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Pennsylvania Patient Safety Reporting System

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Why Near-Miss Reporting Matters

Two recent articles in the national press highlighted the importance of "near-miss" reporting to assuring safety in our daily lives.

Early this month, a Pittsburgh-based reporter for a leading wire service described a new national database for near-misses that are reported by fire departments around the country. As the article noted, "The scene is played out in firehouses every day: firefighters return from a blaze or rescue call and talk about a near-miss that could have injured or killed someone. Now, the International Association of Fire Chiefs wants firefighters nationwide to learn from those stories through the National Fire Fighter Near-Miss Reporting System. The new Web site lets firefighters report near-misses anonymously and without fear of punishment—in hopes others can learn from them." This innovative program will benefit firefighters and other first responders around the country, and the story was picked up by many newspapers, electronic news services and websites.

The following day, the *Wall Street Journal* carried a story about airline safety on its travel page. The headline: "Addressing Small Errors in the Cockpit: Majority of Flights See Mistakes, Research Shows; Reducing Goofs by 70%." Much of the article described the research conducted by Robert Helmreich, professor at the University of Texas, who has written widely on aviation safety and whose findings have frequently been applied to healthcare. By observing more than 10,000 pilots within the cockpit, Dr. Helmreich and his team conclude that errors occur in more than 60% of all flights. Most errors are inconsequential, but, as the article notes, "little goofs can add up to big trouble."

There is a lesson here: reporting near-misses can be beneficial to you and your organization if you look at the details in the near-miss report and implement corrective measures to prevent a reoccurrence. This principle holds true for firefighters (and the people whom they serve), for pilots (and airline passengers) and for healthcare facilities and individual providers (and their patients). Complete, open and honest reporting of both actual events

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Lost Surgical Specimens, Lost Opportunities

At least 30 reports have been submitted to PA-PSRS involving surgical pathology specimens that were lost somewhere between specimen retrieval from the patient and processing in the laboratory. Some specimens can be repeated, such as a bowel biopsy to rule out inflammation or celiac disease. However, doing so places the patient at risk from the additional procedure and imposes a greater burden on the healthcare system through additional costs, time, and labor.

Of greater concern are specimens that cannot be replaced, such as fully excised tumors, skin lesions, or organs. The loss of such specimens may result in inappropriate or unnecessary treatment.[1] Furthermore, lost specimens may delay diagnosis, increase patient anxiety, or be a source of potential litigation.[2]

PA-PSRS Reports

The following examples of PA-PSRS narrative descriptions reflect the scope of the problem:

> *An OR specimen was transported to laboratory. The cutting room called to say there was no specimen in the container. The specimen was a completely excised ovary mass.*

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Why Near Miss Reporting Matters (Continued)

and near-misses—"Serious Events" and "Incidents" within the PA-PSRS system—is essential to ensure the success of patient safety efforts in Pennsylvania.

We have received almost 200,000 reports since PA-PSRS was implemented 15 months ago, and we have learned a great deal from analyzing the Serious Events and Incidents reported by more than 445 facilities in the Commonwealth. More important, we strive to share those lessons with healthcare workers and institutions through quarterly and supplementary *Patient Safety Advisories*. "You can't eliminate human error," notes Dr. Helmreich. "But you can minimize the consequences."

We have received positive feedback from healthcare professionals throughout Pennsylvania and around the country about the utility and practicality of *Advisory* articles. Much of the success of those articles and the clinical guidance they include can be attributed to the willingness of many patient safety officers and other facility staff to share their official findings following a root cause analysis or when PA-PSRS analytical staff have contacted them for additional information about a specific report. We appreciate their commitment to sharing their knowledge and best practices with others.

As we frequently note, the success of the PA-PSRS system is not in the number of reports submitted, but in what facilities do in response to what they learn through the system.

Alan B.K. Rabinowitz
Administrator, Patient Safety Authority

Lost Surgical Specimens, Lost Opportunities (Continued)

A patient underwent a liver biopsy. The pathology lab notified radiology that the patient's specimen bottle was empty. It was discovered that another patient had two specimens in his bottle. The patient had a repeat biopsy performed.

A patient had two specimens excised from her breast. The specimens were sent to radiology for x-ray. The lab reported that only one specimen was received. Unable to locate the other specimen.

The surgeon dissected the patient's ovary and tube and placed it in the cul-de-sac during a (laparoscopically assisted) vaginal hysterectomy. The ovary and tube were not ultimately removed from the cul-de-sac. Upon pathology review it was identified that the ovary and tube were missing. The patient returned to the OR, where the ovary and tube were located and removed.

Specimen was lost for 5 days. Specimen was left in the cooler.

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Lost Surgical Specimens, Lost Opportunities (Continued)

Specimen was discarded during clean up and was not sent to Pathology as requested.

The Process

The handling of specimens before reaching the pathology laboratory is referred to as the preanalytic phase. It involves many healthcare workers. Surgical pathology involves processing multiple specimens collected and labeled by numerous people. There may be little or no automation in the preanalytic phase. The persons handling the specimens have various levels of training. As a result, there is great potential for error.[1] Specimens are more likely to be misplaced, mislabeled, or never collected in the first place, rather than lost in transit.[3]

Getting a specimen to the laboratory for analysis involves the following steps:

1. Correctly identifying the patient.[1,4]
2. Correctly identifying all the tissue/lesion in the patient.[1,4]
3. Collection/biopsy/excision of the tissue.[1,2,4]
4. Placing the specimen in an appropriate container.[1,4]
5. Placing the specimen in an appropriate preservative/fixative.[1,4]
6. Correctly labeling, recording of the specimen.[2,4]
7. Completing a requisition slip that accompanies the specimen.[1,4]
8. Transporting the specimen from the procedure and specimen drop-off area to the pathology department.[1,2,4]

Systems Approach

Attempting to reduce risk using the traditional, person-oriented approach views lost specimens as being caused by aberrations in an individual's performance. Attributing errors to apathy, distraction, or inattention results in corrective interventions such as retraining the "guilty" party or taking disciplinary action.[2]

In contrast, a systems approach views errors in a complex system as being expected. Error analysis focuses on what safeguards can be put into place to reduce the risk of error in a flawed system—a system that may set up healthcare workers for error.[2]

While the proximal cause of an adverse event may involve human lapses/omissions (sharp end of the patient care process), the origins of the error are more likely to be founded upon the organizational (blunt) end of the system's process—institutional, regulatory, cultural, technological, and managerial factors.[2]

Risk Reduction Strategies

Making a flow chart of your facility's specimen collection system is a great way to begin looking at the process – from the time the specimen is obtained until it is received in the pathology department.[1,2] Interviewing healthcare providers directly involved in the process is valuable in determining what actually occurs, rather than what the procedure manual indicates.[1] Such interviews can also identify problems with the existing process and areas of potential improvement.[2] Looking at workarounds in the system may provide insights into how to make the system more reliable. Interventions can then be piloted and outcomes measured to determine the extent of improvement.[2]

Specimen Retrieval

Putting the specimens on the field in sterile containers and labeling the containers immediately when specimens are delivered to any container (on or off the field) makes it more likely that they will not get lost during clean-up. Verbal confirmation of patient/specimen information between the physician and the nurse also can help to ensure that the specimen is retrieved and secured.[4]

Reducing Reliance on Memory

Relying on memory for complex tasks promotes inconsistency and variation in human performance. Pre-printed forms (checklists and daily logs/requisition slips) indicating data to be entered can reduce the need to rely on memory and also can help to ensure that all required information for specimen processing is obtained.[5] Posting a chart of proper handling/fixative procedures associated with each type of commonly retrieved specimen may encourage staff to refer to written protocols, rather than to base their actions upon imperfectly recalled information.

Improving Information Access

Making clinical information easily accessible can be accomplished by computerized medical record information or the availability of the paper medical record when requisitions are completed.[5]

Forcing Functions

Forcing functions apply constraints to the number of options by which a process can be completed. These include barcoding, preprinted supplies that improve labeling, supplies to prevent specimen mishandling, procedures requiring audible verification

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Lost Surgical Specimens, Lost Opportunities (Continued)

(read back) of patient identification and specimen type, hand-offs between personnel or departments at points of specimen transfer.[2,4]

Decreasing Reliance on Vigilance
Both built-in internal checks and pathways can reduce dependence on human vigilance when all personnel use them. Bar codes and remote order entry into a computer system may help track specimens.[5] Chain of custody documentation may help track specimens from the point of specimen generation to its entry into the pathology department.[2]

Chain of Custody
Chain of custody is a process whereby a specimen is tracked from collection, through the steps of handling and transport, to the final disposition. Chain of custody is designed to maintain the integrity of the specimen and to ensure that the specimen and results are correctly matched to the person from whom the specimen was removed.

Chain of custody has been used in law enforcement/forensics to track evidence and to protect evidence from loss and tampering. In the healthcare environment, chain of custody documentation has been used to track such things as police-requested blood alcohol specimens and pre-employment, employment, school drug testing. Chain of custody concepts are also used by blood banks to ensure that the correct blood product is administered to the correct patient.

Chain of custody can also be used in tracking pathology specimens from procurement to arrival in the pathology department. This process may be especially valuable for irreplaceable excisional diagnostic biopsy specimens. In its Sample Protocol for Safe Specimen Handling in the OR, the Association of Perioperative Registered Nurses (AORN) states:

> Establish mechanisms for chain of custody to ensure accountability. Consistent communication patterns should be established between personnel at change of shift or relief.[4]

Information captured on a chain of custody form/log may include: persons and departments releasing the specimen, persons and departments/couriers receiving the specimen, release dates and times, patient identification, specimen number, specimen description, and purpose of the hand-off. If a specimen does not reach pathology, the chain of custody form/log may be helpful as the search is conducted and the error is analyzed for system improvement.

Standardizing Language and Tasks
The development of written policies and procedures, clear specimen acceptability standards, and easily available references provides a two-fold benefit by reducing guesswork concerning the specimen handling process in general, as well as promoting consistency in handling/preserving specific types of specimens.[5] Procedures for responding to specimen handling errors and near misses are incorporated into the system improvement/patient safety monitoring and analysis process.[4]

Reducing the Number of Hand-Offs
Usually there are multiple hand-offs of specimens until the specimen arrives in pathology – each one a potential source of error. Reducing the number of hand-offs and using technology and chain of custody documentation to track specimens reduces complexity,[1,4,5] and, thus, the potential for error.

System Design – Error Detection
Incorporating quality control monitors into the specimen handling process involves reviewing the chain of custody documentation and double checking when the specimen logs do not agree with specimens received in pathology.[5] In addition, the pathology department might also consider reviewing OR schedules daily to determine what specimens are expected. Specimens expected can be compared with specimens received. Any discrepancies can be investigated and reconciled. With these approaches, specimens may be recovered if errors are caught in a timely fashion. Monitoring adherence to clearly defined policies and procedures for specimen handling will confirm competencies,[5] ensuring that the right people are doing the right job.

Workload
Adjusting work schedules in the surgical setting and pathology department is an effective risk reduction strategy, particularly during times of fatigue, unexpected changes, or stress.[4] This includes developing a pick-up/delivery schedule agreed upon by pathology and the perioperative area.[5]

Environment
The physical environment where specimens are stored can be configured to reduce errors by providing dedicated, adequate space with good lighting, an appropriate area for documentation, and appropriate storage and delivery containers.[4,5] Eliminating distractions during each step of the preanalytic phase promotes compliance with specimen handling procedures. The cultural environment – one based on a systems approach rather than individual blame – encourages identification of system

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Lost Surgical Specimens, Lost Opportunities (Continued)

issues, encourages problem solving, and reduces self-protective behavior in which errors are not reported.[5] Some facilities have considered a free-standing pathology satellite department in the OR to handle specimens as they are generated.[2]

Training

Providing appropriate training will help to ensure that responsibilities are clearly defined. Periodic observation of performance helps to confirm that competencies are maintained over time.[1,4,5]

Success Story

In response to a lost specimen Sentinel Event, Slavin, et al.,[2] flowcharted the specimen handling process, interviewed healthcare providers, and conducted multidisciplinary meetings involving representatives from administration, surgeons, nurses, pathology, and administration. The pathology department volunteered to assume responsibility for the specimen transport process. A designated pathology department staff person went to the operating rooms at regular intervals, collecting the specimens and ensuring that all specimens were accounted for and delivered to the laboratory for same-day processing. During the study period of one year, no specimens were lost, and there was a significant reduction in the number of specimen transport times longer than 24 hours.

