 6, 2009, that mentioned medication errors involving the use of insulin products. Categorization by harm score, which is adapted from the NCC MERP harm index,⁸ shows that 78.7% (n = 2,113) of the events reached the patient (harm index = C to I) and 1.8% (n = 49) of the events resulted in patient harm (harm index = E to I). The care areas most often cited in these reports include medical/surgical units (22.3%, n = 599), pharmacy (8.7%, n = 234), and telemetry (7.1%, n = 191). Roughly 53% (n = 1,434) of the events involved elderly patients (ages 65 years and older), while 1.7% (n = 46) involved pediatric patients (ages younger than 17 years).

The predominant medication error event types associated with insulin (see Table) were drug omission (24.7%, n = 662) followed by wrong drug (13.9%, n = 374) and wrong dose/overdosage (13%, n = 348). More than 52% (n = 1,409) of the reported events led to situations in which a patient may have or actually did receive the wrong dose or no dose of insulin (e.g., dose omissions, wrong dose/overdosage, wrong dose/underdosage [5.1%, n = 137], extra dose [8.5%, n = 227], wrong rate [1.3%, n = 36]), which could lead to fluctuations in glycemic control.

Wrong-Drug Errors Associated with Insulin Products

There are numerous case reports in the literature that discuss the issue of wrong-drug medication errors with insulin products due to similarities in the brand and generic names, as well as similarity in labeling and packaging.¹¹⁻¹⁴ The Authority has noted mix-ups between names occurring in Pennsylvania facilities (e.g., Humalog® and Humalog 75/25, Humalog and Humulin® R, Humalog 75/25 and Humulin 70/30, Novolog® and Humalog, Novolog 70/30 and Novolin® 70/30).¹⁵

During review of the wrong-drug medication errors, analysts found that facilities did not enter the actual name of the insulin products consistently into the reports. In fact, 70% (n = 262) of the submitted reports did not list a specific insulin product (e.g., “insulin,” “regular insulin,” “NPH insulin,” “insulin 70/30”) or listed names of products that do not exist (e.g., “Humalog 70/30,” “Humalog R,” “Humulin 75/25”). This imprecise data collection limits individual facilities and the Authority from accurately determining the most common pairs of insulin products involved in wrong-drug errors. In addition, many of these reports did not specifically state why the error occurred or what went wrong that led to the patient receiving the wrong insulin product. Therefore, it was not possible to determine the most common types of wrong-drug errors that occurred (e.g., wrong drugs that may have been written by prescribers, selected during order entry, mislabeled in the pharmacy, wrongly pulled from stock). Analysts were able to determine the following:

- Seventy-five (20%) reports of wrong-drug insulin errors specifically mention that the breakdown occurred when retrieving the medication, for example, from stock or an automated dispensing cabinet (ADC). Specifically, 28 reports (37.3% of stock errors) mentioned the use of overrides to obtain the insulin product from an ADC.
- Sixty-nine (18.4%) of wrong-drug insulin errors involved mix-ups between a rapid acting insulin (e.g., Novolog, Humalog) and regular insulin (e.g., Novolin R, Humulin R, regular insulin).
- Sixty-five (17.4%) reports of the wrong-drug events specifically identified that the error occurred during the prescribing node. Most of these reports involved the clarification of nonspecific (e.g., a specific insulin product was not indicated) orders, such as the following:

The physician wrote an order for “Novolin 18 units bid.” The order was not clarified when taken off, and regular insulin was given for two doses. When the physician came in the following day, the order was clarified, and he ordered Novolin N insulin. The patient was given two doses of Novolin R.

Intravenous (IV) administration of insulin has some advantages over subcutaneous administration, namely (1) more rapid onset of effect in controlling hyperglycemia, (2) more overall ability to achieve glycemic control, and (3) improved nonglycemic patient outcomes.¹⁶ During IV insulin infusion to control hyperglycemic crises, hypoglycemia, if it occurs, is short-lived; however, repeated administration of subcutaneous insulin may result in “stacking” the insulin’s effect, causing protracted hypoglycemia.¹⁶

The stability of an IV insulin infusion is 24 hours and requires the production of insulin infusions by pharmacy when ordered. Unless this infusion is distinguished with highlighting or a prominent sticker, an insulin infusion will resemble other pharmacy-prepared infusions. Of the wrong-drug errors involving insulin reported to the Authority, infusion bags

Table. Predominant Medication Error Event Types Associated with the Use of Insulin (N = 2,057, 76.6%), January 2008 to June 6, 2009

| EVENT TYPE | NUMBER | % OF TOTAL REPORTS (N = 2,685)* |
|------------------------|--------|---------------------------------|
| Dose omission | 662 | 24.7% |
| Wrong drug | 374 | 13.9% |
| Wrong dose/overdosage | 348 | 13% |
| Other (specify) | 309 | 11.5% |
| Extra dose | 227 | 8.5% |
| Wrong dose/underdosage | 137 | 5.1% |

* Sum of percentages exceeds 76.6% due to rounding.

containing insulin were mentioned in 9.4% (n = 35) of the cases. Nearly 88.6% (n = 31) of these reports reached the patient, and 11.4% (n = 4) resulted in patient harm. Patients accidentally received insulin instead of a noninsulin-containing infusion (e.g., antibiotics) in 60% (n = 21) of these wrong-drug, infusion-related reports. Examples are as follows:

An IV insulin bag was hung when replacing the patient's Versed® (midazolam) bag. Two bags of insulin were then hanging, one at rate of 8 (Versed rate) and one at 5 (insulin rate). A [mid-afternoon] accuracy check showed that the [blood glucose] level decreased to 36. D50 was administered as per protocol, and the insulin drip was turned off. The wrong-bag error was found at [the next] change of shift.

A patient was ordered IV Lasix® (furosemide), as well as IV insulin. The nurse meant to hang the IV Lasix but [before midnight] hung a bag of IV insulin instead. The patient already had an insulin infusion running. Approximately [four hours later], the patient was noted to be hypoglycemic. Both IV drips were turned off at that time, and the patient was given 50 ml of 50% dextrose. The RN [registered nurse] still believed that one of the IV drips was Lasix at this time. Four hours later, the oncoming RN was checking and verifying the patient's IV drips and discovered the error. The patient required several more doses of 50% dextrose throughout the morning to correct episodes of hypoglycemia.

Wrong-Dose Errors with Insulin

Analysis of events that resulted in patients receiving a type of wrong dose (e.g., wrong dose/overdosage, wrong dose/underdosage, extra dose) reveals a variety of breakdowns that occurred in the medication-use process, including problems with insulin coverage orders, ambiguous orders written by prescribers, transcription and order-entry errors, the obtainment and/or use of the incorrect blood glucose value of the patient, and the ways in which information about insulin products is displayed on pharmacy labels and medication administration records.

About 10.4% (n = 36) of the wrong dose/overdosage events reported to the Authority involved a tenfold overdose of insulin.

Insulin Coverage Orders

The Diabetes Control and Complications Trial, a prospective, randomized controlled trial of intensive versus standard glycemic control involving inpatients with relatively recently diagnosed type 1 diabetes, showed that improved glycemic control is associated with significantly decreased rates of microvascular (retinopathy and nephropathy) as well as neuropathic complications.¹⁷ This led to the recommendation that type 1 diabetes be treated by using multiple insulin injections (three to four injections per day of basal and prandial insulin) as well as by matching the dose of prandial insulin to carbohydrate intake, pre-meal blood glucose, and anticipated activity.

However, the use of multiple-dose injections of insulin throughout the day has added complexity to

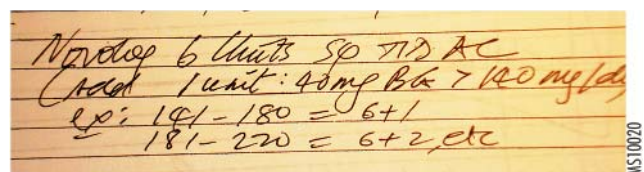
controlling a patient's blood glucose. For example, correction doses, sometimes referred to as "coverage" or erroneously as "sliding scales," are used to adjust glucose levels around mealtimes. Organizations often have multiple algorithms for correction doses, such that a facility may have "low dose," "medium dose," and "high dose" algorithms that require the nursing staff to obtain and document each patient's blood glucose reading, determine the patient's ordered algorithm, and then select the proper dose based on the blood glucose reading.

The predominant theme mentioned in reports of wrong-dose events involves the dosing of insulin based on a range of blood glucose values with a corresponding coverage dose, determined by a patient's blood glucose reading. Of the wrong-dose errors submitted to the Authority (n = 712), 26% (n = 185) mention coverage or sliding scales. (Many events reported to the Authority used the phrase "sliding scale" in the narratives to denote the method used to determine the dose of insulin to administer to patients. While this term may be used in place of "correction dose" or "coverage," it should be noted that sliding-scale insulin regimens used *alone* are ineffective and potentially harmful. When using subcutaneous insulin injection therapy, scheduled or standing insulin regimens should be the standard of care.¹⁸⁻²¹) As mentioned previously, this recommended method of maintaining tight control of a patient's blood sugar, regardless if the patient is diabetic or not, adds complexity to the medication-use process for all healthcare practitioners.

One problem often seen with coverage orders is the clarity of handwritten orders from physicians, a particular problem when an organization does not have a standardized protocol or order form to order insulin, including the type of coverage (e.g., low, high). Adding to the complexity of these orders are the multiple values often used for multiple ranges of blood sugars. Problems have also occurred when shortcuts are taken when writing these types of orders for insulin. For example, orders have been written stating doses of insulin as "6+1" or "6+2" instead of writing out "7" or "8" (see Figure 1).

Once these complex orders have been written, problems have occurred when transcribing the orders to medication administration records (MARs) or entering them into computerized order-entry systems. Errors also have occurred when selecting the blood glucose range, dose, or algorithm from a pharmacy label, a handwritten MAR, or a computer-generated

Figure 1. Example of Ambiguous Insulin "Coverage" Order



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MAR (see Figure 2). Pennsylvania facilities are experiencing these types of errors as evidenced by these events reported to the Authority:

A patient was ordered insulin on sliding scale level 2, but the order was transcribed incorrectly on the MAR as sliding scale level 1. The patient received two doses at level 1 coverage instead of level 2. The error was found during the 24-hour MAR check.

A patient was changed from high-dose sliding scale coverage to moderate dose. Order was transcribed onto medication sheet as bedtime coverage, but original order was for no bedtime coverage. Patient received four units of insulin.

Ambiguous Orders Written by Prescribers

There has been much written about problems with handwritten orders for insulin, including the use of dangerous abbreviations or dose expressions and other shortcuts when communicating orders. How the use of the letter “U” to abbreviate “unit” has contributed to medication errors has been discussed for several decades.²² Errors that have occurred when using “U” for unit have resulted when the “U” resembles the number “0” or “4.” Reports to the Authority reveal similar examples of wrong doses due to the use of shortcuts when writing orders for insulin.

Intern wrote order for 8 U of insulin, which was transcribed as 80 units of insulin.

Order written by the doctor as “ss insulin 10u tid Novolog.” The order should have been clarified but was not and should have been written according to abbreviation policy. The order was transcribed as “Novolog 10 Units TID,” but the order was intended to be “Sliding Scale Low TID.”

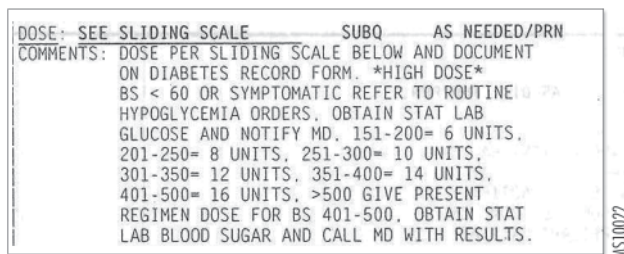
The physician wrote “ss” for sliding scale, and the staff transcribed the order as “55 units.” The error was caught prior to administration.