Resources

The AORN has developed a guidance statement and sample protocol for safe specimen handling in the OR.[4] The College of American Pathologists has a reference pertaining to error reduction: Quality Management in Anatomic Pathology: Promoting Patient Safety Through Systems Improvement and Error Reduction.[5]

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ISMP President Receives National Recognition

Michael Cohen, founder and president of the Institute for Safe Medication Practices (ISMP), was recently named one of this year's MacArthur Fellows by the John D. and Catherine T. MacArthur Foundation.

Recipients are selected for their creativity, originality and potential and receive generous financial support over a five-year period to further their current activities or enable them to work in new areas.

The Foundation specifically cited Dr. Cohen for his efforts to bring about "numerous corrections in error-prone products and practices." The award also notes that Dr. Cohen "continues to be a major force in giving national visibility to the ubiquitous and serious problem of medication errors."

ISMP is a PA-PSRS subcontractor for analysis of all reports related to medications, and Dr. Cohen serves as an advisor for the *Patient Safety Advisories*.

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Expecting the Unexpected: Ambulatory Surgical Facilities and Unanticipated Care

The substantial increase in the number of procedures performed in ambulatory surgical facilities (ASFs)[1] has made it important for clinical staff in ASFs to "expect the unexpected" and prepare for the need to provide unanticipated care to their patients. Of the 1,960 total reports submitted to PA-PSRS from ASFs, approximately 686 (35%) have involved the need to provide unanticipated patient care or to transfer the patient to another provider. The majority of these reports describe procedure cancellations, transfers for emergent intraoperative care, or emergent postoperative follow-up care.

Is there a way to reduce the incidence of cancellations or transfers? The necessity to provide unanticipated care while at the surgical center places the patient, other patients, and the ASF staff at risk. A review of reports to PA-PSRS and the clinical literature suggests the following opportunities for risk analysis and improvement:

- Patient selection, with a focus on procedure, patient medical condition, and location.
- Ability to provide prompt and competent unanticipated care.
- Timely, efficient, and safe transfers to hospitals, when necessary.

Reports to PA-PSRS

A random sample of 100 ASF reports filed in PA-PSRS were reviewed, with 35 reports (35%) related to unanticipated care. Thirty-one percent (11 cases) of the 35 cases involved preoperative procedure cancellations, nearly all of which were secondary to cardiac-related symptoms. In each case, the patient was transferred or referred to another facility for follow-up care. Most patients were transferred by ambulance to the emergency department of a local hospital. The following report narrative is characteristic of this category:

> *Cardiac monitoring preprocedure showed sinus bradycardia. Stat EKG performed. Sinus bradycardia with first-degree block and frequent PVCs in a pattern of bigeminy. Transported to ED.*

Fourteen percent (5 cases) of the 35 "unanticipated care" reports were categorized as intraoperative changes in the patient's condition that necessitated aborting the procedure. Reported complications varied, but perforations were the most frequently reported cause for urgent transfer to the hospital, followed by uncontrolled bleeding. Examples include:

> *During colonoscopy, the colon was perforated. Patient was given Cipro IV and became hypotensive. Anesthesiologist accompanied patient in ambulance and then to OR.*

> *Following removal of hardware, bleeding continued. Dorsalis pedis artery was lacerated. Vascular surgeon called. Artery repaired. Patient transferred to hospital.*

Reasons for postoperative transfers are diverse. Post-op transfers account for 19 (54%) of the 35 cases. Of those 19 cases, 16 (84%) required direct hospital transfers for services ranging from immediate surgical intervention to observation, and three cases (16%) required transfers to emergency departments for observation or follow-up care. The following is an example of a typical report in this category:

> *Post procedure patient received in PACU in respiratory distress, pulse ox 85-90% on room air. O_2 supplemented with non-rebreather mask. Anesthesia and surgeon agreed to ACLS transfer via local medic unit.*

Patient Screening for Risk of Transfer or Unanticipated Hospital Admission

Three studies support the importance of appropriate patient selection for services at an ASF.[2-4] An analysis of Medicare claims found that the strongest predictor of post-procedure admission was hospitalization within the previous six months, with "a 2-fold increased risk associated with multiple prior inpatient hospital admissions."[3] The oldest age cohort (85 years and older) also had a nearly 2-fold increased risk relative to the 65- to 69-year-old cohort.[3]

A study of New York State surgery data searched for predictors of hospitalization or death in 783,483 procedures, 40,000 of which were done in ambulatory settings. The researchers identified the following factors for predicting hospital admission or death following outpatient surgery and concluded that patients with four or more of these risk factors would fare best if treated in a center connected to a hospital:[4]

- Patient age greater than 85 years.
- Peripheral vascular disease.
- Operating room time greater than one hour.
- Malignancy.

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Expecting the Unexpected: Ambulatory Surgical Facilities and Unanticipated Care (Continued)

- Positive HIV status.
- Heart disease.
- A requirement for general anesthesia.

All ambulatory surgical patients require some level of care and support postoperatively. This need may be substantial for medically complex patients. Adequate support at home is needed to provide for treatment and monitoring related to both the surgical intervention and their preoperative state. Therefore, attention to preoperative medical needs, the expected postoperative care, and the level of home support is taken into consideration when deciding on a location for surgery. Additional criteria mentioned in the literature for consideration when screening patients for appropriateness of surgery location are baseline medications, general mental health,[5] functional limitations, and social support.[6]

Examining the patient's history of recent hospitalization and reviewing identified risk factors may provide insight into the potential for transfer or admission postprocedure as well as the likelihood of case cancellation. The routine preoperative assessment completed upon patient admission to the ASF frequently captures critical information necessary to decide whether to abort the case. Changes in the patient's condition, complex medical histories, noncompliance with preoperative instructions, or other unexpected issues may necessitate a case cancellation, as the following case indicates:

> *Upon pre-op assessment for a TURP* [transurethral resection of the prostate] *scheduled under general anesthesia, it was detected the 80-year-old patient had a history of severe COPD* [chronic obstructive pulmonary disease]*, recent cold and cough, and* SpO_2 *89% on room air. Patient stated that after his scope procedure last month, he had to be admitted.*

Canceling this case probably saved the patient from an emergent transfer and hospitalization. Though everyone wants to avoid a cancellation, it is frequently better to interrupt the surgical schedule and inconvenience the patient than to risk an emergent situation.

Emergency Preparedness

Of the 35 reports reviewed, 69% involved patients who required intraoperative or postoperative hospital-level care, with transfers for direct admission, immediate surgical intervention, or emergency department care in which patient observation or follow-up services were provided. Both regulatory and accrediting bodies address the issue of ASF preparation for emergencies.

Emergency preparedness procedures may include designating which practitioner from the ASF will escort the patient during transfer, determining when to activate the 911 system, and deciding where the patient will go.[7] The following case demonstrates the necessity for activation of an emergency medical system and determination of accompaniment:

> *Following a cervical epidural injection, the patient became unresponsive to verbal and tactile stimulation. Patient had a pulse and blood pressure but was not breathing. Manual respirations applied via ambu bag. Physician intubated patient, deemed patient stable for transfer via emergency services (911). Physician accompanied patient.*

As long as a patient is on-site, staff certified in ACLS (and/or PALS, depending on patient age) are available.[7] In addition, Pennsylvania regulations require an anesthetist to remain until the last patient is discharged when general anesthesia, regional anesthesia, or sedation is administered.[8]

A written plan or policy typically addresses the issue of readiness for the unexpected when patients are in the facility. Staff educated in activation of the emergency plan will perform with confidence and efficiency in responding to changes in a patient's condition. Review of this plan, including individual responsibilities according to the various roles delineated in the plan, is important to ensure readiness for urgent or emergent situations. Routine drills may be added to the review process to further ensure that emergency readiness is maintained.

Readiness for transferring a patient is required by the Pennsylvania Department of Health rules and regulations, as follows:

- "An ASF shall be prepared to initiate immediate on-site resuscitation or other appropriate response to an emergency which may be associated with procedures performed there.
- "The ASF shall have an effective procedure for the immediate transfer to a hospital of patients requiring emergency medical care beyond the capabilities of the ASF.

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Expecting the Unexpected: Ambulatory Surgical Facilities and Unanticipated Care (Continued)

- "The ASF shall have a written transfer agreement with a hospital which has emergency and surgical services available or physicians performing surgery in the ASF shall have admitting privileges at a hospital in close proximity to the ASF, to which patients may be transferred.
- "There shall be a written agreement in effect with an ambulance service staffed by certified EMT personnel, for the safe transfer of a patient to a hospital in an emergency situation, or as the need arises."[8]

In addition to the state regulations, the American College of Surgeons *Guidelines for Optimal Ambulatory Surgical Care and Office-based Surgery* and federal regulations describe the need for emergency equipment and transfer agreements.[9,10] The federal regulations, similar to the state regulations, require that surgeons performing procedures at an ASF have privileges at the receiving hospital or that the facility have transfer agreements with the hospital(s), if warranted.[10]

Since 1999, the Association of periOperative Registered Nurses (AORN) has annually updated or revised its comprehensive publication *Standards and Recommended Practices for Ambulatory Surgery,* which provides detailed information specific to any ambulatory surgical setting. This text includes AORN practice standards specific to ambulatory settings, providing pre-, post-, and intraoperative nursing care considerations, as well as guidance related to issues specific to the ambulatory setting.[7]

Conclusions

As the shift to outpatient surgery is fueled by technological advances, the current proportion of all surgical procedures that occur on an outpatient basis (60%) is likely to increase.[11] This expected industry growth increases the need for vigilance in early identification of patients at risk of intra- or postoperative complications. As resources are extended to meet the projected rising demand, anticipate scrutiny of case cancellations and tightly managed transfers. Expect focused attention on maintaining quality care, helping to ensure that ASFs provide competent and consistent surgical care of the highest standard, with appreciation for the strain that unanticipated care places on the patient and caregiver, the staff, and the schedule, not to mention the inherent risk to all involved. Readiness for unexpected patient transfers and attention to patient selection provides for optimal patient outcomes, staff satisfaction, and best use of resources in delivering high-quality care.

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Continuity of Oxygen Therapy During Intrahospital Transport

PA-PSRS has received many reports of unintended interruptions in oxygen therapy. Oxygen therapy may be necessary for patients with respiratory diseases (such as emphysema) that decrease the lungs' natural ability to extract oxygen from the air. Even a small amount of supplemental oxygen can make an enormous difference in a patient's arterial oxygen saturation.

Cases in which supplemental oxygen cylinders were inadvertently turned off or became depleted during patient transport are frequently reported to PA-PSRS. These cases have occurred throughout the hospital environment and in all types of facilities. A heightened sensitivity to the critical nature of oxygen therapy (even at low flow rates) is warranted, as the following cases indicate:

> *After returning a patient from physical therapy, a transport aide reported to the floor nurse that oxygen and pulse oximetry had been provided during physical therapy but, during transport, the pulse oximeter alarmed. The oxygen saturation was 85%. It was discovered that the oxygen canister was turned off.*
>
> *When a patient arrived in the operating room holding area for surgery, the oxygen cylinder was empty, and the patient's oxygen saturation was 70%.*
>
> *A patient receiving high-flow oxygen was taken to the radiology department for an ultrasound examination. No replacement oxygen cylinders were available in the radiology department, and a misunderstanding had occurred regarding the availability of in-line oxygen. The patient experienced a decrease in oxygen saturation until a replacement cylinder arrived.*
>
> *A mechanically ventilated patient was transported from the intensive care unit to a cardiac catheterization lab for an emergent procedure. After being placed on a ventilator by a respiratory therapist, the patient appeared to be "bucking the vent" and went into respiratory distress. Though the ventilator was connected to the oxygen tubing, the oxygen was not turned on.*

Failure Modes

Oxygen therapy requires multiple steps and multiple equipment connections. Each step holds the potential for failure.

A review of the reports submitted to PA-PSRS indicates that interruption of oxygen therapy can occur secondary to the following failure modes:

- Failure to treat with oxygen when ordered.
- Failure to initiate flow from the oxygen source (cylinder or wall outlet).
- Failure to connect the oxygen tubing to the oxygen source.
- Failure to place the oxygen delivery device on the patient.
- Failure to anticipate oxygen demand throughout patient transport and to provide an adequate supply.

How Can These Occurrences Be Prevented?

Risk reduction can be addressed by standardizing procedures, by reducing reliance on memory, and by clarifying responsibilities. The following two success stories are examples of these interventions to provide safe patient transport.

A formalized hand-off of patients with supplemental oxygen was implemented by a Pulmonary Clinical Nurse Specialist at Hines' Veterans Hospital (Hines, Illinois).[1] A standardized form was developed, "Oxygen Patient Transport Communication Tool," which requires documentation of the oxygen delivery device, flow rate, PSI, and available minutes of oxygen in the cylinder at each patient hand-off.[2] The use of this form provides both a consistent reminder and trail of accountability, preventing a potential error of omission: failing to check the cylinder for adequacy of oxygen.

This program has been widely successful according to Eileen Hagarty, the nurse responsible for the program. This tool has been disseminated across the VA system and the private sector.[2] Tips from the VA implementation include:

- Providing education and maintaining competency of the transport staff and the treatment/procedure staff.
- Recognizing the transporters'/escorts' contribution as team members responsible for maintaining supplemental oxygen during transport.
- Assessing availability of oxygen throughout the facility, addressing potential shortages (by banking cylinders strategically) and, routinely monitoring these storage areas.[1,2]

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Continuity of Oxygen Therapy During Intrahospital Transport (Continued)

A 1992 Harborview Medical Center (Seattle, Washington) study focused on oxygen therapy during transport and found that supplemental oxygen was interrupted in 55% of transports.[3] Similar to the VA intervention, staff education, along with a structured approach to oxygen use during transport, was implemented. In a final audit, one hundred percent of the patient transports successfully delivered uninterrupted oxygen. The interventions consisted of:

- Educating staff of the risk of breakdowns in oxygen therapy during transport.
- Developing and posting guidelines for oxygen use during transport.
- Determining who is responsible for completing certain steps in the oxygen therapy process:
  - When can therapy be discontinued for transport?
  - What is done by whom, especially when oxygen care is complicated?
  - When is the respiratory therapy department involved?
- Posting a chart to assist staff in estimating oxygen cylinder duration.[1] [The chart in Table 1, provided by Hines VA Hospital, is an excellent example of this.[2]]

Efficient and timely transport drives the schedule of activities in hospital departments such as radiology, occupational therapy, and physical therapy. Therefore, the urgency of timely transport can overshadow the attention to detail necessary when a patient is being prepared for transport with oxygen. Consider using mnemonic triggers to help staff remember the steps needed to set up the patient and equipment for supplemental oxygen during transport. A mnemonic reduces reliance on memory and promotes standardization. For example:

START transport with supplemental oxygen using this mental checklist:

Supply adequate oxygen for the trip.

Turn on the oxygen cylinder.

Apply the cannula or mask to the patient.

Rate as ordered and verified.

Trace the connections from the patient to the oxygen source.

Implementing a standard approach to the hand-off of patients with supplemental oxygen, educating staff in their role and use of oxygen equipment, and providing tools such as charts and mnemonics may reduce the potential for mishaps when supplemental oxygen is needed during patient transport.

Notes

1. NCPS TIPS – March/April 2002 [online].[Cited 1 Sept 2005] Available from Internet: http://www.patientsafety.gov/TIPS/Docs/TIPSMar02.pdf.

2. Hagarty E. Telephone conversation with: Monica Davis. August 22, 2005.

3. Stubbs, C., Crogan, K., Pierson, D. Interruption of oxygen therapy during intrahospital transport of non-ICU patients: Elimination of a common problem through caregiver education. Respiratory Care 1994;(39)10.

Table 1. Guide for Estimating Minutes of Available Oxygen

Liters per Minute	Pressure (PSI) in E cylinder							
	500	*750*	*1000*	*1250*	*1500*	*1750*	*2000*	*2200*
	Approximate Minutes of Operation							
1	140	210	280	350	420	490	560	616
2	70	105	140	175	210	245	280	308
3	46	70	93	116	140	163	186	205
4	35	52	70	87	105	122	140	154
5	28	42	56	70	84	98	112	123
6	23	35	46	58	70	81	93	102
10	14	21	28	35	42	49	56	61
12	11	17	23	29	35	40	46	51
15	09	14	18	23	28	32	37	41

Note: Shaded area indicates "at-risk" minutes. When psi regulator readings are between the psi readings on the table, use the lower psi reading to determine the approximate minutes of oxygen available. Consult with respiratory staff to gauge calibration and approximate times. **Source:** Hines VA Hospital and VA National Center for Patient Safety. See Reference No. 1.

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Is CT a High-Risk Area for Patient Transport?

Transports to CTs (computed tomography) have been identified as high-risk situations for patient mishaps.[1-3] CT was the destination of approximately 50% of the patients transported for treatment or diagnostic studies, according to Stevenson (2002), with the average time away from the unit ranging from 62 to 95 minutes.[1] Add to the volume of scans, the high level of patient acuity and it is not surprising that patient mishaps occur in this area.[4]

CT scans are not portable and are time consuming. The patient is in an isolated situation when being scanned, distant from the caregivers and at risk of a sudden change in condition as the following cases submitted to PA-PSRS indicate:

> *Patient "coded" after completion of the CT scan. Code unsuccessful; patient expired.*

> *Patient was being taken off CT table after completion of CT of head when it was noted that patient did not appear the same as when he was brought in or while the scan was being done. Code called. ER doctor came immediately. Compressions were done. Pulse checked. Code team took over.*

> *Patient had surgery and continued to complain of pain. CT ordered, gastrograffin consumed, test done, patient alert and oriented. On transport back to unit became unresponsive in elevator. Code blue initiated. Pulseless electrical activity noted on monitor. Patient expired.*

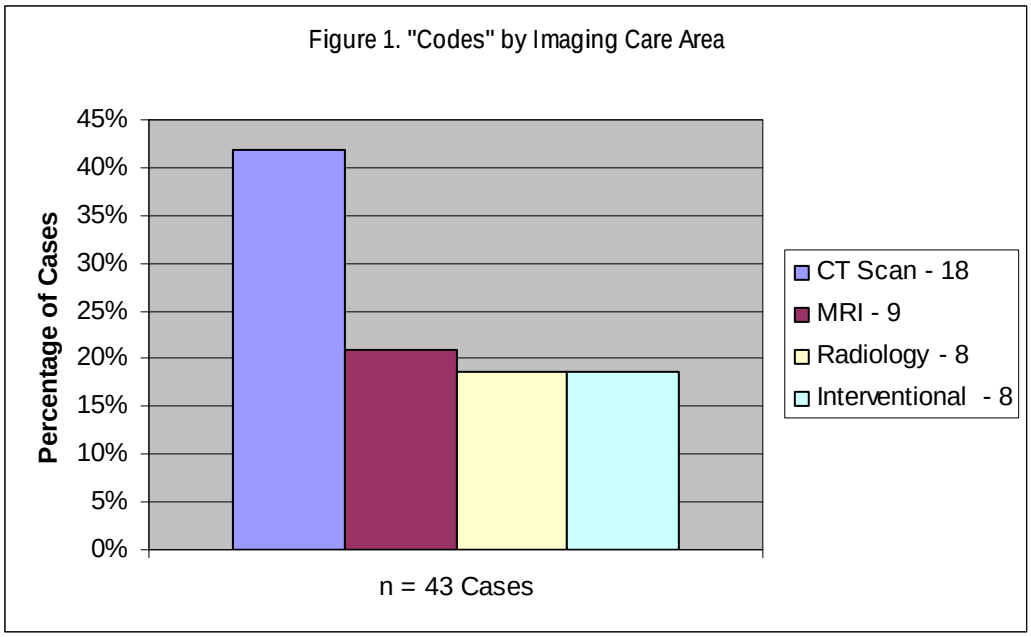
A review was done of the reports of cardiac arrests in PA-PSRS where patients were away from the unit for CT scan, MRI, radiologic exams, or procedures supported by radiology such as arteriograms. The data from PA-PSRS are consistent with the literature; the CT scan clearly stands out as a location where emergent situations occur.

National hospital data indicates that the number of CT scans are three and a half times more frequently performed then MRI scans.[4] The high volume of CT scans together with the time necessary to complete the scan expose the already compromised patient to the risk of a mishap. Figure 1 represents the distribution of these reports to PA-PSRS by care area.

This finding supports the necessity for staff to be in readiness for an urgent situation, to have emergency equipment immediately available, and to maintain vigilance while monitoring the patient in the CT scanner or until returned to their unit.

In other reported cases, expert clinicians anticipate potential patient changes and maintain a state of readiness to the patients' and staffs' ultimate advantage:

> *Patient accompanied to CT by the critical care nurse. Crash cart brought to area.*



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Is CT a High Risk Area for Patient Transport? (Continued)

Patient's heart stopped prior to getting injected. Patient was successfully resuscitated.

Patient was post open heart surgery and valve repair. Remained in critical condition, on a ventilator and required a tracheostomy. Physician ordered a head, neck and chest CT. The patient was accompanied to CT by the critical care nurse. A crash cart was brought to the area as a precaution. Prior to injection the patient's heart stopped. The patient was resuscitated and returned to the critical care unit.

Written patient transport policies provide guidance and directives to help ensure consistently safe care for all patients requiring transportation, and they serve as a starting point for efforts to improve care. Such policies can help to eliminate any guesswork associated with orchestrating a move involving oxygen equipment and multiple personnel.[5-7]

Notes

1. Stevenson VW, Haas CF, Wahl WL. Intrahospital transport of the adult mechanically ventilated patient. Respiratory Care Clinics of North America 2002 Mar;8(1):1-35.

2. Weg J, Haas C. Safe intrahospital transport of critically ill ventilator dependent patients. Chest 1989 Sept:96(3):631-5.

3. Smith I, Fleming S, Cernaianu A. Mishaps during transport from the intensive care unit. Critical Care Medicine 1990 Mar;18(3):278-81.

4. Internet Citation: HCUPnet, Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality, Rockville, MD. [online] 2003 [cited 2005 Aug 29]. Available from Internet: http://www.ahrq.gov/HCUPnet/.

5. Caruana M, Culp K. Intrahospital transport of the critically ill adult: a research review and implications. Dimensions of Critical Care Nursing 1998 May-Jun;17(3):146-56.