Order on chart is for Humalog 4 units, but it had said 5 units, and the 5 was crossed off, and the 4 was placed in front of the crossed-off 5. Therefore the order appeared to say 45 units and was placed in by pharmacy . . . and verified by the nurse as 45 units. The chart was reviewed due to the very high dose of Novolog to be given, and it was found that the 5 was crossed off. The pharmacy was called, and they corrected the dose.

Although writing out the complete word “units” is the recommended alternative to using the abbreviation “U,” be aware that tenfold overdoses may still occur when writing the word “unit(s),” particularly when there is inadequate white space between the dose number and the word (see Figure 3). Examples reported to the Authority include the following:

A patient was admitted to the ED [emergency department] after [the patient’s] morning insulin had been administered. The ED completed medication reconciliation documentation, including “insulin 7units.” The resident referred to the written medication reconciliation document, perceiving the insulin dose to read “70units.” Resident ordered Lantus 70 units bid, and the pharmacy verified the order. The patient was

Figure 2. Example of “Coverage” Order Complicated Directions on a MAR



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transferred, and the nurse administered the evening dose of Lantus 70 units as ordered, with appropriate double check. The patient later questioned dose, stating “I take 7 units.”

A patient was ordered “20 units Lantus q 24hr.” The pharmacist misread the order and transcribed the order onto the MAR as “Lantus 200 units.” The nurse administered 200 units Lantus [that evening], and [two hours later], the patient’s blood sugar was reported as 54. The nurse increased tube feedings, and subsequent accuchecks were read as “error.”

The physician transcribed an incorrect insulin dose from the transfer orders. Physician wrote 70 units of insulin instead of 7 units of insulin. The physician misinterpreted the order due to the fact that the u (for units) was very close to the 7 on the transfer orders.

Transcribing and Order-Entry Errors

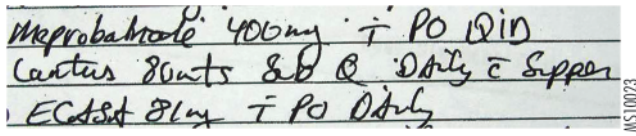
Among the wrong-dose insulin errors, 13.8% (n = 98) of the events involved breakdowns that occurred when transcribing orders, such as when entering orders into an MAR or a computerized order-entry system. Examples reported to the Authority include the following:

A patient was ordered “human regular insulin 150 units subcutaneously qam prn,” with the reason stating that the patient was on the medication at home. The order was entered as a nonformulary drug request. I questioned the order and discovered that the patient has a sliding scale regimen [as follows:] if blood sugar is 150 to 200: give 2 units; blood sugar 201 to 250: 4 units; blood sugar 251 to 300: 6 units; blood sugar 301 to 350: 8 units; blood sugar 351 to 400: 10 units; and blood sugar 401 to 500: 12 units. The first blood sugar parameter was incorrectly entered by the [physician] as the insulin dose.

A physician wrote an order for a patient to receive four units of regular insulin if the patient’s early morning blood sugar was equal to or greater than 250. Blood sugar was checked, and it was 179, so patient should not have received any insulin. The original order was transcribed incorrectly in that clerk wrote four units of Humalog 75/25 instead of regular insulin. Not only did patient receive insulin when he shouldn’t, but he received the wrong insulin. The transcription on the medication Kardex had not been cosigned by two nursing staff as is our policy.

Medication verification sheet documented a wrong dose of 70/30 insulin as per patient’s spouse bringing

Figure 3. Order Written for 8 Units of Lantus Insulin Misread as 80 Units



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in recent hospital discharge instructions sheet of medications as proof. The patient was ordered 10 units of 70/30 insulin, but the order was transcribed as 40 units.

Obtaining and/or Using the Correct Blood Glucose Value of the Patient

In addition to the 30 events reported as “Monitoring errors/Clinical lab values,” 12.9% (n = 92) of the wrong-dose events involved breakdowns with obtaining and/or communicating patients’ blood glucose values. Specific problems reported to the Authority included reporting an incorrect value, confusing the patient’s weight for his or her blood glucose level, and communicating the wrong patient’s value, as well as simply documenting the wrong result. Both licensed professionals and support staff have been involved in these breakdowns.

The patient’s blood sugar was written on the board as 148. The patient was given two units of regular insulin [that evening]. When the history in the glucometer was checked, the patient’s actual reading was 450. An additional 10 units of regular insulin was given at [one and a half hours later].

The nurse asked the nursing assistant for the patient’s Accucheck results. The nurse was told that the blood glucose was 377. The patient was covered with 10 units of Humalog per sliding scale guidelines. When the nursing assistant wrote the Accuchecks on the bulletin board, the blood glucose of 97 was written for that patient.

The nurse used the wrong number for the coverage, using the patient’s weight of 341 pounds, when the BG was 81. The nurse’s aide gave her the wrong number.

A nurse extern came out of patient’s room at the time accuchecks are performed. The nurse extern stated “211,” and RN repeated “211, right?” The nurse extern was referring to the patient’s daily weight, which is supposed to be performed at 7:30 a.m. The nurse covered the patient with four units of regular insulin when five minutes later nurse extern informed the RN that the patient’s blood glucose level was 130.

In a similar example reported by the Institute for Safe Medication Practices (ISMP), a nurse picked up a piece of scrap paper that listed several patients with a number next to each name.²³ All of the numbers were well above 200. Assuming the numbers were blood glucose results, she administered insulin to each patient using a sliding scale protocol. Afterward, she realized that the numbers were actually patient room numbers.

Displays on Insulin Products on Pharmacy Labels and MARs

Most pharmacy-generated labels, both in acute care and outpatient settings, display the name and strength (i.e., concentration) of the drug on the same line. For Humalog, many labels read “Humalog 100 units/mL” on the first line, with the intended dose for the patient appearing on the line below the drug name and concentration (see Figures 4 and 5). Similarly, pharmacy-provided, computer-generated MARs and other forms of drug information display dosage strength or concentration information the same way as the label. Display of drug and dosing information in this way has led practitioners to misinterpret the drug’s strength or concentration (100 units/mL) as the patient’s dose. Although this issue was only apparent in 14 events reported to the Authority, it is of great concern because of the potentially large difference between the intended dose and the administered dose.

Patient was on Lantus insulin at the nursing home. When physician was reviewing the medication orders from the nursing home, the Lantus order read “Lantus 100 units/ml vial inject 15 units sub q at bedtime.” The physician misinterpreted this order to mean Lantus 100 units sub q at bedtime and ordered it as such. The patient’s blood sugar was 85 [that evening], so this dose was not given, and it was subsequently decreased to 80 units. The patient did receive the 80 units the next day, and the blood sugar dropped to 52 two days later. The Lantus dose was decreased again to 40 units on the following day and was administered at bedtime. [The follow morning,] the patient arrested, and patient’s blood sugar was 12.

The printed medication list from a previous facility indicated “Lantus 100 units/ml 15 units once a day subcutaneously at 8pm.” The nurse reconciling the patient’s medications misread the order as 100 units. The medications were reviewed with the physician and obtained telephone order for “Lantus 100 units SQ at hs.” The nurse administering medications gave as ordered.

The patient’s medication reconciliation form indicates that the patient takes 100 units of Lantus in addition to Januvia® and metformin. When I saw these medications ordered for [the evening dose], I questioned the patient on the amount of Lantus he takes at home. He said “15 cc.” I explained that insulin comes in units. I brought him a syringe and asked how high he fills it, and he pointed to 15 units. I asked how much he had last night, and he said the nurse brought in a large syringe full of insulin. The nurse gave 100 units of Lantus last night according to the computer screen. The patient only takes 14 units at dinnertime.

U-500 Insulin

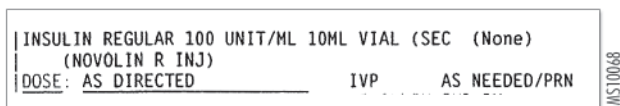
Most insulin products are supplied from the manufacturer in a 100 unit/mL concentration. The insulin is then administered using an insulin syringe specially designed for use with this concentration of insulin. When a patient needs a dose of 40 units, a caregiver draws the insulin to the designated 40-unit marking

on the insulin syringe. However, there is a more concentrated form of insulin that comes as a 500 unit/mL concentration.

The use of U-500 insulin has been increasing due to factors including an escalating obesity epidemic, increasing insulin resistance, growing use of insulin pumps, and rising usage of high doses for tight glucose control.²⁴ However, there are no insulin syringes designed to measure doses of U-500 insulin; therefore, healthcare practitioners are forced to prescribe, dispense, and administer U-500 insulin using insulin syringes designed for 100 units/mL insulin or other syringes marked in mL. For example, a patient using U-500 insulin with a U-100 syringe might state his dose as “40 units” because he is reading 40 units on the U-100 syringe he used to administer the insulin. However, he is actually administering 200 units of insulin because of the higher concentration. This increases the risk that a fivefold dosing error will occur when the patient communicates his dose to a healthcare practitioner. The Authority’s database includes the following examples:

A patient was admitted on routine regular insulin, and sliding scale was ordered at admission. [On Monday, the] physician ordered that the patient may use home insulin. The pharmacist modified the insulin orders with additional signature of the patient’s own medications. The order in the computer system used 100 units/mL, and the patient’s actual med was Humulin R U-500 (a concentration of 500 units/mL). The regimen ordered was Humulin R 85 units before lunch, 70 units before breakfast, 95 units before supper, and 35 units [at bedtime]. Doses [Monday evening through Tuesday bedtime] may have been given using ordered volume in computer (based on 100 unit/mL) using the patient’s own 500 unit/mL concentration; therefore, possibly five times the desired amount was given. The glucose reading [6 a.m. Wednesday morning] was 39 (25 mL D50W given), and repeat readings at 8:30 a.m. and 8:35 a.m. were 23 and 26 respectively

Figure 4. Section of an MAR Listing Insulin Name with Concentration of 100 Units/mL on the Same Line



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Figure 5. Outpatient/Community Pharmacy Label Listing Insulin and Concentration of 100 Units/mL on the Same Line



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(another 50 mL D50W given). The patient returned to normal blood glucose of 85 at 9:30 a.m. Wednesday after D50W administration and eating breakfast.

U-500 insulin was prescribed as units (from a U-100 syringe) instead of volume. The patient subsequently received 1/5 of his insulin dose, and his blood sugars became excessively high.

A case reported by ISMP involves an endocrinologist who wrote an order for 25 units of U-500 insulin to be given in the morning.²⁵ Nurses correctly calculated that the volume needed for a 25-unit dose of the 500 units/mL concentration was only 0.05 mL. A call was made to the physician to ask about changing to U-100 insulin for more accurate measurement. The doctor said that he actually wanted his patient to receive 125 units. He simply thought it would be easier for the nurses if he prescribed 25 units knowing that the “25 units” marking on a U-100 insulin syringe scale would actually measure 125 units when U-500 insulin was used. In another case, a physician changed a patient’s insulin to U-500 and prescribed 5 units at noon and 8 units at dinnertime. As in the first case, the doctor meant for the nurses to use a U-100 syringe when preparing and administering the U-500 insulin. Thus, he intended the patient to receive 25 units at noon and 40 units at supper.²⁵

Problems also arise with the vials on nursing units. One case involved a vial of U-500 insulin that was left in a nursing unit refrigerator after the patient for whom it was prescribed went home.²⁶ While looking for regular insulin in the refrigerator, a nurse saw the familiar brand name, Humulin R (regular insulin) but did not notice the U-500 concentration. She drew the prescribed dose into a U-100 insulin syringe and administered it. Luckily, another nurse saw the vial that was used and noticed that the U-500 insulin was given in error—a fivefold overdose.

Risk Reduction Strategies

Organizations should strive to identify system-based causes of errors with the use of both insulin vials and insulin pen devices and implement effective types of error reduction strategies. Error reduction strategies such as constraints and standardization, which are more powerful because they focus on systems, will be more effective than education alone, which relies on individual performance and will likely be ineffective when used alone.