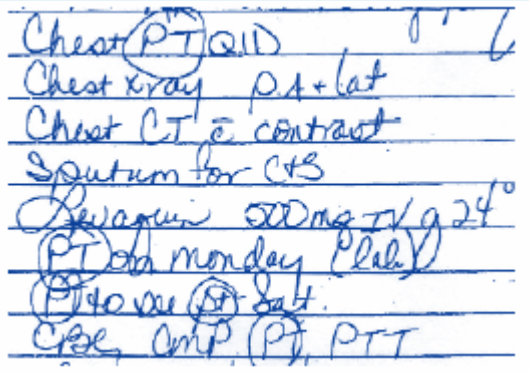
6. Lovell MA, Mudaliar MY, Klineberg PL. Intrahospital transport of critically ill patients: complications and difficulties. Anesthesia and Intensive Care 2001 Aug;29(4):400-5.

7. Beckmann U, Gillies DM, Berenholtz SM, et al. Incidents relating to the intra-hospital transfer of critically ill patients. Intensive Care Medicine 2004 Feb;26(30):1579-85.

PT—How Many Meanings?

In his book *Medical Abbreviations* (www.medabbrev.com), Neil Davis points out that there are no standards for many abbreviations used in healthcare. He notes that, because many people use their own variations of abbreviations, they are not always understood and may be misinterpreted. This can cause delays in initiating therapy, perpetuate serious errors, waste time obtaining order clarification, and increase the resources needed to educate healthcare providers. As an example, in the following set of orders, the abbreviation "PT" is used five different times with four different meanings: percussion therapy, physical therapy, patient, and prothrombin time.

Davis calls for a controlled vocabulary, similar to what is used in aviation and the military, where accurate communication is so critical. All pilots and air traffic controllers use a standard nomenclature when repeating back the letters in a word: they say "alpha," "bravo," and "charlie" (for A, B, and C), not "apple," "beef," or "candy." They also say "two-seven-zero," not "270," which can sound like "two seventeen." The idea of a controlled vocabulary is behind Joint Commission's and ISMP's efforts to standardize abbreviations that should never be used in medicine. While the Joint Commission has already established a minimum requirement with its list of abbreviations that should never be used, we hope that healthcare organizations will take note of our full list of abbreviations (www.ismp.org/PDF/ErrorProne.pdf) that have, at one time or another, led to medication errors.



What does "PT" mean? Imagine you're a new student reading this order set!

Editor's Note: This article first appeared in the publication *ISMP Medication Safety Alert!,* Volume 10, Issue 8, April 21, 2005. It is reprinted here with permission of ISMP.

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Unexpected Risk from a Beneficial Device: Sequential Compression Devices and Patient Falls

At least 40 reports have been submitted to PA-PSRS in which patients fell while wearing sequential compression devices (SCDs). SCDs are considered to be a safe, noninvasive, and effective method of preventing deep vein thrombosis in post-surgical patients[1] and in patients who are immobile for extended periods.[2]

SCD units comprise an electric air compression pump and tubing that transfers the air from the pump to three-chambered pneumatic sleeves, which are placed over a patient's leg. These chambers inflate in a cycle, applying pressure in a sequential fashion, starting from the ankle/foot to the calf or thigh.[2] This results in a wavelike, milking motion that stimulates muscle activity[3] in the immobile patient, thus promoting venous blood flow and preventing thrombosis.[1]

While multiple studies demonstrate the benefits of SCDs,[4] reports submitted to PA-PSRS indicate that SCDs may increase the risk of harm when patients fall. Reports of falls in patients with SCDs were more than three times as likely to be reported as Serious Events compared to reports of falls in which SCDs were not mentioned.

The proportion of Serious Events reported in patients who fell while wearing SCDs was 15% (compared to 4.7% in all reports of falls*). Further, 23% of those occurrences categorized as Incidents had minor injuries requiring such interventions as application of a dressing, ice, cleaning of a wound, limb elevation, or application of a topical medication. Other characteristics of patients who fell wearing SCDs are described below.

Reports of falls among patients with SCDs were more than three times as likely to be reported as Serious Events.

Time

Fifty percent (50%) of these falls occurred between midnight and 8 a.m., when staffing levels are reduced, and when patients are sleepy, in the dark, and more prone to disorientation.

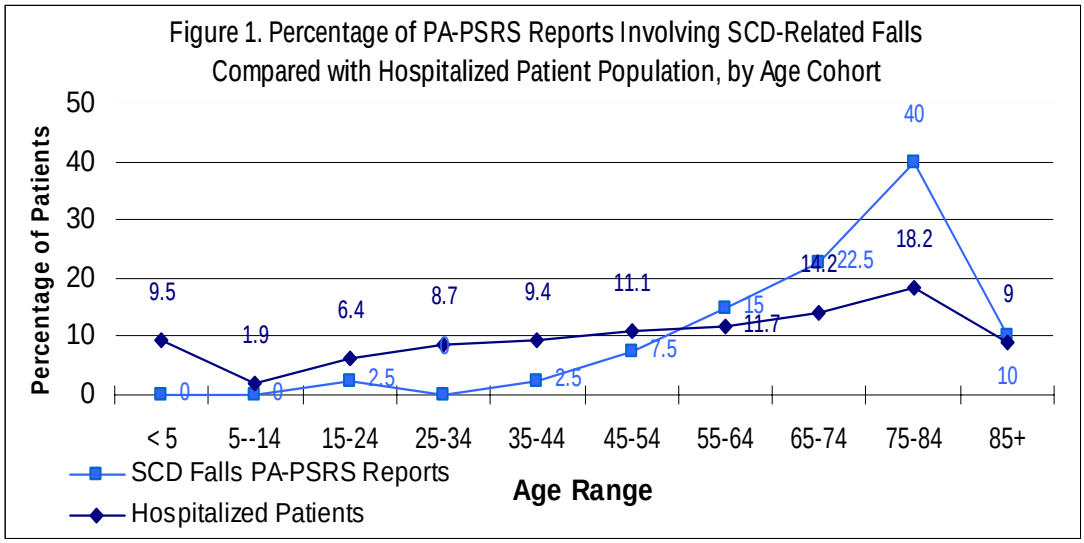
Age

While 62% of the patients were in their 70's and 80's, a patient as young as 22 years old fell while wearing SCDs. An additional 30% of these patients were in their 50's and 60's, suggesting that this type of problem may occur throughout all adult age ranges--not solely among the advanced elderly.

Figure 1 displays the following data according to age cohort: 1) the proportion of reports submitted to PA-PSRS concerning patient falls with SCDs applied, and 2) the proportion of hospitalized patients.** The display reveals that patients 75 to 84 years of age may be at greater risk for falling with SCDs applied than other age cohorts.

* Based on an analysis of all reports of falls received through August 18, 2005. Relative risk ratio was 3.18 (95% CI: 1.52-6.66).

** Based on publicly available data from the Pennsylvania Health Care Cost Containment Council (www.phc4.org). Estimates were based on statewide inpatient hospital data from the fourth quarter of 2003 through the fourth quarter of 2004.



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Unexpected Risk from a Beneficial Device Sequential Compression Devices and Patient Falls (Continued)

Fall Circumstances

Fifty-eight percent (58%) of the reports were associated with patient toileting: ambulating to the bathroom, using bedside commode, fall in the bathroom, and using a urinal to void. In most reports, the narrative description indicated that the patient was independently mobile. Many reports reflected that the patient got tangled up/tripped on the SCD tubing.

Risk Reduction Strategies

The patterns in these reports provide clues to risk reduction strategies that may promote a safer environment when patients require SCDs. The following tips may be applicable to patients wearing intermittent pressure devices, as well:

- Regularly assessing patients for the need for SCDs. If a patient is mobile, SCDs may no longer be required. Timely discontinuation of SCDs when medically appropriate may help to prevent falls.
- Providing patient and family education (verbal, videotape, and written) concerning the reason for SCDs, how long they are to

SCD Misconnection Could be Fatal

While this issue has not yet been identified in PA-PSRS reports, a potentially fatal hazard associated with sequential compression devices (SCDs) has been reported elsewhere.[1,2] SCD hoses can be mistakenly attached to needleless Luer ports of intravenous (IV) administration sets. Since SCD units pump air under pressure, a misconnection to a patient's IV system could result in fatal air embolism.

Such misconnections have occurred when the SCD unit had male Luer-type connectors on the end of the hoses. The male SCD Luer fittings may be compatible with the needleless Luer ports on certain IV administration sets or extension lines.

Some SCD units have a protective mechanism that shuts the unit off when back pressure is not detected. However, this shut-off protection may not be activated because back pressure can be created when air infuses into a patient.

Several strategies may help to reduce the risk of misconnection:

- Heightening staff awareness of the possibility of such misconnections. This means reaching all staff that may connect, reconnect, or disconnect any tubing for patient use throughout the facility (transport, students, technicians, nurses, physicians).
- Assessing whether the facility's SCD equipment has male Luer connectors.
- If feasible, purchasing SCD units that have male fittings that are mechanically incompatible with your facility's female IV ports.
- If purchasing new SCD equipment is not feasible, considering permanent attachment of non-Luer connectors to SCD hoses and purchasing compression sleeves with a compatible non-Luer female connector (recognizing that this option may void certain legal protections and warranties).
- Establishing a tracing protocol that involves having every person trace tubing back to the source (such as the SCD unit) before connection or disconnection occurs.
- Developing a written policy that identifies the categories of healthcare workers who are authorized and not authorized to make tubing connections, disconnections, and reconnections.
- Providing education concerning the reason for the prohibition both to those authorized and those not authorized to perform such tasks.
- Facilitating practice/role playing exercises to assist unauthorized staff in learning how to decline request to connect or disconnect medical tubing.
- As a supplement to the above risk reduction strategies, labeling SCD tubing indicating that it supplies air.

Misconnections of oxygen tubing and noninvasive blood pressure (NIBP) monitoring tubing to needleless IV ports have resulted in fatal air emboli.[3,4] The potential for misconnection errors exists with intermittent compression devices, as well.

Notes

1.ECRI. Hazard report: fatal air embolism caused by the misconnection of medical device hoses to needleless luer ports in IV administration sets. *Health Devices* 2004 Jun;33(6):223-5.

2.Institute for Safe Medication Practices. Safety briefs: misconnection of IV tubing. *ISMP Medication Safety Alert!* 2003 Sep 4;8(18):1.

3. Institute for Safe Medication Practices. Blood pressure monitor may connect to IV ports. *ISMP Medication Safety Alert!* 2003 Jun 12;8(12):1-2.

4. Institute for Safe Medication Practices. Problems persist with live-threatening tubing misconnections. *ISMP Medication Safety Alert!* 2004 Jun 17;9(12):1-2.

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Unexpected Risk from a Beneficial Device: Sequential Compression Devices and Patient Falls (Continued)

be applied, and calling for assistance so that the sleeves can be removed prior to leaving bed. Such education could be provided pre-operatively and when SCDs are applied.

- Automatically instituting fall prevention protocols on all patients wearing SCDs regardless of age, including a toileting schedule, rapid response to call bells, and regular re-orientation.
- Assisting with patients' toileting needs–particularly on night shift.
- Considering the feasibility of SCD units that have an audible disconnect/low pressure alarm or using bed/chair exit alarms so that healthcare providers can hear and quickly respond to patients wearing SCDs that are attempting to ambulate.
- One manufacturer has developed a miniature SCD that not only operates via line current but can also be powered by battery for up to four hours. The battery pack is worn during ambulation.[2] Such devices may reduce patient falls caused by getting tangled or tripping on tubes connected to an SCD unit hooked on the bed.
- Determining the proper size of the compression sleeves for each patient by using a measuring tape.[1] This will help prevent the compression sleeves from slipping out of place because of poor fit.

These measures may enhance the benefits of sequential compression device use while, at the same time, reducing the risk of patient harm.

Notes

1. Daly S, ed. *Nursing procedures.* Springhouse (PA): Springhouse Corporation; 1996:184-187.

2. ECRI. Circulatory assist units, intermittent; sequential; stockings; compressing; pneumatic. *Healthcare Product Comparison System* 2004 Jul:1-44.

3. Markel DC, Morris GD. Effect of external sequential compression devices on femoral venous blood flow.*J South Orthop Assoc* 2002 Nov 15;11(1):2-8.

4. Kleinbart J, Williams MV, Rask K. Prevention of venous thromboembolism. Chapter 31. In: *Making health care safer: a critical analysis of patient safety practices.* Agency for Healthcare Research and Quality Pub No. 01-E058; 2001:333-348.

Upcoming PSA Public Meeting in Southeastern Pennsylvania

The October 11, 2005, public meeting of the Patient Safety Authority Board of Directors will be held at the Hilton Valley Forge Hotel, 251 West DeKalb Pike, King of Prussia. The meeting starts at 10:30 a.m. The Authority welcomes attendance by representatives of area facilities and would be pleased to receive brief comments during the public comment period. Although it is not required, you can ask to be included on the agenda by contacting the Authority at patientsafetyauthority@state.pa.us.

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PA-PSRS Data Brief

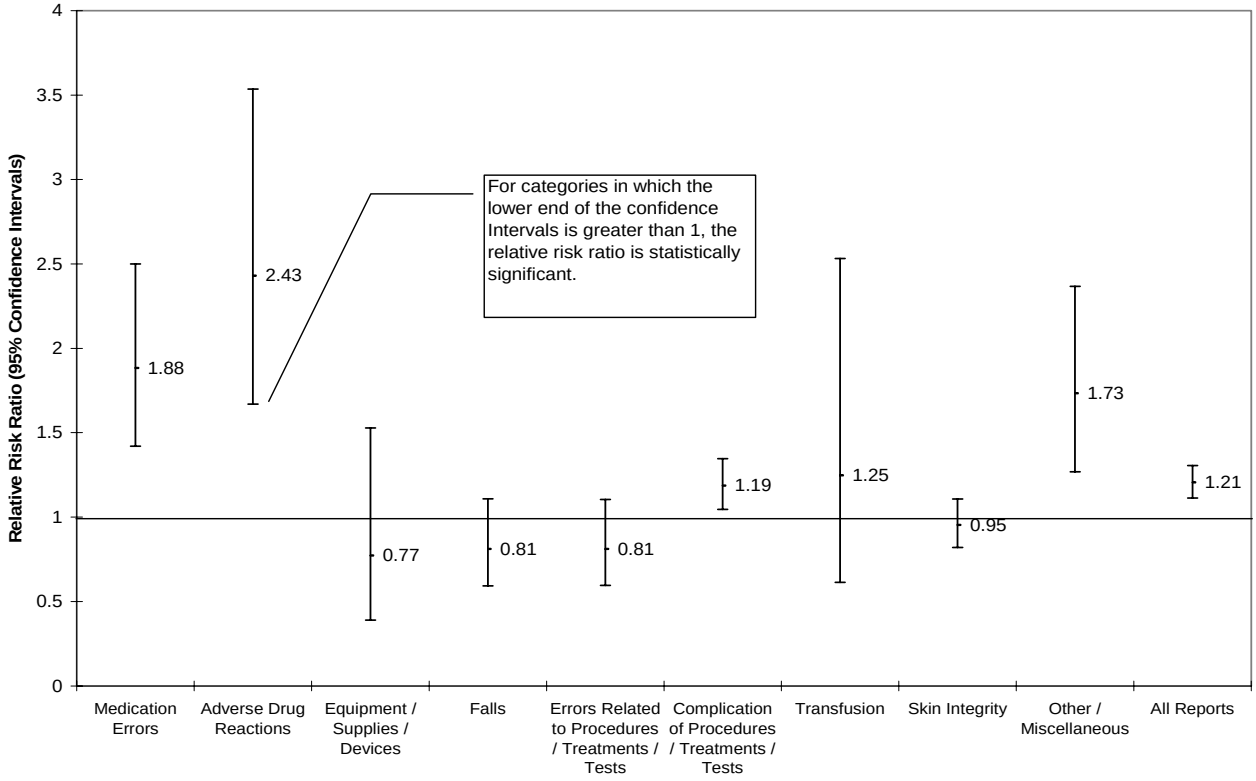
ICU Reports More Likely to be Reported as Serious Events

Patients in intensive care units (ICUs) may be more likely than non-ICU patients to be injured by adverse events. The procedures performed on critically ill patients and the quantity and type of drugs used in their care may also increase their risk relative to non-ICU patients.[1]

An analysis of one year's data from seven Australian ICUs collected 536 reports, identifying 610 incidents, that reduced or could have reduced the "safety margin" for the patient (i.e., it included near misses and no-harm events).[2] A recent one-year observational study estimated the rate of adverse events in the ICU as 80.5 per 1,000 patient days.[3] Another study reported a rate of 89 events per 1,000 ICU days, including near misses as well as harmful events.[4] In terms of errors (as distinct from adverse events) a study of a single university-based medical-surgical ICU estimated an error rate of 1.7 per patient day.[5]

An analysis of reports submitted to PA-PSRS supports the hypothesis that ICU patients may have an increased risk of injury from adverse events. Among reports from hospitals, reports involving the ICU were about 20% more likely to be identified as Serious Events* than those that did not involve the ICU. As shown in Figure 1, reports of Adverse Drug Reactions† were 2.4 times as likely to be identified as Serious Events if they involved the ICU. Reports of Medication Errors and Complications of Procedures, Treatments, and Tests were 88% and 19% more likely to be Serious Events, respectively.

Figure 1. Reports from ICUs Identified as Serious Events, Relative to Non-ICU Reports (Based on Reports Submitted by Hospitals from 6/7/04 through 6/6/05)



*Relative Risk Ratio was 1.205 (95% C.I.: 1.113,1.305). For readers who may not be familiar with the statutory definitions, PA-PSRS staff receives two types of reports: Serious Events (similar to "adverse events") and Incidents (similar to "near misses" and "no-harm events").

†The World Health Organization (WHO) defines Adverse Drug Reaction (ADR) as "Any response to a drug which is noxious and unintended, and which occurs at doses normally used in man for prophylaxis, diagnosis, or therapy of disease, or for the modification of physiological function." Source: WHO. Requirements for adverse reaction reporting. Geneva, Switzerland: WHO; 1975.

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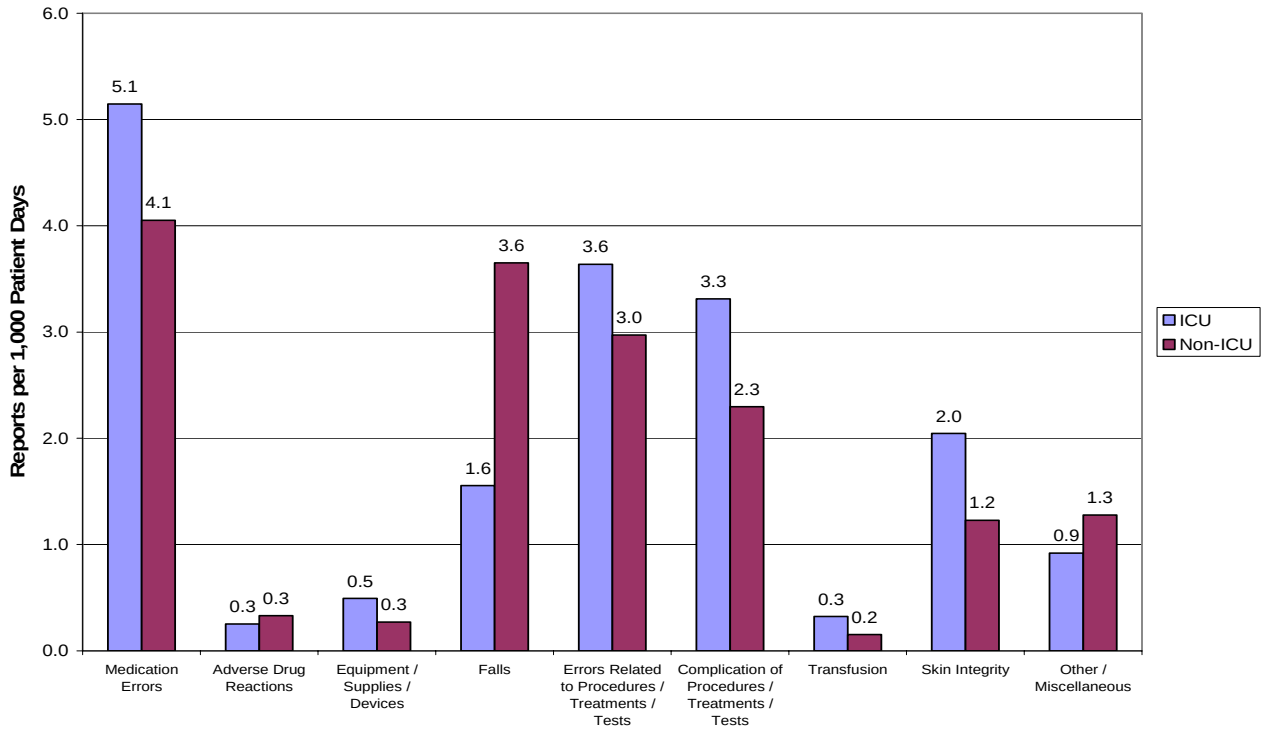
ICU Reports More Likely to be Reported as Serious Events (Continued)

During the first year of mandatory reporting, Pennsylvania hospitals submitted 11,959 reports identified as occurring in the ICU (or 17.7 reports per 1,000 ICU patient days[‡]). Of those reports, 5.4% were Serious Events, a significantly greater proportion than that from non-ICU areas.[§] Reports involving the ICU accounted for 8.5% of all reports submitted by hospitals. Figure 2 presents the number of reports from ICU and non-ICU areas by Event Type in terms of the number of patient days.

Table 1 presents the most frequently cited contributing factors in ICU-related reports providing detailed causative information. Factors shown on this table are those with at least a 1-in-10 likelihood of being cited as a contributing factor in the set of analyzed reports. All of the contributing factors shown related to staff, team, environment, and organizational factors were significantly more likely to be reported in ICU-related reports than from other reports from hospitals. Patient compliance and patient understanding were significantly less likely to be cited as a contributing factor in ICU-related reports.

Figure 2. Reports per 1,000 Patient Days by Event Type and ICU Involvement (Based on Reports Submitted by Hospitals from 6/7/04 through 6/6/05)



[‡]Based on data from: Pennsylvania Department of Health, Bureau of Health Statistics and Research. Hospital and ambulatory surgery center data, standard output reports 2003-2004, Report 2A, Inpatient hospital unit data by facility and county. Reporting period: July 1, 2003, through June 30, 2004. Accessed 15 Aug 2005. Available online at www.health.state.pa.us.

[§]Based on a Chi square test of significance ($p<0.05$).