Constraints

Organizations should use strategies that lessen the chance of harm with the use of insulin. For example, an organization could attempt to reduce or limit the variety of insulin products on its formulary.²⁷ In addition, organizations could remove patient-specific insulin vials, including U-500 insulin, from patient care areas upon patient discharge.

Standardization

Many strategies that could prevent harm with the use of insulin could be addressed by simplifying and

standardizing the many processes surrounding its use. They include the following:

- Standardize and simplify orders for insulin.²⁸
 - Develop standardized protocols and a standard format for prescribing insulin, preferably using preprinted order forms or electronic order sets that list specific products, ingredients, and component ratios.²⁹
 - Include generic names for insulin products on protocols, computer screens, MARs, and labels, when possible, to reduce confusion between brand names.²⁹
 - Establish a standardized algorithm within the organization for the dosing of insulin when providing coverage with meals.
 - Avoid the use of abbreviations or other shortcuts when communicating orders for insulin. Use the complete word “units” when expressing doses and concentrations of insulin.²⁸ Do not use the abbreviation “U.” In addition, do not use “SSRI” as an abbreviation for sliding-scale regular insulin, because it has been misinterpreted as selective serotonin-reuptake inhibitor.²⁹
 - Use a single, standard concentration for adult IV insulin infusions. If a nonstandard insulin concentration is needed, list the concentration and the patient’s dose in units and volume.²⁹
 - Establish a plan for treating hypoglycemia for each patient. Track all episodes of hypoglycemia in the hospital.³⁰
- Safely store and dispense insulin.²⁸
 - Do not keep insulin vials on top of medication carts or counters or under pharmacy compounding hoods, as insulin could be confused with heparin, which also is measured in units. Put all insulin back in the appropriate storage area immediately after use.²⁸
 - Separate insulin products from one another in refrigerators (i.e., avoid storing multiple types of insulin together in a single bin). Consider using visual clues, such as affixing a photo to the bin of the vial that should be stored there, to help ensure that the correct vial is returned to the correct bin.

Differentiate

Employ strategies to distinguish or make insulin products different in appearance, such as the following:

- Have pharmacy prepare and dispense prefilled syringes for once daily doses of long-acting insulin (e.g., insulin glargine).²⁸
- Emphasize the word “mixture” or “mix,” along with the name of the insulin product mixtures, for drug selection screens.²⁹
- Use tall man lettering in order-entry screens, medication administration records (MAR) and pharmacy labeling (e.g. NovoLOG, NovoLIN, HumaLOG, HumaLIN).

- Apply bold labels on atypical insulin concentrations.²⁷

Redundancies

For example, require an independent double check of all doses before dispensing and administering IV insulin. Build the double check into daily work processes so it can be accomplished without disruption.²⁸

Education and Information

Education and information strategies include the following:

- Provide staff with ongoing education about insulin products and methods of delivery.²⁸
- Prepare a chart that lists all insulin products used in your facility. Include generic and brand names; concentration; onset, peak, and duration of action; acceptable routes of administration; time of administration in relationship to meals; appropriate drug delivery devices; and special precautions (e.g., measuring the proper dose, mixing instructions, more frequent patient glucose monitoring). Pictures of the boxes in which insulin is packaged also would be helpful. Post the charts in areas where insulin is prescribed, dispensed, and administered.²⁸
- Check MARs and pharmacy labels to identify truncated information about insulin products and take steps to clarify important drug information as needed.³¹ Work with vendors to modify the appearance of MAR/eMAR and pharmacy labeling entries so that the wording is congruent with how medications will be administered (e.g., 10 units) rather than how they are supplied (e.g., 100 units/mL)²⁸

Monitoring of Adverse Events

Historically, measurement efforts have focused on practitioner reporting of medication errors, which, at best, uncovers just a fraction of the errors, most of them harmless.³² Consider measures other than practitioner reporting of medication errors to evaluate your organization’s safe use of insulin, including the following examples:

- Assess core processes associated with insulin use by using process measures.
- Obtain outcome measures by evaluating patient records using a list of triggers is the most effective means of collecting data on adverse drug events.

(Visit the Authority’s Web site at <http://patientsafetyauthority.org/EducationalTools/PatientSafetyTools/Pages/home.aspx> to view or download a sample tool that can be used to identify and monitor actual or potential problems with the use of insulin.)

U-500 Insulin Strategies

Strategies unique to the use of U-500 insulin include the following:

- Ensure consistent use of a tuberculin syringe with U-500 insulin, with total doses expressed in terms of both units and volume (e.g., 200 units [0.4 mL]).³³
- Establish a practice to have pharmacy draw up and dispense the ordered dose of U-500 insulin with a second individual (e.g., nurse, technician) performing an independent check of the vial, syringe, and contents.²⁵

Beside Blood Glucose Monitoring

Organizations must determine the safest way to receive, document, communicate, and verify glucose meter readings. Sample strategies include the following:

- Nurses need to know patient's blood glucose level before administering insulin. A flow sheet for recording each dose of medication and corresponding lab values allows nurses to review previously administered doses and track the patient's overall response to therapy.³⁴
- Require nursing assistants to write the patient's blood sugar on the MAR so the nurse can give the correct amount of insulin.²³
- Discourage verbal communication of blood glucose results.

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Self-Assessment Questions

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

1. What is the most common type of reported medication error associated with the use of insulin?
 - a. Wrong drug
 - b. Wrong dose/overdosage
 - c. Dose omission
 - d. Extra dose
 - e. Wrong dose/underdosage
2. Breakdowns or errors that lead to reported wrong-dose medication errors associated with insulin include all of the following EXCEPT:
 - a. Use of insulin coverage orders
 - b. Ambiguous orders written by prescribers
 - c. Inaccuracies when obtaining and/or using a patient's blood glucose value
 - d. Errors when transcribing and entering orders into a computer system
 - e. Use of a standardized protocol or order form to order insulin
3. Which of the following statements about the reported wrong-drugs errors associated with insulin products is INACCURATE?
 - a. A majority of the submitted wrong-drug reports did not list a specific insulin product or listed names of products that do not exist.
 - b. Wrong-drug insulin errors included breakdowns that occurred when retrieving the medication from stock or an automated dispensing cabinet.
 - c. Most of the submitted reports that occurred during the prescribing phase involved the clarification of non-specific orders (i.e., a specific insulin product was not indicated).
 - d. The most common type of wrong-drug errors involving insulin occurred when insulin vials were mislabeled in the pharmacy.
 - e. Most of the wrong-drug errors involving infusion bags containing insulin reached the patient.
4. All of the following strategies can be used to prevent errors with the use of insulin EXCEPT:
 - a. Limiting the variety of insulin products on an organization's formulary
 - b. Establishing a standardized algorithm for dosing insulin when providing coverage with meals
 - c. Using multiple, patient-specific concentrations for adult IV insulin infusions
 - d. Having pharmacy prepare and dispense prefilled syringes for once-daily doses of long-acting insulin
 - e. Requiring an independent double check of all doses of insulin before dispensing and administering IV insulin infusions
5. Which of the following statements about concentration and U-500 insulin is INACCURATE?
 - a. The use of U-500 insulin has been increasing due to factors including an escalating obesity epidemic, increasing insulin resistance, growing use of insulin pumps, and rising usage of high doses for tight glucose control.
 - b. Prescribe U-500 insulin in units based on a U-100 syringe.
 - c. There are no insulin syringes designed to measure doses of U-500 insulin.
 - d. Use tuberculin syringes when administering U-500 insulin, with total doses expressed in terms of both units and volume (e.g., 150 units [0.3 mL]).
 - e. Establish a practice to have pharmacy draw up and dispense ordered doses of U-500 insulin.
6. A physician wrote an order for a patient to "decrease Lantus insulin to 8 u qd," but the order was transcribed as 80 units. The medication was administered as transcribed, and the patient's blood sugars were documented as 40 mg/dl. Predict which of the following strategies would NOT help prevent this event from reoccurring.
 - a. Develop a standard format for prescribing insulin, preferably using preprinted order forms or electronic order sets that list specific products, ingredients, and component ratios.
 - b. Avoid the use of abbreviations or other shortcuts when communicating orders for insulin.
 - c. Use tall man lettering in order-entry screens, medication administration records, and pharmacy labeling.
 - d. Require an independent double check of all doses before dispensing and administering IV insulin.
 - e. None of the above.

Communication of Radiograph Discrepancies between Radiology and Emergency Departments

ABSTRACT

A radiograph ordered in the emergency department (ED) may not be reviewed immediately by a radiologist for a number of reasons, including limited availability of radiology services after hours and the increasing demand on radiology services due to growing ED volume. In 2008, facilities submitted 195 reports to the Pennsylvania Patient Safety Authority identifying a discrepancy between an ED physician's preliminary radiograph finding and the results of a radiologist's final reading. Processes for communicating radiograph readings from the radiology department to the ED vary among facilities due to factors including the availability of radiology services during off hours and availability of technologic services such as picture archiving and communication systems. When discrepant interpretations occur between the preliminary reading by an ED physician and the final reading by a radiologist, communicating the radiologist's findings to the ED and patient for follow-up is essential to ensure that the patient has received appropriate care. This article examines risk reduction strategies, including standardization of systems for communicating and reconciling radiograph discrepancies between the radiology department and ED that will promote optimal patient care. (Pa Patient Saf Advis 2010 Mar;7[1]:18-22.)

Introduction

The number of emergency department (ED) visits in the United States increased substantially between 1995 and 2005, from 96.5 million to 115.3 million. Along with an increase in ED volume is an increase in radiologic examinations performed on ED patients.¹ According to the National Center for Health Statistics, in 2005, radiographic imaging was ordered in 43.7% of ED visits, representing at least 50.3 million radiographs performed that year.¹ A radiograph ordered in the ED may not be reviewed immediately by a radiologist for reasons including limited availability of radiology services after hours and the high demand on radiology services due to growing ED volume. Typically, unless an immediate consult is required, the radiologist reviews the radiograph and generates a final report within 24 hours.² A process must be in place so that, if there is a discrepancy between the ED physician's preliminary interpretation and the radiologist's subsequent interpretation, it is communicated to ED providers so that the patient will receive appropriate follow-up care. Processes for communicating the radiograph readings from the radiology department to the ED vary among facilities because of factors such as the availability of radiology services during off hours and availability

of technologic services (e.g., picture archiving and communication systems [PACS], electronic medical records [EMRs]). Accordingly, discrepancies may be handled by means such as electronic- and paper-tracking systems. Regardless of the method, consistent and reliable communication between the ED and the radiology department is essential to ensure timely and adequate follow-up of any discrepancy.

Clinical Literature

A review of the literature found that discordance between ED physician and radiologist interpretations of radiographs has been reported in a number of studies as ranging from 0.3% to 17%.³⁻⁶ The majority of studies focus on rates of discrepancies; however, few studies evaluate the clinical impact of discrepancies on patient care. Not all discrepancies have the same degree of clinical significance. A 2003 study comparing ED physician and senior radiologist interpretations of 509 chest radiographs investigated the effects of misinterpretation of chest radiographs on discharge recommendations.⁷ The study showed that, when classified by level of clinical significance (i.e., mild, moderate, high), the highest sensitivity of the ED physicians' interpretation (60%) was found in the group with highly significant clinical findings (e.g., consolidation, congestion, pleural effusion, mediastinal widening). While this study found that the missed findings were of a minor nature, another study found that follow up of ED radiographs detects clinically important abnormalities that may have been overlooked. During a six-month study period, 19,468 ED visits generated 11,749 radiographic examinations. Discrepancies were detected in 175 patients (1.5%). Of these 175 patients, 136 (78%) were subsequently shown to have been incorrectly interpreted in the ED (i.e., false negatives), with 40 patients (23%) undergoing a change in management as a result. In the remaining 39 discrepancies, the ED interpretation was evaluated to be correct, with 16 patients requiring additional investigations or visits to the ED to confirm the radiographic finding.⁸

While the literature is inconclusive about the impact of discrepancies on patient management, reports submitted to the Pennsylvania Patient Safety Authority show that discrepancies occur often and may have an impact on patient safety if not communicated by the radiology department to the ED.

Authority Reports

The Authority received 3,173 reports from June 2004 to December 2008 related to discrepancies between the ED physician interpretation of a radiograph and the final reading by a radiologist. The Authority received 2,699 of these reports over a two-year period

from the same facility, possibly reflecting a targeted quality-improvement project. In 2008, facilities submitted 195 reports of this event type, which Authority analysts reviewed individually. None of these reports were submitted as a Serious Event. However, 68 (35%) of the reports indicated that the discrepancy involved a potentially significant clinical finding, as follows:

- Fracture: 50
- Pneumonia: 14
- Appendicitis: 4

The information in the reports does not convey how or when the discrepancies in the radiology findings were communicated between the radiology department and ED, although 55 (28%) of the reports indicate that communication was a factor contributing to the event. Also, the reports do not indicate that an error occurred in every case in which a discrepancy occurred. The reports do reflect the potential for patient harm if a discrepancy is not communicated between the radiology department and ED in a timely manner.

Examples of Authority reports related to such communication issues follow.

Communication of Radiology Discrepancies to the ED

A patient presented to the ED with the complaint of a seizure. The patient had a seizure and fell. A preliminary reading of a CT [computed tomography] scan was reported as negative, and the patient was discharged from the ED. A review of the radiographs the next day showed the patient had compression of the spine. The results were not conveyed to the ED physicians. The patient returned to the ED several days later and was admitted for neurosurgical intervention.

[A radiology staff member left a voice-mail message] regarding x-ray discrepancy for ED support staff. The voice mail was listened to later the next day. The support staff discussed [the discrepancy] with the physician. The physician stated the patient must return to the ED. Voice mails should not be left on ED support staff phone. If [there is] no answer, [the caller] MUST [sic] notify charge nurse.

Communication of Radiology Reports to the ED

An x-ray was done and the report was signed 45 minutes later. The ED physician/department was not notified of a result of subdural hematoma.

A patient was admitted from the ED. The physician reported several hours later that the patient had a dissecting aneurysm. A review of the chart showed patient had a CT done in the ED. The overnight radiology service report of CT showed dissection of aneurysm. [The aneurysm was] not documented in ED notes and was not treated.

A patient was diagnosed with a sprain. The patient was discharged and instructed to follow up with orthopedics. The patient returned later that day with pain. Radiology report was reviewed and was negative. A quality review of radiology report two

days later found a radiology report addendum from the previous day showing a dislocation that was not reported to ED.

Practice Guidelines

The Joint Commission National Patient Safety Goal for improving communication among caregivers addresses critical test results by requiring that facilities have a process in place for verbal and telephone communication of such results. The 2009 communication goal requires that facilities “measure, assess, and, if appropriate, take action to improve the timeliness of reporting, and the timeliness of receipt by the responsible licensed caregiver, of critical test results and values.” Accredited facilities are expected to apply this goal not only to laboratory tests, but also to all diagnostic tests (e.g., imaging studies, arterial blood gas assessments, electrocardiograms).⁹ The Joint Commission requires organizations to define an acceptable length of time between when critical tests are first ordered and when critical results are reported.⁹

The American College of Radiology (ACR) guideline on communication maintains that the radiologist is to provide imaging services to patients seen in the ED, including interpretation and appropriate communication.¹⁰ The guideline emphasizes that interpretation should be timely to facilitate decisions regarding treatment, although it does not specify a time frame in which radiology results should be communicated. The ACR guideline also addresses discrepancies in interpretation between a preliminary and final radiology interpretation. Changes between preliminary and final interpretation should be reported in a manner that reasonably ensures timely receipt by the referring or treating physician when such changes could impact patient care.

The American College of Emergency Physicians (ACEP) endorses that the interpretation of diagnostic studies ordered for the immediate evaluation of and management of ED patients should be done contemporaneously with the ED visit.¹¹ If the ED physician believes that urgent consultation is needed for the interpretation of a diagnostic study, the radiologist must be immediately available. The interpretation of the diagnostic study, both preliminary and final, must be documented in writing and entered into the patient’s medical record.

Risk Reduction Strategies

Although Joint Commission, ACR, and ACEP do not provide specific guidelines related to how a facility should communicate discrepancies, a number of methods for following up on ED/radiology discrepancies have been suggested. The process has been referred to as an “information chain,” starting with image generation, proceeding with image interpretation, and ending with communication of the interpretation.¹² The goal of the entire process is to follow up on any clinically significant discrepancies with the patient. The way the process operates

will depend on the availability of technology such as PACS, voice-recognition dictation systems, and EMRs. However, with any system, it is important to do the following:

- Develop a system for interpreting radiographs and communicating the interpretations that can be implemented regardless of the time of day or day of the week.^{13,14} A hospital may have separate processes for each shift for handling radiograph interpretation, depending on availability of radiology services. In the case of plain radiographs, a common scenario is interpretation of ED radiographs by the radiologist during normal business hours and interpretation by the ED physician during after-hours shifts, with a radiologist overreading the radiograph the next day. Although rates of discrepancies between ED physician and radiologist interpretations vary in the literature, standardizing the method of identifying discrepancies and the action plan for responding to them—for all shifts—will avoid confusion related to the use of multiple systems.¹³
- Implement a standardized method for informing the radiologist of the ED physician's interpretation.^{13,14} If the hospital uses a paper-based system, the ED physician can document his or her interpretation for requisition by the radiologist.¹⁵ Another paper-based approach involves the radiology department maintaining a log in the ED to document all radiographs. Radiology staff are responsible for logging the patient's name and views taken. The ED physician can make a notation of his/her reading in the log. The log can then be taken to the radiologist for review.¹⁵ If PACS technology is available, methods for integrating notations into the system from the ED physician and the radiologist have been described in the literature.¹⁶⁻¹⁸ For example, one facility successfully implemented a PACS that includes a preliminary note window. The window contains two text boxes—one for the ED physician's preliminary interpretation and the other for the radiologist's interpretation.¹⁶
- Implement a standardized system for communication of the radiologist's interpretation of the ED radiograph to the ED in a timely manner.^{13,14} If a discrepancy occurs between the ED physician's and radiologist's interpretations, it is important that the ED receives this information. A 2008 survey of current ED imaging practices showed that the most commonly used method of communicating urgent findings or a discrepancy is verbal communication between practitioners.¹⁹ Documentation of any verbal communication in the patient's record is essential. Voice-recognition dictation systems can expedite the availability of a radiologist's final report, but they do not eliminate the need for a consistent method to transmit the report to the ED in a timely manner.¹⁶⁻¹⁸

- Develop a consistent method to reconcile the radiographic interpretation with the actual care provided.^{13,14} A consistent system for identifying the clinical significance of the finding is essential. The ED physician may find that (1) the discrepancy has no clinical importance, (2) the patient has already been admitted and the subsequent treating physician needs to be notified of the finding, (3) the patient has been transferred to another facility and the subsequent treating physician needs to be notified of the finding, (4) the patient has received appropriate treatment in the ED and requires no follow-up, (5) the finding was missed and the patient requires a follow-up contact, or (6) follow-up studies are required for equivocal findings.¹⁵
- Develop a consistent method for timely communication of radiographic readings to the referring or subsequent treating physician and the patient as appropriate. One approach described in the literature for ensuring that radiologic findings are communicated in a timely manner is direct communication of the findings by the radiologist or radiology facility to the patient.²⁰

Conclusion

As Authority reports indicate, discrepancies may occur between the ED physician's interpretation of a radiograph and the final interpretation of the radiologist. A discrepancy may be clinically significant, and a system must be in place to communicate the discrepancy to the ED. Every ED needs a system to ensure that once a discrepancy is communicated to the ED, the discrepancy is correlated with the patient record to determine whether follow-up is necessary. Although systems may vary depending on factors such as availability of an electronic record, the system of communicating discrepancies should be simple and broadly applicable across all hours and days of the week. Finally, open communication among ED and radiology providers will help promote patient safety by ensuring that the patient will receive timely and appropriate follow-up care should a discrepancy occur.

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Self-Assessment Questions

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

1. Risk reduction strategies to ensure timely and adequate communication and reconciliation of radiograph discrepancies between the radiology department and the emergency department (ED) include all of the following EXCEPT:
 - a. Eliminate the need for a consistent method to transmit a report from the radiology department and the ED by the implementation of a voice-recognition dictation system.
 - b. Develop a consistent method to reconcile the radiographic interpretation with the actual care provided.
 - c. Implement a standardized method for informing the radiologist of the ED physician's interpretation.
 - d. Standardize the method of identifying discrepancies and the action plan for responding to them—for all shifts—to avoid confusion related to the use of multiple systems during different shifts.
2. Which of the following statements about the potential impact of radiographic discrepancies between the radiology department and the ED on patient management is INACCURATE?
 - a. Discordance between ED physician and radiologist interpretations of radiographs has been reported in a number of studies as up to 20%; however, not all discrepancies have the same degree of clinical significance.
 - b. The majority of studies regarding discordance between ED physician and radiologist interpretations of radiographs focus on rates of discrepancies; however, few studies evaluate the clinical impact of discrepancies on patient care.
 - c. A 2003 study comparing ED physician and senior radiologist interpretations chest radiographs showed that, when classified by level of clinical significance, the highest sensitivity of the ED physicians' interpretation was found in the group of chest radiographs with highly significant clinical findings.
 - d. Studies about the effects of misinterpretation of chest radiographs in the ED on discharge recommendations have consistently shown that discrepancies are of a minor nature and subsequently have little to no effect on patient management.

3. All of the following are potential barriers to the communication of radiograph readings from the radiology department to the ED EXCEPT:
 - a. Limited availability of radiology services after hours
 - b. Different communication processes according to the shift or day of the week
 - c. Reliance on paper-based communication systems
 - d. Lack of documentation of any verbal communication between the ED and the radiology department in the patient record

4. Which of the following statements is **INACCURATE** according to accrediting bodies and organizational guidance about communication of radiographic results between the ED and radiology department?
 - a. The Joint Commission requires organizations to define an acceptable length of time between when critical tests, which include all diagnostic studies, are first ordered and when critical results are reported.
 - b. The American College of Radiology guideline on communication maintains that the radiologist is to provide imaging services to patients seen in the ED, including interpretation and appropriate communication within a time frame defined by the facility.
 - c. The American College of Emergency Physicians (ACEP) endorses that the interpretation of diagnostic studies ordered for the immediate evaluation and management of ED patients should be done contemporaneously with the ED visit.
 - d. ACEP endorses that if the ED physician believes that urgent consultation is needed for the interpretation of a diagnostic study, the radiologist must be immediately available.

5. A 56-year-old patient presented at 11 p.m. to the ED with the complaint of a seizure. The patient had a seizure in the ED and fell off the stretcher, striking his head on the floor. A preliminary reading of a computed tomography (CT) scan of the patient’s head was reported as negative, and the patient was discharged from the ED. An overread of the CT scan the next day showed the patient had a subdural hematoma. The results were not conveyed to the ED physicians. The patient returned to the ED several days later with a severe headache and was admitted for neurosurgical intervention.