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ICU Reports More Likely to be Reported as Serious Events (Continued)

Table 1. Frequently Cited Contributing Factors in Reports Related to the ICU (Based on Reports Submitted by Hospitals from 6/7/04 through 6/6/05)

Selected Contributing Factors	ICU-Related Reports Citing this Factor (%)[a]	Relative Risk Ratio (with 95% CI)[b]	Significance Relative to Non-ICU-Related Reports[c]
Staff, Team, Environment, and Organizational Factors			
Failure to follow procedures	36.5	1.24 (1.17-1.31)	Higher
Communication	25.6	1.29 (1.20-1.38)	Higher
Staff proficiency	22.7	1.19 (1.10-1.29)	Higher
Distractions	12.0	1.13 (1.01-1.27)	Higher
Training	9.6	1.50 (1.32-1.71)	Higher
Patient–Related Factors			
Patient compliance	17.0	0.60 (0.55-0.66)	Lower
Patient understanding	9.7	0.85 (0.75-0.97)	Lower

(a) Proportion is based only on reports that provided detailed information on contributing factors.
(b) A ratio of the likelihood that a contributing factor will be cited in an ICU-related report relative to the likelihood that the same factor will be cited in a non-ICU-related report. For example, "Training" is 50% more likely to be cited as a contributing factor in an ICU-related report than a non-ICU-related report.
(c) Based on Chi square tests of significance ($p<0.05$).

Notes

1. Cullen DJ, Sweitzer BJ, Bates DW, et al. Preventable adverse drug events in hospitalized patients: a comparative study of intensive care units and general care units. Crit Care Med. 1997 Aug;25(8):1289-97.
2. Beckmann U, Baldwin I, Hart GK, Runciman WB. The Australian incident monitoring study in intensive care (AIMS-ICU). An analysis of the first year of reporting. Anaesth Intensive Care. 1996 Jun;24(3):311-3.
3. Rothschild JM, Landrigan CP, Cronin JW, et al. The critical care safety study: the incidence and nature of adverse events and serious medical errors in intensive care. Crit Care Med. 2005 Aug;33(8):1694-1700.
4. Osmon S, Harris CB, Dunagan WC. Crit Care Med. Reporting of medical errors: An intensive care unit experience. 2004 Mar; 32(3):727-33.
5. Donchin Y, Gopher D, Olin M, et al. A look into the nature and causes of human errors in the intensive care unit. Crit Care Med. 1995;23;294-300.

100,000 Lives Campaign

The Patient Safety Authority previously recommended the "100,000 Lives Campaign" for adoption by facilities as part of the insurance premium reduction program identified in Act 13. Soon after, the Authority joined with other Pennsylvania healthcare organizations to form a "Node" that encourages and facilitates participation by Pennsylvania facilities in one or more of the specific "100,000 Lives" interventions.

Recently, several hospitals from around the state participated in a press and legislative briefing and panel discussion in Harrisburg with staff from the Institute for Healthcare Improvement (IHI), the organization responsible for the "100,000 Lives Campaign," to highlight the campaign's progress to date. This event was part of a national IHI tour that will include additional stops in other Pennsylvania communities and elsewhere in the country.

The Authority continues to encourage facilities to participate in this important patient safety initiative. In conjunction with the "100,000 Lives Campaign," three of Pennsylvania's Node Partners-- the Hospital and Healthsystem Association of Pennsylvania (HAP), the Health Care Improvement Foundation of DVHC and the Hospital Council of Western Pennsylvania (HCWP)-- are presenting a training session on Central Line and Ventilator Bundle Compliance in the ICU.

The program will be offered twice: the first on October 26, 2005, at the ECRI facility in Plymouth Meeting and the second on November 17, 2005, at the Hospital Council of Western Pennsylvania in Warrendale. Details will be forthcoming from the Node Partners.

More information about the "100,000 Lives Campaign" is available at www.ihi.org.

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Patient Receives Shock During Defibrillator Operational Check

Defibrillators are routinely checked for proper operation by clinical staff typically at the beginning of each nursing shift. The check by the nursing staff is relatively basic compared to the more extensive inspection and preventive maintenance of the defibrillator performed by hospital clinical or biomedical engineering personnel. The operational check is performed to ensure that the defibrillator is performing as intended and properly supplied with the appropriate accessories (e.g., monitoring electrodes, conductive gel) in the event it is needed during a patient resuscitation attempt.

PA-PSRS received a report describing a patient receiving an unintentional shock of approximately 150 joules (J) during a daily bedside defibrillator check, but was reportedly uninjured during the event. According to the report, a nursing assistant (NA) was doing the check. The NA believed she was checking the defibrillator using the device's paddles, but didn't realize that electrodes (pads) were affixed to the patient at the time.

In some situations, clinicians may use a defibrillator, with physiologic monitoring capability, to monitor patient vital signs (ECG, SpO_2). This practice is sometimes used when no other monitoring option is available. However, a major disadvantage of this practice is that defibrillators do not allow for central alarm notification. Defibrillators do not incorporate any safety mechanisms to prevent unintentional energy discharges from occurring.

Regardless of whether a defibrillator is used as a physiologic monitor, operational checks should *never* be performed while the unit's electrodes are attached to anyone. Consider limiting the performance of operational checks to nurses or to equally qualified clinicians, rather than a nursing assistant or other nonqualified staff member who may not be intimately knowledgeable of the functions of a defibrillator and the dangers it can present.

Visual checks are typically performed daily and operational checks weekly. However, before revising any procedures, review the defibrillator manufacturer's recommended operational check procedure and frequency of testing. Also, some current defibrillator models perform automatic weekly or daily self-discharge tests, which may also impact the frequency of operational checks.

The visual check[1] typically consists of the following procedures but may vary among facilities:

- Ensuring that the defibrillator's chassis is intact, clean, free from spills, and void of any objects on and around the unit that may interfere with properly using the device.
- Verifying that all appropriate accessories such as monitoring electrodes are present and within the expiration date.
- Verifying that paddles are clean and not pitted and that they release from the defibrillator chassis easily.
- Inspecting cables and connectors for damage and that the connectors are securely attached.
- Verifying that the AC charger is plugged into a "live" electrical outlet and that the AC power and/or battery-charging indicators are illuminated.
- Verifying that a fully charged battery is in place.
- Verifying that all appropriate indicators and displays are functional.
- Verifying that the device has sufficient paper for ECG recording.

The operational check[1] typically consists of the following procedures but, again, may vary:

- Verifying proper operation of the pacemaker feature, if so equipped.
- Verifying proper operation by performing energy charge and discharge cycles during battery operation according to the manufacturer's recommendations.

Suggestions for mitigating shock hazards to patients and staff during defibrillator operational checks include:

- Providing education and training on the proper operation, operational check, and

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Patient Receives Shock During Defibrillator Operational Check (Continued)

dangers associated with using or testing defibrillators.

- Allowing only qualified clinical staff to perform defibrillator operational checks.
- Consulting the defibrillator's user manual or contacting the manufacturer for directions on performing operational checks and the frequency of checks.
- If possible, avoiding use of a defibrillator as a physiologic monitor. If its use as a monitor is unavoidable, discontinue operational checks while the device is in contact with patients.

Notes

1. ECRI User Checklist for Defibrillator/Monitor/Pacemakers [Evaluation]. *Health Devices* 1993;22(5-6):292.

Update on Alcohol-Based Surgical Prep Solutions

This article updates the June 2005 *PA-PSRS Patient Safety Advisory* article titled "Risk of Fire from Alcohol-Based Solutions,"[1] in which we reported on the hazards of fire from misuse of alcohol-based liquid germicides during surgical procedures and on the controversy over the use of flammable liquid germicides during electrosurgical or electrocautery procedures.

The controversy existed because of interpretations by several government public safety organizations such as the State of Nebraska (state fire marshals, government health and human services departments) and Centers for Medicare and Medicaid Services, of inconsistencies in the 2005 National Fire Protection Association Standards for Health Care Facilities (NFPA 99) between the permitted and restricted use of flammable aerosol and liquid germicides, respectively, in anesthetizing locations during electrosurgical or electrocautery procedures.

Since publication of our June article, the NFPA has issued a Tentative Interim Amendment (TIA 05-2) to NFPA 99 standard section 13.4.1.2.2[2] on germicides which became effective August 18, 2005. This amendment now permits the use of flammable liquid germicides in anesthetizing locations during electrosurgical, electrocautery, and laser procedures provided specific fire prevention precautions are followed. The proposed revised language of NFPA section 13.4.1.2.2 on germicides can be obtained at NFPA's web site at http://www.nfpa.org/assets/files/PDF/TIA99-05-2.pdf.

Notes

1. Patient Safety Authority (PSA). Patient Safety Advisory. *Risk of Fire from Alcohol-Based Solutions* [online]. 2005 Jun [cited 2005 Aug 31]. Available from the internet at http://www.psa.state.pa.us/psa/lib/psa/advisories/june_2005_advisory_v2_n2.pdf.

2. National Fire Protection Association (NFPA) Standard for Health Care Facilities. NFPA 99. Quincy, (MA):2005.

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Problems Associated with Automated Dispensing Cabinets

Traditionally, hospital pharmacies provided medications for patients by filling patient-specific cassettes of unit-dose medications, which were then delivered to the nursing unit and stored in medication carts. The Automated Dispensing Cabinet (ADC), a computerized point-of-use medication management system, is designed to replace non-automated floor stock storage, offer better control of medications that are available in the patient care area, and/or support the traditional patient cassette exchange drug delivery system. However, such systems cannot improve patient safety unless cabinet *design* and *use* are carefully planned and implemented to eliminate opportunities for wrong drug selection and dosing errors.

PA-PSRS has received a number of medication error reports that cite an ADC as the source of the medication. In fact, nearly 15% of all medication error reports cite ADCs as the source of the medication, and 23% of these reports involve high-alert medications. Many of these reports describe cases in which the design and/or use of ADCs has contributed to the errors. The types of errors include wrong drug errors, stocking/storage errors, and medications being administered to patients with a documented allergy.

Examples of contributing factors that may have led to these errors include:

- Lack of pharmacy screening of medication orders prior to availability for administration.
- Excessive use of overrides in cabinets with patient profiling, placing the patient at risk of allergic reactions, drug interactions, and other hazards.
- Failure to recognize look-alike names in the design of an ADC's alphabetic pick list or storage compartments, which can lead to choosing the wrong medication.

Types of Errors

One unsafe practice with the use of these devices includes the excessive use of overrides and workarounds to bypass pharmacy screening of medication orders prior to administration. The use of overrides, except in an emergency, results in circumventing the pharmacy verification process in order to obtain and administer medications prior to delivery by the pharmacy. Below are examples that have been reported to PA-PSRS:

> *A patient was ordered ZOSYN (piperacillin and tazobactam). The first dose was given in the emergency department, and a second dose was given on the medical unit. Both doses were retrieved from an ADC prior to review by the pharmacy. However, when pharmacy reviewed the order, it was noted that the patient had a documented allergy to penicillin.*

> *An order was given for a stat dose of morphine. The patient had a documented allergy to this drug. A pharmacist caught the error and contacted the physician, but not before the nurse had used the override function to take morphine out of the ADC and administered it to the patient.*

Luckily, neither of the above patients experienced serious adverse effects due to these errors.

Overrides are not the only examples of workarounds used to access medications from ADCs. Other types of workarounds include the removal of medications using the "inventory" function (designed to determine the current number of doses of a particular medication on hand) to gain access to medications for patients without pharmacy screening, removing a larger quantity of medications than ordered for one patient, and removing medications for multiple patients while the cabinet is open.

Choosing the wrong medication from an alphabetic pick list is another common contributing factor for medication errors arising from medication names that look alike. For example, one organization reported to the USP-ISMP Medication Errors Reporting Program (MERP) three errors regarding mix-ups between diazepam and diltiazem removals from the ADC in their intensive care unit. In one case, diazepam was given at the ordered diltiazem dose. In another, a physician noted the amber color of the diazepam vial as the nurse was drawing up the dose (of what the nurse thought was diltiazem).

The organization concluded that once the wrong drug was chosen, the cabinet seemed to "confirm" that the correct drug was chosen since the nurse assumed the correct drug was chosen from the menu and thought the correct drug was in the drawer that opened. The nurse "relied" on the ability to choose the right drug from the pick list and, in these cases, no physical check of the product or

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Problems Associated with Automated Dispensing Cabinets (Continued)

reading of the label was done. Also in these cases, the cabinet did not contain a patient profile system, which may have prevented this error. For example, the cabinet would not have allowed entry if diltiazem had been picked from the screen display since diazepam had been entered on the patient's profile.