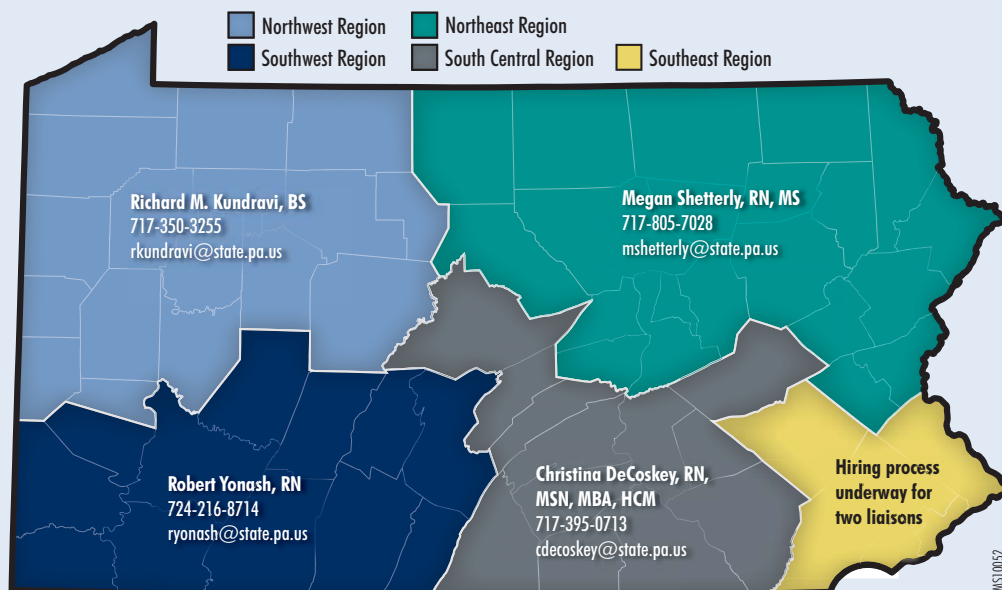
Predict which of the following risk reduction strategies would **NOT** help prevent the recurrence of this type of event.

 - a. Communicate findings by means of a telephone conversation between the radiologist reviewing the preliminary reading the next morning and the ED physician who was on duty.
 - b. Report changes between preliminary and final interpretation in a manner that reasonably ensures timely receipt by the referring or treating physician when such changes could impact patient care.
 - c. Expedite the availability of the radiologist’s final report by using a voice-recognition dictation system (recalling that there needs to be a consistent method to transmit the report to the ED).
 - d. Ensure that the hospital has consistent processes for each shift for handling radiograph interpretation.

Get to Know Your PSL

The Pennsylvania Patient Safety Authority’s Patient Safety Liaisons (PSLs) provide guidance, coordinate educational programs, encourage collaboration, and solicit feedback from healthcare facilities that report Incidents and Serious Events under Act 13 of 2002. Their primary contacts within healthcare

facilities are the facility Patient Safety Officers. Authority PSLs interact with Pennsylvania healthcare facilities according to region, as illustrated below. The Authority is in the process of hiring two additional PSLs dedicated to the significant number of facilities in the southeast region.



Preventing Corneal Burns during Phacoemulsification

ABSTRACT

The Pennsylvania Patient Safety Authority has received 20 reports of corneal burns during cataract surgery (December 2004 through July 2009). Corneal burns occur immediately following any compromise to irrigation or aspiration while ultrasound power is being applied to remove a cataractous lens. Surgical staff must be alert to any condition that could reduce delivery of saline, which cools the probe used to extract the lens. This article identifies several conditions known to reduce saline delivery and provides guidance for avoiding these conditions. (Pa Patient Saf Advis 2010 Mar;7[1]:23-5.)

Extraction of lenses for cataract surgery is one of the most frequent outpatient surgical procedures; more than three million cases are performed annually in the United States.¹ Phacoemulsification is the commonly used method for cataract extraction. Phacoemulsification systems (also known as phacoemulsifiers, cataract extraction units, or simply, phaco units) apply high-frequency oscillations to remove a cataractous lens from the patient's eye. A cataract is a foggy area in the normally transparent lens that reduces light transmission to the retina and causes cloudiness of vision. The lens is then replaced with an artificial lens.

The entire procedure, including implantation of an intraocular lens, can be performed through one (coaxial) incision or two (bimanual) small incisions under conscious sedation. A vitrectomy is performed to remove extraneous vitreous material if the posterior capsule is accidentally ruptured during the phacoemulsification procedure.

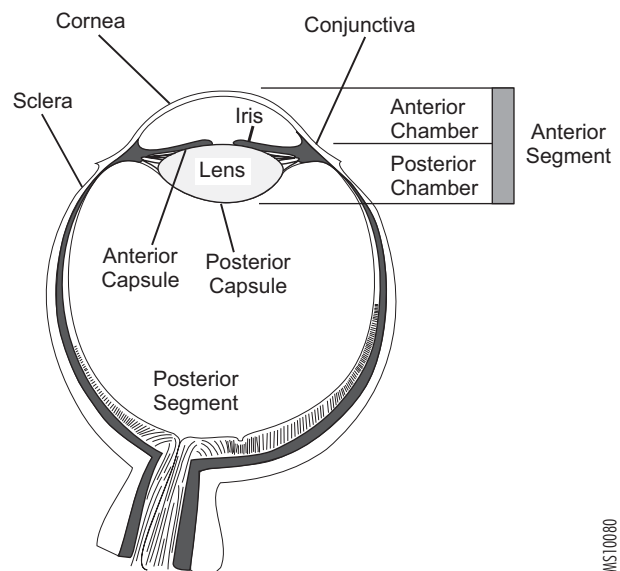
Saline is used to irrigate and aspirate surgical debris and to prevent the oscillating tip of the system's probe from overheating. In coaxial procedures, a single probe contains both irrigation and aspiration ports. In bimanual procedures, the probe contains only the aspiration port, and irrigation occurs through a separate probe inserted through a second incision. In both types of procedures, the surgeon inserts the probe(s) after removing the anterior lens capsule (see Figure) and depresses a footswitch to activate probe tip oscillation simultaneously with saline irrigation and aspiration. The cataract is not broken up by sound waves but rather by the probe tip moving against the cataract. The cataractous lens is emulsified using shaving or scooping motions with the probe tip, and lens fragments are then aspirated from the eye.

Controlling the Phacoemulsification Unit

Maintaining control of the phacoemulsification unit in the eye requires the surgeon to achieve balance between irrigation and the two aspiration parameters: flow and vacuum. During surgery, aspiration flow draws the lens and lens fragments toward the probe tip. The vacuum then holds the lens or fragments at the tip, while the lens material is broken apart. When small enough, the fragments are then aspirated through the probe tip at a rate determined by the aspiration flow. The flow parameter describes the rate at which fluid and lens fragments travel toward and through the probe tip. The vacuum parameter describes the suction force that holds material at the probe tip.

Phacoemulsification units allow surgeons to control the aspiration parameters using either a fixed or variable mode of operation. In fixed modes, the unit provides aspiration at set levels (as specified on the control panel) when the surgeon depresses the foot pedal. In variable modes, the depth to which the surgeon depresses the foot pedal controls one of the aspiration parameters. Operating the unit in a fixed mode is relatively straightforward; however, achieving the desired clinical performance also requires an understanding of the unit's variable modes of operation. The number and type of aspiration controls, as well as the use of the variable modes of operation, depend on the type of pumping mechanism the unit uses to generate flow and vacuum.

Figure. The Anatomy of the Eye



Callouts indicate the areas of interest during phacoemulsification. Reprinted with permission from ECRI Institute, Plymouth Meeting, Pennsylvania.

Peristaltic pump. Systems with peristaltic pumps have two aspiration controls: aspiration flow and vacuum limit. The aspiration flow control determines the pump's operating speed; the faster the pump operates, the greater the resulting flow rate. The vacuum limit is simply a safety setting that stops the pump when the vacuum reaches a set limit. Peristaltic systems can have linear flow and/or linear vacuum (vacuum limit) modes. The availability of these modes for each machine function (e.g., phacoemulsification, irrigation/aspiration, vitrectomy) depends on the device manufacturer and model. In the linear flow mode, the flow rate is controlled by the foot pedal, and the vacuum limit is constant. This mode allows the surgeon to adjust the speed with which fluid and objects move toward the tip. In the vacuum limit mode (sometimes called the variable vacuum mode), the pump speed remains constant, but the vacuum level at which the pump shuts off varies depending on the depth to which the foot pedal is depressed (i.e., as the pedal is depressed, the vacuum limit increases before the pump shuts off).

Venturi or diaphragm pump. On systems using either a venturi or diaphragm pump, the only aspiration control is vacuum. This vacuum setting is the actual negative pressure applied to the collection container and aspiration tubing. For a given vacuum setting, the flow rate is determined by the dimensions of the tubing, fluid viscosity, and the degree of occlusion (i.e., typically, the flow rate will be proportional to the applied vacuum). These systems have a fixed or variable vacuum mode. In the variable mode, the applied vacuum is controlled by the foot pedal. With this type of pumping mechanism, adjusting the vacuum affects the flow rate.

It is important to understand that the vacuum setting on a peristaltic system does not control the same aspiration characteristic as the vacuum setting on a venturi or diaphragm system.

The Problem: Overheating of the Probe Tip

In the 20 events reported to the Pennsylvania Patient Safety Authority (December 2004 through July 2009) and in the more than 1,400 reports to the U.S. Food and Drug Administration's Manufacturer and User Device Experience (MAUDE) database (May 1992 through June 2009), thermal injuries at the location where the probe entered the eye were most likely caused by overheating of the probe tip. During extended use of the probe, the rapid oscillatory motion of the probe tip and the friction generated are known to cause excessive heating. Tests with porcine eyes and egg albumin have shown that overheating of the tip can occur very rapidly (within one to three seconds) and can cause injury even if present for only a short time.² However, the same tests demonstrated that excessive heating does not occur when both irrigation and aspiration flow are present.

Insufficient irrigation or aspiration can have many causes. For example, irrigation can be blocked or

inhibited if the irrigation fluid bottle is empty, if the bottle is positioned too low for adequate flow, or if the irrigation tubing or sleeve is crimped or compressed. Similarly, aspiration flow can be inhibited or stopped if the probe tip becomes occluded (e.g., by lens fragments), if the vacuum limit is set too low, if the aspiration tubing becomes crimped, or if the cassette/tubing set is not correctly installed. Burns caused by a lack of sufficient irrigation and aspiration flow—both of which help cool the probe tip—can be avoided if proper surgical technique and procedures are observed. Factors that contribute to problems with the use of these devices are discussed below.

Causes of the Problem

Lack of Familiarity with the Equipment Used

Because maintaining control of a phacoemulsification unit requires achieving a delicate balance between irrigation and aspiration flow and vacuum, the use of unfamiliar equipment can lead to undesirable results. Surgeons often learn a procedure on one machine, memorizing that system's settings; however, if they try to use those settings on another supplier's system—particularly one that employs a different aspiration system—the likelihood of problems will increase.

For example, some systems use a peristaltic pump that automatically adjusts the pump's speed in relation to the achieved vacuum and the set vacuum limit. As the actual vacuum exceeds the manufacturer's set limit, the system automatically slows the pump to reduce the vacuum rise time after the tissue is captured. This feature has been implemented to avoid undesirable vacuum overshoot. To achieve the flow rate characteristics they are accustomed to, surgeons can set the vacuum limit higher than on previous systems. This is because the flow rate on this unit would be significantly lower than expected at the vacuum limit settings that they have used on other systems.

Lack of Experience Performing the Procedure

Surgeons performing the phacoemulsification procedure gain proficiency with the technique over time. However, because phacoemulsification is such a delicate and complex procedure, thermal burns can—and occasionally do—occur even when the operating surgeon has a great deal of experience performing the procedure. Authority reports suggest that surgical staff may simply forget to perform a pre-use test or be distracted and fail to notice a nearly empty saline container. To prevent these kinds of errors, it is good practice to frequently monitor the drip chamber while the phaco unit is activated to ensure that saline is flowing.

When surgeons start using a new phacoemulsification technique (e.g., transitioning from coaxial to bimanual procedures) or a different phacoemulsification system model, they are again operating at a level of reduced proficiency. For example, phaco models have different warning signals (e.g., audio signal, vibrating foot pedal, automatic ultrasound mode change from continuous to pulse) that indicate a full occlusion,

and the surgeon must be able to recognize the signal to deactivate the ultrasound mode. Therefore, it is important to take the time to master both the surgical technique and the controls of the new unit when making such changes.

Use of Smaller Incisions and Smaller-Diameter Probe Tips

A trend in cataract surgery is to use smaller incisions and smaller diameter phacoemulsification tips. Surgeons should be aware that the smaller diameter will further restrict aspiration flow and be easier to occlude than standard tips.³

Risk Reduction Strategies for Avoiding Corneal Burns

None of the Authority reports of thermal injury suggested a failure of either the phacoemulsification unit or the probe used for the procedure. There is also no information indicating that corneal burns are more frequently associated with a particular phacoemulsification model. Any phacoemulsification system can cause thermal lesions.

Surgeons and nurses must, therefore, understand how the fluidic systems (i.e., irrigation and aspiration) operate on the phacoemulsification units they use. Specifically, surgeons need to understand how fluid flow and vacuum affect the clinical performance they are trying to achieve. For example, consider the following event reported to the Authority:

The handpiece was handed to [the physician] without the irrigation tubing being inspected by technician for verification that tubing was attached. The tubing was not secured to the handpiece, which resulted in a corneal burn of moderate severity that required suturing.

The report further noted that this event resulted from human error and that the facility should reeducate staff about the importance of equipment verification prior to handoff to surgeons for use.

The following strategies may reduce the risk of thermal injury during phacoemulsification. They are directed to surgeons and circulating nurses who perform phacoemulsification procedures; the last four strategies⁴ are surgeon-specific.

1. Distribute this article to ophthalmic surgeons at the facility and to circulating nurses who assist them. Ensure that they are experienced in the operation of the phacoemulsification unit to be used. In particular, surgeons need to be familiar

with the unit's aspiration characteristics and follow the manufacturer's recommendations, which might include different parameter settings than those used with other models.

2. Perform all pre-use irrigation and aspiration tests recommended by the manufacturer. Such checks can help prevent problems with tubing placement, cassette loading, and irrigation bottle height.
3. Use audible vacuum indicators and alarms to call attention to blockages of aspiration on machines with peristaltic pumps. (Machines with venturi or diaphragm pumps supply a constant vacuum level, regardless of occlusions.)
4. Monitor the saline drip chamber to verify that aspiration and irrigation are unrestricted during activation of the ultrasonic generator.
5. Verify that the incision is large enough throughout its entire depth to avoid pinching the irrigation and/or aspiration sleeve and to allow some fluid leakage.
6. Avoid using excessive ultrasound power. Apply power only while shaving the lens, not while the tip is imbedded in the lens or while moving the tip away from the lens. Reducing the amount of phacoemulsification power where possible will also help limit heat generation.
7. Avoid over-torquing the wound. Excessive probe manipulations can narrow the incision and increase friction.
8. Avoid coring the lens with the probe tip, or, if such a technique is used, ultrasound should not be activated while the tip is embedded in the lens.

Notes

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Quarterly Update on the Preventing Wrong-Site Surgery Project: Digging Deeper

Don't you love it when you find a cache of old things in your drawers . . . and it is overdue bills! Pennsylvania Patient Safety Authority analysts noted a wrong-site surgery report that was not captured by the reporting system identification algorithm and followed the thread to discover four missed reports going back to the second quarter of 2008. This article includes these past reports. On the other hand, five tube thoracostomies, previously in the database, were identified as having not been done in the operating room (OR) or ambulatory surgical venues. Although wrong-site events in other parts of the healthcare system are a problem in their own right, the focus—and metrics—of this project has been on events in OR and surgical procedure room venues; therefore, those reports have been deleted from this operating team project. The latest figures incorporate these adjustments, among other updates and corrections (see Figure 1). The good results in the second quarter of 2009 now stand uniquely luring to the potential for improvement.

Is Pennsylvania making progress? Possibly, although not as fast as theoretically possible. Perhaps, comparing the downward trend in Pennsylvania to other publicly available trends for wrong-site surgery (see Figure 2). Although the downward trend in Pennsylvania is not statistically significant, it is at least in the right direction. Although the trends may be informative, the numbers of events reported from each source should not be compared, because the populations which they cover, the exact time periods for each year, and the exact criteria for reporting are not the same among the entities (see the caption for Figure 2 for qualifications about each source). The downward trend in Pennsylvania is notably volatile, suggesting inconsistent compliance with known best practices or wide variation in compliance with known best practices among facilities.

Unfortunately, the successive shutouts of wrong-site surgery by the Health Care Improvement Foundation's regional collaborative to prevent wrong-site surgery have come to an end with wrong-site blocks.

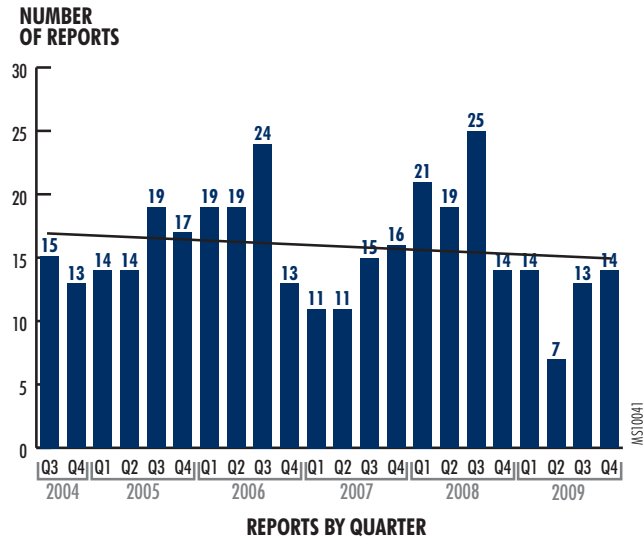
Local and Regional Anesthesia Blocks

Wrong-site local and regional anesthesia blocks represent a major portion of wrong-site OR procedures in the recent past. This quarter, 7 of the 14 reports (50%) were wrong-site local or regional anesthetic blocks, as follows:*

I asked the patient which side the procedure was on; the left leg was raised. A left femoral nerve block was performed with the patient awake. Upon turning prone for the popliteal block, I discovered the wrong-side error.

* All reports have been edited to remove identifying information or have not been reported if that could not be done.

Figure 1. Pennsylvania Patient Safety Authority Wrong-Site Surgery Reports by Quarter



I asked the patient again which side we were doing, and the patient pointed to the right. The patient then underwent a right popliteal block.

The patient, prior to left knee surgery, was given a right sciatic nerve block by the anesthesiologist. During the block time-out, the patient told the anesthesiologist that the operative side was the right side. A right-sided sciatic block was performed. The anesthesiologist then performed a left sciatic block.

A femoral nerve block was performed on the wrong leg prior to surgery. An alternative method of pain management was implemented postoperatively.

At the time of time-out, the staff discovered the surgeon had begun to inject local anesthesia around the right ear. The surgery was consented and scheduled for the left ear.

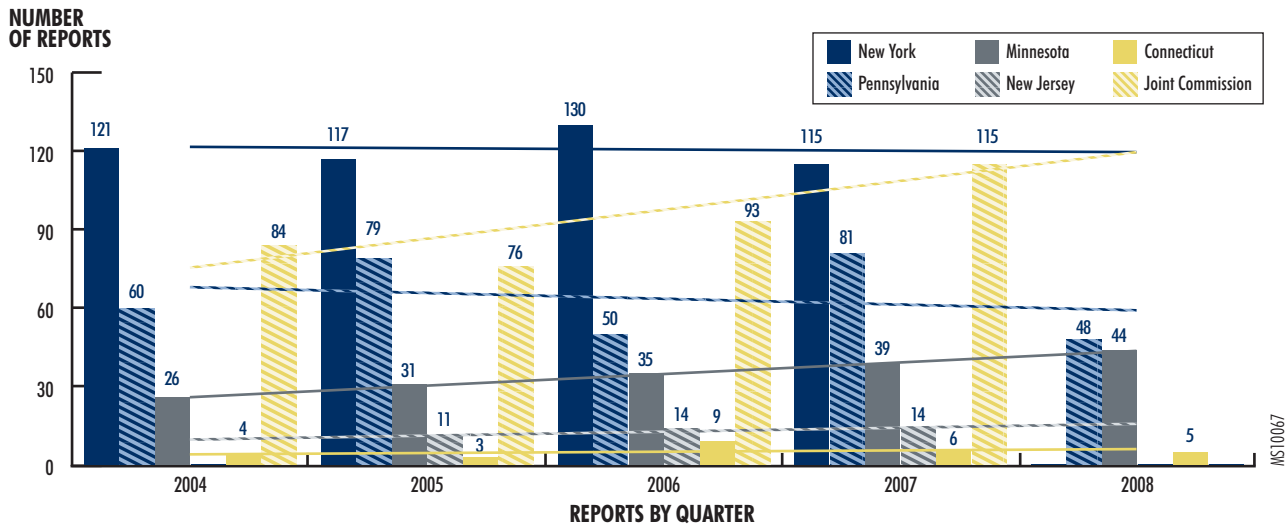
The patient was prepped, and a femoral nerve catheter was inserted on the wrong side; the right side procedure was then completed without complication.

The left knee site was marked for arthroscopy according to the surgical consent and patient's verbal response. In the OR, the doctor injected the right knee with 15 ml of lidocaine. The site discrepancy was discovered by staff. The procedure on the left knee was confirmed by time-out, and the left knee arthroscopy was performed.

A femoral block [was performed] on the left leg in error. The time-out was completed with the correct leg identified. [It was an] anesthesiologist error.

Notable in all seven reports is the limited use of information to confirm the side. The Authority has shown that it is necessary to validate the side against

Figure 2. Comparison of Pennsylvania Trend and Publicly Available Trends for Wrong-Site Surgery



New York data are NYPORTS codes 911: Wrong Patient, Wrong Site – Surgical Procedure and 912: Incorrect Procedure or Treatment – Invasive. New York data includes procedures performed in settings other than the operating room (OR). Data are for calendar years 2005 to 2008; data for calendar year 2009 (79 reports) is currently incomplete because of reporting delays. Data courtesy of NYPORTS (personal communication with John N. Morley, MD, and Ruth W. Leslie).

Pennsylvania data are for wrong-site, wrong-procedure, and wrong-patient reports, restricted to OR and ambulatory surgical facility procedures. Data are reported for years running from October to September to match Minnesota data. Pennsylvania’s downward slope is not statistically significant.

Minnesota data are for wrong-site, wrong-procedure, and wrong-patient reports for years running from October to September Minnesota data include reports from outside of the OR. The data are from the Minnesota Department of Health’s Adverse Health Events in Minnesota Reports from 2005 through 2010. See: <http://www.health.state.mn.us/patientsafety/publications/index.html>.

New Jersey data are for wrong-body-part, wrong-patient, and wrong-procedure reports. Data are for calendar years 2005 to 2007 only. The data are from the New Jersey Department of Health and Senior Services’ Patient Safety Initiative 2007 Summary Report. See: http://www.state.nj.us/health/ps/documents/ps_initiative_report07.pdf.

Connecticut data are for surgery performed on the wrong body part, surgery performed on the wrong patient, and wrong surgical procedure performed on a patient. Data are from July to June. Data are from Connecticut Department of Health’s Legislative Report to the General Assembly on Adverse Event Reporting, October 2009. See: <http://www.ct.gov/dph/lib/dph/hisr/hcqsar/healthcare/pdf/adverseeventreportoct2009.pdf>.

Joint Commission data are for reviewable sentinel events involving surgery on the wrong patient or wrong body part. Data are for calendar years 2005 to 2008. The data can be seen graphically on the Joint Commission sentinel event trends reported by year—updated through 2008. See: http://www.jointcommission.org/NR/rdonlyres/67297896-4E16-4BB7-BF0F-5DA4A87B02F2/0/se_stats_trends_year.pdf.

the patient’s understanding and all documents (the consent, the history and physical examination, and the schedule at a minimum) to minimize the risk for error.