Storing medications with look-alike names and/or packaging next to each other in the same drawer or bin is one of the major contributing factors leading to errors.[1] A common cause of these mix-ups is what human factors experts call "confirmation bias,"[2] in which one "sees" what one expects to see. When confirmation bias occurs, it is unlikely that the practitioner would question what is being read. This can occur both in the removal of medications and in the restocking of the ADC.

Examples of these type errors from PA-PSRS include:

> *During a cardiac catheterization procedure, a nurse received a verbal order for IV LOPRESSOR (metoprolol). However, when retrieving the medication from the ADC she withdrew LEVOPHED (norepinephrine) instead due to these look-alike medications being stored in adjacent bins. The patient received the incorrect medication and required an increased level of care.*
>
> *A nurse took a verbal order from a physician for hydroxyzine 25 mg IM every 3 hours as needed for itching and wrote the order correctly in the patient's chart. However, when she went to the ADC, she pulled hydralazine and administered 25 mg IM to patient, resulting in a significant decrease in blood pressure.*
>
> *A prescriber ordered HYDROmorphone 0.5 mg IV for a patient. However, when the ADC drawer was opened both morphine and HYDROmorphone were available for retrieval. The healthcare practitioner mistakenly retrieved morphine and administered it to the patient.*

Storing excessive quantities of medications in ADCs can set practitioners up to make errors. For example, in a report submitted to the MERP, an order was written for "calcium gluconate 1 g IV," but a nurse misread the label on the medication vial and believed that ten vials of 10% calcium gluconate were needed (each 10 mL vial containing 98 mg/mL of elemental calcium, or 980 mg total). Ten vials of medication (each containing 98 mg/mL) could have been removed from the ADC, but this error was avoided because the cabinet contained only six vials of calcium gluconate. The error was detected when the nurse contacted a pharmacist at home to obtain additional vials.[3] This error highlights the importance of limiting stock in ADCs.

The process of restocking medications into an ADC is primarily a pharmacy function. Unfortunately, cabinets that do not have bar coding capabilities must rely on individual vigilance or the use of a double check involving two individuals. That leaves the process vulnerable to errors, as illustrated by the following reports submitted to PA-PSRS:

> *A patient was ordered BUPRENEX (buprenorphine) 0.3 mg as needed for pain. The nurse found that NUBAIN (nalbuphine) was stocked in the Buprenex drawer. The patient was medicated with the correct medication which was found in a storage compartment beside the Buprenex compartment.*
>
> *A patient was ordered FIORINAL (aspirin, caffeine, and butalbital). However, the wrong medication, FIORICET (acetaminophen, butalbital, and caffeine), was stocked in the Fiorinal compartment. The patient received one dose of Fioricet instead of Fiorinal. The patient experienced no adverse effects.*
>
> *A nurse noted HYDROmorphone 4 mg injections had been stocked in the morphine 4 mg compartment in the ADC. Pharmacy was notified and it was found that two patients may have received the wrong drug.*

In this last case, a serious error could occur if HYDROmorphone (DILAUDID) was used in place of an ordered morphine dose since HYDROmorphone is several times more potent than morphine.

The MERP has also received reports of similar occurrences. For example, one hospital reported placing the muscle relaxant tizanidine (ZANAFLEX), in the ADC compartment intended for tiagabine (GABITRIL), an anticonvulsant. The typical starting doses for each of these medications are similar as are their generic names, so the error was not discovered for a number of days; one patient received

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Problems Associated with Automated Dispensing Cabinets (Continued)

four incorrect doses but fortunately suffered no ill effects. In another hospital, a nurse found an Abbott Carpuject syringe of digoxin 0.25 mg/mL in the drawer that was to contain ketorolac 30 mg. Many of the Carpuject syringes look similar to one another, which could easily result in a mix-up during the stocking process. Until barcode technology is utilized during the stocking process, a check process after restocking automated dispensing cabinets may be as important as the check process conducted in the pharmacy.[4]

Strategies to Improve ADC Safety

Consider the following strategies to promote the safe use of ADCs:[3]

- If your organization is purchasing an automated dispensing cabinet, consider those that allow for patient profiling so pharmacists can enter and screen drug orders prior to their removal and administration.
- Consider purchasing or upgrading to systems that utilize bar-code technology for restocking of medications.
- Ensuring medication orders are screened by the pharmacy for the appropriateness of the drug, dose, frequency, and route of administration, therapeutic duplication, allergies or sensitivities, interactions between the prescription and other medications, food, and laboratory values, and other contraindications. This is particularly important for “high-alert” medications stored in ADCs.
- Considering the needs of each patient care unit as well as the age and diagnoses of patients being treated on each unit when deciding what drugs will be stocked in each unit’s ADCs.
- Avoiding bulk supplies of medications (e.g., multidose vials, bulk oral solutions). Instead, try stocking drugs in ready-to-use unit doses.
- Using individual cabinets or storage drawers to separate pediatric and adult medications.
- Developing a check system to help ensure accurate cabinet stocking. Another staff member from pharmacy or nurse on the unit can verify accurate stocking by having pharmacy provide a daily list of items added to the cabinet. Employing bar-code technology during the stocking process can also help assure accuracy.
- Placing allergy reminders for specific drugs, such as antibiotics, opiates, and nonsteroidal anti-inflammatory drugs (NSAIDs) on the cabinet screens or with each individual medication’s cube. Some systems allow staff to build alerts that appear on the screen when attempting to access selected drugs.
- Limiting the override function to *emergency* situations. A list of medications that can be obtained without pharmacy profile is not needed. Lists can give the false impression that certain medications may always be obtained rather than incorporating an understanding that only medications needed in an emergency situation can be obtained via override.
- Routinely running and analyzing override reports to help identify changes that need to be incorporated in the system.
- Removing only a single dose of the medication ordered. If not administered, returning the dose to the pharmacy or ADC return bin to allow pharmacy to replace it in the cabinet.
- Periodically reassessing the drugs and quantities stocked in each unit-based cabinet.

Notes

1. ISMP. ISMP Medication Safety Alert!® Acute Care Edition. 6 October 1999;(4)20.

2. Cohen MR. The role of drug packaging and labeling in medication errors. In: Cohen M, ed. Medication errors. Washington (DC): American Pharmaceutical Association; 1999.

3. ISMP. ISMP Medication Safety Alert!® Acute Care Edition. 2 December 1998;(3)24.

4. ISMP. ISMP Medication Safety Alert!® Acute Care Edition. 6 February 2003;(8)3.

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Anesthesia Awareness

Awareness has been associated with the administration of general anesthesia since its inception. More than 150 years ago, when William Morton administered ether as the first anesthetic, his patient reported being aware during the surgical procedure.[1] Not until the early 1960s did anesthesia awareness became a significant subject of inquiry, with reports estimating the incidence and the psychological consequences of awareness during general anesthesia.[2]

Types of Awareness

Awareness is usually defined simply as the patient remembering an event that occurs during anesthesia.[3] A variation of anesthesia awareness is awake paralysis, in which the patient inadvertently receives a paralytic agent but is still awake because an anesthetic agent is not given or the level of anesthesia is not adequate.[4]

Another way of categorizing anesthesia awareness is from the perspective of memory. Explicit memory (remembering) is conscious recall of a previous event or stimulus.[3,5] Implicit memory involves no conscious recollection of the event that contributed to the memory,[5] but nevertheless, emotions and behavior may be adversely affected.[3,5]

PA-PSRS Reports

Pennsylvania facilities have submitted at least 22 reports indicating awareness during general anesthesia since the inception of PA-PSRS on June 7, 2004. While most have come from hospitals, at least three reports were submitted by an ambulatory surgery unit or facility. Seventy-seven percent of patients in these reports were female. The procedures being performed varied considerably (see Table 1). Most patient complaints were of pain or feeling an incision or surgical manipulation; others indicated intraoperative patient movement, overheard conversations, and waking up. The anesthetic used was rarely specified in the reports submitted to PA-PSRS.

A few reports indicate the cause of the episode. Three reports attribute the cause to patient factors (e.g., history of reduced oxygen saturation during anesthesia). Two reports questioned the potency of the anesthetic drug (pentathol in both cases). Other causes described include:

- The anesthesia canister was locked in place but not seated properly, presumably preventing the anesthetic gas from flowing to the patient.
- A discrepancy between the vaporizer setting and the amount of anesthesia the patient actually received.
- A procedure was started before the anesthetic was administered.
- The anesthesiologist thought the procedure was completed and woke the patient prematurely.

Incidence

Historically, anesthesia awareness has been under-recognized and under-treated. As a result, the incidence of intraoperative awareness and recall has been poorly documented in the past. More recent studies, however, report that the incidence of awareness with recall while undergoing general anesthesia ranges from 0.1% to 0.2%,[2,6,7] or about 1 to 2 cases per thousand.[2,6]

While these estimates make the problem seem rare, with an estimated 20 to 21 million patients receiving general anesthesia annually in the US, approximately 100 cases occur each work day across the nation.[6,7] Further, incidence estimates have increased over the past decade as recognition of this problem has increased.[8] The incidence of anesthesia awareness is higher for certain types of procedures. For example, estimates range from 1.1% to 1.5% in cardiac surgery,[1,3] 0.4% to 4% in obstetrics,[1,3,8] and 11% to 43% in major trauma surgery.[1,3,8]

Table 1. Procedures Being Performed in Reports of Anesthesia Awareness

Procedure	Number
Colonoscopy or cystoscopy under general anesthesia	2
Laparoscopic cholecystectomy	2
Cesarean section	2
Unspecified abdominal procedure	2
Gastric bypass	1
Unspecified cardiac surgery procedure	1
Exploratory laparotomy	2
Mastectomy	1
Prolonged/difficult intubation for unspecified surgical procedure	2
Other unspecified surgical procedure	7

Immediate Manifestations

Patients' experience of anesthesia awareness includes many

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Anesthesia Awareness (Continued)

sensory perceptions. Patients may be aware of conversations, voices, and other sounds around them.[1,4-7] Others may be aware of the sensation of paralysis.[1,4-6] When neuromuscular blocking drugs are used, the patient is completely paralyzed and unable to communicate to the surgical team.[5,9] In addition, they may sense the endotracheal tube[1,6] or their inability to breathe for themselves.[5-7] Patients may experience pain when the incision is made/closed or during surgical manipulation.[1,2,4,5,9] They may also feel pressure without pain[1,6] Less commonly, the patient may have visual perceptions.[1] Intraoperatively, anesthesia awareness may produce stress, mental distress, anxiety, panic and terror,[1,2,4-6,9] as well as feelings of helplessness and powerlessness.[1,5,9]

Sequelae

Patients' responses to anesthesia awareness may range from simple dissatisfaction[2] to severe psychological sequelae. Studies indicate that from 50-70% of patients experiencing intraoperative awareness experience unpleasant after effects.[1,5,7,8] These include phobias such as fear of intraoperative awareness recurring if anesthesia is required in the future.[3,5,8] Other sequelae include recurrent dreams and nightmares, flashbacks, sleep disturbances/insomnia, daytime anxiety, and panic attacks.[1,3-5] Impaired social and work interactions are also reported.[8] Patients may feel betrayed or abandoned by their healthcare workers.[1,9] This may result in unwillingness to discuss symptoms or the anesthesia awareness experience, general distrust of healthcare personnel, as well as avoidance of healthcare workers and environments that remind them of their surgical and anesthesia experience.[1,3,4] Without intervention, from 10 to 25% of patients experiencing anesthesia awareness develop post-traumatic stress disorder (PTSD).[1,3,4] PTSD may continue for months, and even years, after the awareness event.[1] Permanent disability from these symptoms may ensue.[8]