Wrong-site blocks represent 29% of all reports of wrong-site procedures in the surgical suites, the largest cohort of wrong-site procedures within a single specialty in the suites. Over time, wrong-site blocks have increased significantly from less than 20% of all reports to more than 40% of all reports (see Figure 3, $p < 0.05$ by Pearson’s Correlation Coefficient), suggesting that the implementation of best-practices to prevent wrong-site blocks lags behind other efforts to prevent wrong-site surgery. The proportion of wrong-site anesthesia blocks is more notable given that only a fraction of patients who are vulnerable to wrong-site surgery receive anesthesia in the form of blocks.

The 2010 revision of the Joint Commission’s Universal Protocol will, in the analysts’ opinion, aggravate this concerning trend. The 2009 version of the Universal Protocol stated that the time-out should be done before the start of anesthesia; the 2010 version

reverts to stating that the time-out should be done prior to the incision.¹ Based on multiple studies from its Preventing Wrong-Site Surgery Project,* the Authority strongly advises that a formal time-out be done with the anesthesia provider just before any anesthetic block and that another time-out be done with the surgeon just before the incision, unless the surgeon performs the anesthetic block and incision in continuity after the surgical field has been prepped and draped.

Pain Management Procedures

Pain management is not immune from wrong-site problems, even though the patients are awake, as

* The Pennsylvania Patient Safety Authority has a Web page devoted to educational tools for preventing wrong-site surgery (available at <http://www.patientsafetyauthority.org/EducationalTools/PatientSafetyTools/PWSS/Pages/home.aspx>). Its resources include all of the Authority’s publications on the subject, including self-assessment tools, sample forms and checklists, educational posters and videos, illustrative figures and tables, and patient education brochures, as well as links to information from other Web sites.

The Authority strongly advises that a formal time-out be done with the anesthesia provider just before any anesthetic block and that another time-out be done with the surgeon just before the incision.

noted in another of the most recent 14 reports, as follows:

The patient was admitted to the procedure room. The physician reviewed the medical record; then, the physician and nurse performed the time-out procedure. The physician performed the preprocedural skin prep, then inserted the spinal needle into the left side of the patient's sacral (SI) epidural space rather than the right side. We did not learn of the error until the spouse questioned [bandages] on the left side of the spine rather than the right.

The 30 wrong-site procedures for pain management represent another 8% of the wrong-site procedures done in surgical suites. An earlier 2009 report illustrates another need to follow the Universal Protocol for pain management procedures, as follows:

The patient was scheduled for left cervical injection. The time-out was done prior to procedure, and all parties, including the patient, verified the procedure was to be done on the left side. The doctor injected the right side. He did not mark the site since he was

in constant attendance with the patient. The patient asked after the procedure why the right was injected rather than the left. The doctor was notified, and the correct side was then done. No adverse outcomes were noted from the injections.

A site marking, visible in the prepped and draped field, is essential to avoid problems arising from disorientation, right-left confusion, and confirmation bias.

Ureteral Stenting

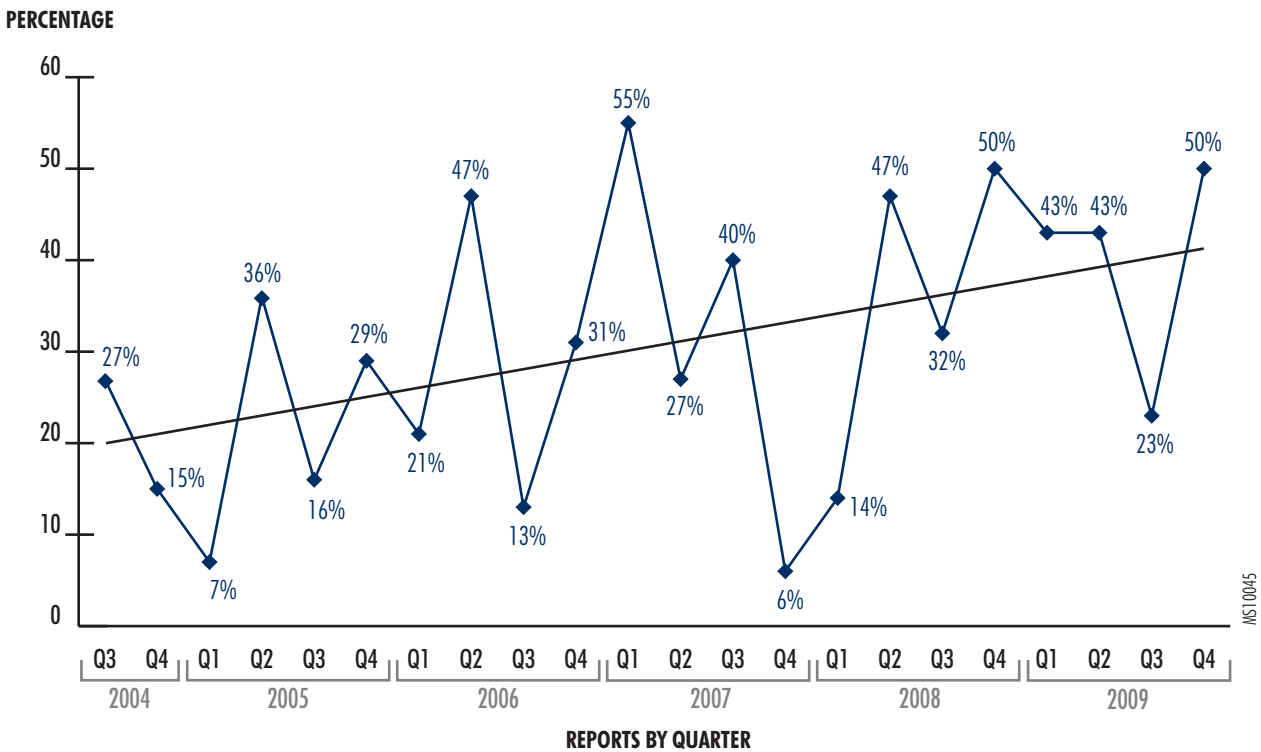
Two of the reports this quarter involved stenting the wrong ureter:

A stent was placed in the left ureter instead of the right. Following scheduled cystoscopy, with right retrograde, and placement of right ureteral stent, the x-ray tech stated "stent in left ureter, not right." Physician was informed. Procedure was repeated with removal of left ureteral stent, . . . and the right ureteral stent was placed in patient without any complications or problems.

Overall, ureteral procedures account for 21 (6%) of all wrong-site surgery reports and 81% of wrong-site urological procedures. All but one were wrong-side procedures, and all but one occurred in hospital ORs. Some of the other examples of stenting the wrong ureter in the Authority reporting system database include the following:

Patient with signed consent for cystoscopy and right stent replacement. The final time-out was completed. During the cystoscopy, the surgeon stated the anatomy

Figure 3. Percentage of Wrong-Site Surgery Reports that Describe Wrong-Site Anesthesia Blocks



caused him to insert stent in the left side. The procedure was not done under x-ray visualization. The surgeon assumed the consent was in error. After patient was in PACU [postanesthesia care unit], the surgeon confirmed with his office that the right side was the correct side. [Staff] took the patient back to the OR; the surgeon removed the left-sided stent and placed the right stent.

Medical evaluation of a [patient] revealed obstructing calculus within the range of the left ureteropelvic junction, producing hydronephrosis. The patient was taken to the OR . . . for stenting of the left ureter. The time-out verifying right patient, right procedure, right side was performed. Upon arrival in the PACU, the physician reviewed x-ray films completed during the procedure and confirmed misplacement of the stent in the right ureter instead of the intended left ureter. The . . . patient was returned to the OR for removal of the right urethral stent and placement of a left urethral stent. The procedure occurred without further complication. Complete disclosure was [done].

[A patient was] admitted for insertion of a ureteral stent. [The patient] had stones bilaterally. One side was worse than the other. Per radiology interpretation, insertion of stent was planned and completed for the left side. [Staff] determined following procedure [that] the stones in the right side were actually more problematic. The patient returned to the OR. Left-side stent was removed; right-side stent was inserted.

Office incorrectly scheduled case. Schedule read ureteroscopy with possible insertion of stent. Consent read right ureteroscopy with possible insertion of stent. The OR nurse confirmed with patient, at the time of preoperative checklist completion, and the patient confirmed above. A time-out was completed in the room, and staff confirmed with consent and surgeon the right ureteroscopy and stent. After completing the procedure, the surgeon reviewed his office record and noted that the procedure should have been completed on the left side.

Patient underwent left ureter stent placement [instead of] right. Consent, preoperative interview, and holding area confirmed with patient for right cystoscopy with stone retrieval from right ureter. A time-out was completed prior to procedure. The surgeon completed procedure. The patient was taken to PACU. The surgeon was documenting and noted that the stent was placed in the wrong side. The patient was returned to surgery for right side ureter stone retrieval.

The physician inserted the stent into the wrong ureter even after discussion with staff and the time-out process. The patient was taken from the recovery room back into the OR where the stent was removed and placed in the right kidney.

A physician reported to the patient safety officer that he had placed a right ureteral stent in a patient when he should have placed the stent on the left. The physician was clear that the hospital OR staff had correctly followed the Universal Protocol on time-out

prior to surgery, had hung the correct CT [computed tomography] films, etc. He removed the incorrect stent in his office the day following the original procedure, and the patient came back to the hospital two days later to have the correct stent placed.

The patient, with a history of bilateral kidney stones, was scheduled to have a left kidney stone removed due to left-sided pain. Preoperatively, the surgeon spoke with the patient and verbally identified with the patient that surgery was to be performed on the right side; the surgeon marked the right side. In the OR, the surgeon identified the patient and the fact that he was doing a right-sided ureteroscopy, which he performed, inserting a stent in the right ureter. The surgeon then realized the surgery was to be on the left side, and he proceeded to do a ureteroscopy with removal of the stone on the left side. The patient did well postoperatively and was discharged home.

The patient was scheduled for a left ureteroscopy and left retrograde with removal of stone. The patient went back to the OR and underwent a right ureteroscopy. The procedure was completed; no stone was found. In the PACU, the surgeon said he was to do the left, and he did the right. The patient was taken back to the OR to undergo the left ureteroscopy and removal of stone.

Procedure was consented for right ureteroscopy. No stone [was] seen in right ureter. A stone was seen in the left ureter. A left ureteroscopy was performed. The surgeon called the office to review [imaging] results, which reported a large stone in the patient's left ureter.

Patient had a cystoscopy and right retrograde for ureteral calculus. When the radiologist was reviewing intraoperative films the next day, she recognized discrepancy between the preoperative CT [film] and the intraoperative films. The preoperative CT [film] indicated left ureteral calculus. A cystoscopy and left retrograde were performed the next day.

The physician originally told office staff to schedule patient for a left ureteroscopic stone removal. After review of a subsequent CT scan, the patient was consented for a right ureteroscopic stone extraction. In the OR, the patient confirmed left side, and the left side was done. When no stone was found, the right side was then done.

Preoperatively, patient, surgeon, and nurse identified right side for procedure, and the right side was marked. In room before procedure began, a time-out was performed stating the right side was the correct site. Near the end of the case, the anesthesia provider asked the surgeon to state the procedure. The surgeon stated that he had done a left retrograde and stent insertion. The nurse then stated that the permit, history and physical, and markings all stated right. Surgeon then removed the left stent and did a right retrograde and stent insertion.

A patient was scheduled and consented for a right ureteroscopy and placement of a right ureteral stent. During procedure, a renal stone was identified to be on left side by the doctor and verified by in-room fluoroscopy. [Staff] scheduled a procedure to be performed on left side.

The provider inserted a stent into left ureter and then discovered after viewing CT and images that he placed the stent in the wrong side.

The patient consented to cystoscopy with left ureteral stent insertion. The RN [registered nurse] confirmed operative consent verbally with patient, and a bracelet was applied confirming left side. Intraoperatively, it was discovered that it should have been right ureter. The procedure was stopped, and physician spoke [with the] patient and family and then did the right side.

The patient was diagnosed with bilateral renal stones with left urethral obstruction. The patient inadvertently consented to have urethral stent placed on the right side instead of the left side that was obstructed. The patient underwent the right-side stent placement. It was discovered, while the patient was in the PACU, that the incorrect side was stented. Consent was obtained for the patient to return to the OR to have the left-side stent placed. The patient and family were informed of the error.

Contributing factors that were reported multiple times included bilateral pathology (four times), patient indicated the incorrect side (four times), schedule was incorrect (three times), consent was incorrect (three times), preoperative image was not referenced (three times), and office notes were not referenced (three times). Overall, 10 (50%) of the reports specifically mentioned some form of misinformation, correctable prior to entering the OR, as a contributing factor.

Six stents were placed on the wrong side despite specific reference to doing a time-out. This suggests that perhaps the side is not referenced during the time-out. The reports also suggest that wrong-side ureteral stenting can still occur because the intervention on the wrong side occurs *after* the operation has begun, rather than initially, and that the side of the instrumented ureter may only be known to the surgeon visualizing the landmarks, not to the other members of the OR team, who have more limited views of the procedure, if any. These reports suggest that stenting of the ureters has similarities with localization of the vertebral levels. The surgeon may be victim to right-left confusion or the fact that the two ureteral orifices are only about 4 cm apart, but are usually not in the same field of vision.

A review of the reports shows that the failure to do intraoperative imaging was cited as a contributing factor in one case and that patients were returned to the OR to correct errors documented by intraoperative radiographs on two occasions and, most certainly, by a postoperative CT scan on a third occasion. The error identified by fluoroscopy was corrected

in mid-procedure, and one of the recent confusions was detected by the radiography technician. These experiences suggest that the urologists should follow the same principles as vertebral surgeons by obtaining an intraoperative imaging study to confirm proper stent placement, with the interpretation documented at the time. Pregnant patients could have ultrasound imaging.

The review of wrong-side stents suggests that they could be prevented by mentioning the correct side when scheduling; verifying and reconciling the side on the schedule, the consent, the history and physical examination and/or the office notes, and the preoperative imaging studies, rather than relying on memory; and properly marking the side before entering the OR. During the time-out, the surgeon should be engaged, the side should be mentioned, and, as with all time-outs, the OR staff should be explicitly empowered by the surgeon to speak up if concerned.

It may be helpful to “call out” the placement of the stent, including the side, when it is placed intraoperatively and have the circulating nurse verify this information mid-operation against the documents.

Finally, it may be useful to follow an intraoperative verification protocol, similar to that for spinal surgery, using an intraoperative imaging study to confirm proper stent placement, with the interpretation documented at the time.

Hand Surgery

One report this quarter involved hand surgery, as follows:

The patient was scheduled for left trigger thumb release. The surgeon made the incision for carpal tunnel release. The surgical technician questioned the procedure. The correct procedure was then done.

Overall, hand surgery accounts for 21 (6%) of all the wrong-site surgery reports. All of the wrong sites were on the correct hand, but in the wrong part of the hand; 11 were the wrong procedure altogether, and the other 10 were the correct procedure but on the wrong digit. Remarkably, 7 of the 11 incorrect procedures were carpal tunnel releases when the patients were scheduled for release of “trigger fingers” (or “trigger thumbs”). Of the other 10, 7 mentioned both the correct and incorrect locations and, in all cases, involved adjacent digits, albeit not in any pattern.

Misinformation in the schedule and consent was only mentioned in one report, whereas misorientation was a factor in six: a loss of orientation in one, the absence of a proper mark in two, and starting before or without a time-out in the other three. The absence of a proper mark and the loss of orientation resulted in reports of mental lapses, as indicated by the following reports in the series:

Scheduled, consented, and marked for release of trigger; area prepped [with] alcohol; during prep site, mark washed off [with] alcohol; time-out done;

surgeon proceeded to do carpal tunnel . . . surgeon told staff he was thinking about a patient he had done the previous day.

Verification of procedure was performed with all OR staff for the procedure to be done on the left ring finger. The surgeon turned from field to consult records, turned back to field, picked up long finger, and proceeded with surgery.

The errors were reported to have been detected and corrected during 17 of the procedures. Seven were realized by the surgeon, four were brought to the attention of the surgeon by members of the OR staff (as in the example above), and three by the patients; the remaining three did not mention how the error was detected.

It appears that wrong-site hand surgery is almost always the wrong procedure or in the wrong location of the correct hand documentation. Five reports mentioned that an appropriate time-out was done. As illustrated in the examples, the reports suggest that the errors resulting in wrong-site hand surgery frequently begin with confusion in the mind of the surgeon between the pause for a time-out and the incision. This confusion at the start of the operation is in contrast to heart surgeons and upper abdominal surgeons. No reports have been submitted to the Authority of a surgeon intending to do a coronary artery bypass and doing a valve replacement instead (or vice versa) or of a surgeon intending to remove one upper abdominal organ and removing another instead. And, hand surgeons even have the advantage of being able to mark different, specific incision locations unique to the correct procedures.

Errors were brought to the surgeons' attention by others as often as self-correction occurred. The majority

of this help came from members of the staff, reinforcing the importance of specifically empowering the OR staff to speak up if concerned during the time-out.

The review of hand surgery reports suggests that errors would best be prevented if the surgeon made the mark as close as possible to mimicking the incision and by doing the time-out as close as possible to actually making the incision. The surgeon should be engaged in the time-out by actively stating the procedure to be done and by pointing to the marks in the areas of the planned incisions. The surgeon should explicitly empower the OR staff to speak up if concerned.

The Wrong-Site Surgery Consultation Program

The Authority has begun an on-site consultation program for Pennsylvania facilities that wish to analyze their vulnerability for wrong-site surgery, particularly following a wrong-site event (or a close call) in a surgical suite. Requests can be made through the Authority office or the regional Patient Safety Liaison. The Authority clinical specialists will assist facilities in assessing policies and procedures, measuring staff compliance, and doing a thorough analysis of any events, using resources developed by the Authority (see footnote on page 27).

The Pennsylvania Patient Safety Authority is committed to having no patient experience wrong-site surgery. Are you?

Note

1. Joint Commission. Revised Universal Protocol; some changes are effective immediately. Joint Commission Online 2009 Sep 9 [cited 2010 Jan 25]. Available from Internet: <http://www.jointcommission.org/NR/rdonlyres/25D5EC4D-F17C-4DCB-B0D2-8967EE48D5F1/0/jconlineSept909.pdf>.

Editorial: the Pennsylvania Patient Safety Advisory at Seven

The *Pennsylvania Patient Safety Advisory* begins its seventh year of conveying educational information from the Pennsylvania Patient Safety Authority's patient safety reporting system to healthcare providers. Pennsylvania Patient Safety Authority analysts draw from more than one million reports, submitted by Pennsylvania healthcare facilities, for information not available in the literature.

The Authority's *Advisory* staff is aided by an editorial advisory board that assists in the peer-review process and provides other valuable feedback. I wish to acknowledge and thank three members whose terms have expired for their service: William Dubin, MD, and Pekka Mooar, MD, both from Temple University, and David W. Orskey, MSHS, formerly from the Hershey Outpatient Surgery Center. I also wish to welcome nine new members to the editorial advisory board: Mary Blanco, RN, MSN; Lawrence M. Borland, MD; Frank M. Ferrara, MD, MBA; Daniel Haimowitz, MD; Mary T. Hofmann, MD; Cheryl Squier, RN, BSN; Donald C. Tyler, MD; Debra Verne, RN, MPA; and Michael R. Weitekamp, MD. Doctors Haimowitz and Hofmann will expand the editorial advisory board's expertise in the area of nursing homes, and Ms. Squier will also add to the board's expertise in infections.

How is the *Advisory* doing? In addition to feedback from the editorial advisory board, feedback was provided by responses from 204 Pennsylvania acute healthcare facilities through the Authority's 2009 annual survey, plus 364 newly added nursing homes. More than 600 changes have been reported by Pennsylvania healthcare facilities in response to *Advisory*

articles, and dozens of suggestions were made for new *Advisory* topics. In response to some comments from the survey, the Authority's Web site allows for browsing the *Advisory* articles by topic, key word search, and by issue; the educational Webinars for Pennsylvania healthcare facilities are free.

The Authority's *Advisory* staff also benefited from a critique following a two-day visit by Tjerk van der Schaaf, PhD. (See picture.) Dr. van der Schaaf, a world expert in chemical safety and near-miss reporting, developed the Eindhoven Classification Model for System Failure. He was also a member of the Institute of Medicine Committee on Data Standards for Patient Safety that made the recommendations that became the Patient Safety and Quality Improvement Act of 2005, establishing national patient safety organizations in the United States. He visited in late 2009 and provided many useful comments.

The Authority hopes that healthcare facilities will share their experiences implementing best patient-safety practices, either through the Authority's imminent Pennsylvania PassKey (Patient Safety Knowledge Exchange) initiative or directly to the *Advisory*. Together, we can discover not only what works best but also how to make it work reliably.

John R. Clarke, MD
 Editor, *Pennsylvania Patient Safety Advisory*
 Clinical Director, Pennsylvania Patient Safety Authority
 Professor of Surgery, Drexel University



Tjerk van der Schaaf, PhD (back row, sixth from left), visits with analysts and editors for the *Pennsylvania Patient Safety Advisory*.



Online Resources Associated with Patient Safety Advisories

Patient Safety Officers have expressed their interest in distributing educational resources within their healthcare facilities. The Pennsylvania Patient Safety Authority provides a growing collection of resources related to *Pennsylvania Patient Safety Advisory* articles to help increase situational awareness and patient safety within healthcare facilities. Examples include sample policies, educational videos and posters, brochures, interactive learning graphics, and reference materials.

This collection of resources is available online at <http://www.patientsafetyauthority.org>. Topics addressed include the following:

- ▶ Preventing wrong-site surgery
- ▶ Aspiration screening
- ▶ Diagnostic radiation and pregnancy
- ▶ ASF patient screening and assessment
- ▶ Hospital bed safety
- ▶ Airway fires during surgery
- ▶ Color-coded wristbands
- ▶ Common hazards in the behavioral health patient room

More improvement comes from improving a system than improving the performance of individuals within an existing system.



An Independent Agency of the Commonwealth of Pennsylvania

Whether you would like to learn more about the topics described above, or you need tools to help you meet other challenges, these educational resources can help.

If you would like additional information, please contact us at (866) 316-1070, or e-mail support_papsrs@state.pa.us.

PENNSYLVANIA PATIENT SAFETY ADVISORY

THE PENNSYLVANIA PATIENT SAFETY AUTHORITY AND ITS CONTRACTORS



The Pennsylvania Patient Safety Authority is an independent state agency created by Act 13 of 2002, the Medical Care Availability and Reduction of Error (“Mcare”) Act. Consistent with Act 13, ECRI Institute, as contractor for the Authority, is issuing this publication to advise medical facilities of immediate changes that can be instituted to reduce Serious Events and Incidents. For more information about the Pennsylvania Patient Safety Authority, see the Authority’s Web site at <http://www.patientsafetyauthority.org>.



ECRI Institute, a nonprofit organization, dedicates itself to bringing the discipline of applied scientific research in healthcare to uncover the best approaches to improving patient care. As pioneers in this science for nearly 40 years, ECRI Institute marries experience and independence with the objectivity of evidence-based research. More than 5,000 healthcare organizations worldwide rely on ECRI Institute’s expertise in patient safety improvement, risk and quality management, and healthcare processes, devices, procedures and drug technology.



The Institute for Safe Medication Practices (ISMP) is an independent, nonprofit organization dedicated solely to medication error prevention and safe medication use. ISMP provides recommendations for the safe use of medications to the healthcare community including healthcare professionals, government agencies, accrediting organizations, and consumers. ISMP’s efforts are built on a nonpunitive approach and systems-based solutions.