Patients who experience anesthesia awareness may not report it. Those who do not suffer during awareness may not feel there is a reason to tell anyone or may not care about it.[2] Patients who are traumatized by the event and who develop dissociation may appear calm or unaffected by the event. Patients with PTSD or post-awareness dissociation may not, therefore, be identified as having suffered.[9] Postoperative psychiatric complaints that appear unrelated to anesthesia awareness may also be reflective of a post-anesthesia awareness psychiatric complication.[9]

Factors Contributing to Anesthesia Awareness

Patient Condition

Anesthesia awareness may occur with normal doses of anesthesia in patients who have increased anesthesia requirement and/or who are unexpectedly tolerant to anesthesia.[5] Such patients include those with chronic use of amphetamines, opioids/cocaine, or alcohol.[1,3,5,8,10] Other factors associated with an increased anesthesia dose to produce unconsciousness include a younger age, tobacco smoking, and morbid obesity.[3,5]

Other patient conditions may require light anesthesia, thus increasing the risk of anesthesia awareness.[10] For example, patients with ASA ratings of III to V are at increased risk if heavy anesthesia is used.[6] The risk of anesthesia awareness is therefore increased in such patients. In patients undergoing major trauma or cardiothoracic surgery, or in hypovolemic patients and those with minimal cardiac reserve, anesthesia may need to be reduced to maintain blood pressure.[1-3,5,7,10] For patients undergoing obstetric procedures, such as Cesarean section, light anesthetic technique is used to reduce the potential for depression of the fetus.[1-3,5,7,8,11] Abdominal and ophthalmic surgery has also been associated with anesthesia awareness.[6]

Process/Type of Anesthesia

The use of inhalation volatile anesthetic is more effective than nitrous oxide in reducing the incidence of recall during general anesthesia.[1,7,8] The risk of intraoperative awareness is increased with the use of nitrous oxide only, or in combination with IV opioids, benzodiazepines, barbiturates, propofol, and muscle relaxants.[1,4,5,7,10] There appears to be greater patient-to-patient pharmakinetic variability with IV agents than with volatile anesthetics.[1,10] Thus, titrating the IV agents may be more difficult to meet a specific patient need. Malpractice claims for recall during general anesthesia are more likely to involve techniques using nitrous oxide/narcotic/relaxant techniques than volatile anesthetics.[1,3]

Also, during a difficult intubation, anesthetic drugs may wear off during an intubation period that is longer than originally anticipated.[1,2,5,10]

If intraoperative hypotension occurs, anesthetic agents may be prematurely discontinued, increasing the risk of intraoperative awareness.[1,5]

Some small studies have found that women wake up faster from nitrous oxide with propofol/alfentanil

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Anesthesia Awareness (Continued)

than men.[1,5,12] This may explain why malpractice claims for recall during general anesthesia are more likely to be filed by women.[4] However, a study of 19,000 cases of general anesthesia found that sex did not influence the incidence of awareness.[6] Further study of the pharmacodynamics of anesthetic drugs would be needed to determine the role of gender in anesthesia awareness.[4]

Medications/Drugs

Anesthesia in the presence of amnestic drugs increases the risk of anesthesia awareness.[8] Use of amphetamines[3], beta blockers, and calcium channel blockers can mask physiologic responses to inadequate anesthesia.[7] A high level of Vitamin C may interfere with anesthetic effect.[13] The use of neuromuscular blocking agents/muscle relaxants may contribute to unintentional provision of insufficient anesthesia.[3,8,11] When a non-paralyzed patient is inadequately anesthetized, the patient is able to communicate awareness through movement. This cue is absent when patients receive a neuromuscular blocking agent.[3]

Medication Errors

Calculation errors or infusion pump programming errors may result in failure to administer an appropriate dose of an anesthetic agent.[1,8,10,11] During a long intubation, the healthcare worker may not administer a second anesthetic dose on a timely basis, thus increasing the possibility of awareness.[1,10] Awake paralysis events are most likely to be associated with errors in labeling[10] and sequence of administration during the pre-induction phase.[4] The ASA closed claims project indicated that two-thirds of the awake paralysis claims related to succinylcholine infusions being unlabeled or mislabeled, or failure to check labels.[8] In addition, swapping of properly labeled syringes has been reported.[8] In some cases, muscle relaxants were administered first instead of a sedative or hypnotic agent.[1,10]

Machine Malfunctions

The delivery of anesthetic agents to the patient can be impeded/prevented through many equipment-related issues. Vaporizers may malfunction, not be turned on, or may be empty.[3,5,8] The source of anesthetic gas (such as a nitrous oxide cylinder) may be empty.[3] Intravenous pumps may malfunction.[3] There may be leaks or disconnections between vaporizers and circuits or delivery tubing.[1,3,5,10] Technical equipment failures of the anesthesia machine can affect the delivery of the anesthetic agent to the patient.[5,10,11]

Interventions

If anesthesia awareness is reported, the foremost therapeutic interventions are to respect the patient by taking it seriously and to treat the patient sympathetically.[1,5,9,10] While spurious claims have been reported,[14] for the most part, reports of anesthesia awareness are genuine and can have significant consequences. Ignoring or disbelieving the report is likely to promote more serious emotional aftereffects. Effective interventions include: compassionate debriefing; assuring the patient that the report is credible; and empathizing with the patient's suffering.[1,3,7,10] If awareness is discovered intraoperatively, patient stress may be reduced by offering comforting/affirming comments until anesthesia is increased and the patient loses consciousness.[10]

Investigation of the event is conducted,[5] followed by explaining what happened to the patient.[1,3] The explanation is more effective if an apology is offered,[1,3,7] and the reason is presented (such as light anesthesia was required because of substantial cardiovascular instability).[7] Explaining to the patient methods to prevent recurrence of anesthesia awareness can be reassuring.[1,3]

Counseling or other forms of psychological support are indicated, particularly if anxiety, flashbacks, or persistent nightmares exist.[3,5,7,10] Anecdotal evidence suggests that debriefing by the anesthesiologist after an awareness event may be effective in preventing a chronic traumatic reaction. In addition, early referral for psychological/psychiatric counseling may also reduce the occurrence and severity of the emotional aftereffects of PTSD.[1,3,5]

When interviewing the patient who reports awareness, information can be encouraged by asking several questions (See Table 2).[3,15] Such an interview reaffirms that the patient's report is respected, and it provides an opportunity for the anesthesiologist to assess not only the patient's perceptions of the experience, but also to determine adverse aftereffects for which early referral for psychological support are indicated.[5,7]

Communicating with healthcare workers involved in the procedure helps to ensure their contribution to the investigation of the event as well as validation and support of the patient.[9] The healthcare team can be instrumental in identifying adverse outcomes that may require treatment,[9] as well as ensuring that a support network is available to the patient. Healthcare workers can document in the medical record the conversations with the patient,

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Anesthesia Awareness (Continued)

Table 2. Post-Anesthesia Interview Questions

The following questions may be helpful in eliciting information from patients concerning anesthesia awareness.[15]

Questions asked of all patients who have undergone general anesthesia

1. What was the last thing you remember before going to sleep before your surgery/procedure?
2. What is the first thing you remember when waking up from your surgery/procedure?
3. Do you recall anything in between?
4. Did you have any dreams while you were asleep during your surgery/procedure?
5. What was the most unpleasant thing you remember from your surgery/procedure and your anesthesia?

Additional questions to ask if a patient reports anesthesia awareness

1. What do you remember (tactile sensations, pain, sounds, conversations, visual perceptions, pain, paralysis)?
2. Did you feel something in your throat or mouth?
3. What was going through your mind during this experience?
4. Did you think you were dreaming?
5. How long do you think this recollection lasted?
6. Did you try to alert anyone during your surgery/procedure?
7. How was your emotional/mental state before your surgery/procedure?
8. Have there been any consequences of this awareness experience?
9. How do you feel now?
10. Did you inform any healthcare worker of this experience after you woke up?
11. Has this experience changed your opinion about anesthesia, your healthcare workers, or healthcare facility?
12. What can I, as a healthcare worker, do to help you?

Adapted from: Wennervirta J, Ranta S O-V, Hynynen M. Awareness and recall in outpatient anesthesia. *Anesth Analg* 2002;95:72-7.

the details of the experience expressed by the patient, the patient's response, and recommendations/referrals for follow-up care.[3,5,7]

Maintaining contact with the patient is helpful to monitor and refer for psychological sequelae.[1] The post-anesthesia visit conducted within the first 24 hours after surgery, daily visiting during hospitalization, and regular telephone contacts thereafter until the patient appears to have recovered from the event allows the healthcare team to determine whether complete recovery has occurred or additional intervention is required.[3]

Prevention/Risk Reduction

The following actions may reduce the risk of anesthetic awareness.

Administration of Anesthetic Agents/Drug Associated with Anesthesia

- Administering amnestic premedications when light anesthesia is necessary (scopolamine, benzodiazepines, midazolam,[1,7,10] or subanesthetic doses of ketamine or inhalation agents[4]).
- Minimizing the use of complete neuromuscular blockade[1] and avoiding muscle paralysis unless absolutely necessary.[3,11] By avoiding complete muscle relaxation, patients may have a movement response or may open their eyes in response to a verbal command if anesthesia awareness is imminent.[5,7,10] Usually, a patient does not recall responding to a verbal command by movement, because movement occurs at a higher dose of anesthetic agent than the level allowing recall. Likewise, if a patient does not respond to a verbal command to move, recall under general anesthesia is less likely.[1]
- Supplementing nitrous oxide/opiate anesthesia with a potent volatile anesthetic, with end-tidal concentrations of 0.6 minimum alveolar concentration (MAC).[1,3,4]
- When a potent volatile anesthetic agent is used by itself, maintaining 0.8 to 1.0 MAC.[1,3]
- If tracheal intubation is to follow immediately, or if a difficult intubation requires repeated intubation attempts over an extended period of time, administering more than a "sleep dose" of induction agents[1,4,7,11] or repeating the induction agent.[5,10]
- Giving adequate doses of anesthetic agents that are safe for the patient, consistent with patient history and medical conditions.[3,5,10,11] Intraoperatively, if low anesthesia concentrations are required, adding a sedative agent such as scopalamine and talking to the patient during the procedure to explain why awareness may be occurring.[5]
- Scrupulous checking of syringes before administration. Labeling all syringes and checking prefilled syringes by two persons.[16]

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Anesthesia Awareness (Continued)

Assessment/Identification of Patients at Risk

- Using the anesthesia preoperative assessment to identify patients who are at risk for anesthesia awareness.[5]
- For those at risk, using the informed consent process prior to surgery to discuss the concept of anesthesia awareness, the reasons it might occur, and interventions to prevent its occurrence.[1,3,5,17]

Post Operative Assessment

- Incorporating assessment for anesthesia awareness as part of the ongoing postoperative process for all patients including children,[17,18] from the recovery room through postoperative visits by the anesthesiologist, as well as office visits with the surgeon.[9]

Memory of intraoperative awareness may be delayed by several days in as many as 50% of patients who experience awareness.[2,6] Some patients may recall this awareness one to two weeks after surgery because subhypnotic concentrations of anesthetics may impair recall during the first 24 hours after surgery.[2,3] In addition, no relationship has been found between when recall first occurs and the severity of the patient's experience.[2] Postoperative inquiry over time would help identify patients who may have delayed recall.

Postoperative inquiries (See Table 2) of all patients who have undergone anesthesia may also encourage those patients who would not ordinarily report the experience to discuss this issue.[3] Such patients might include those who were not disturbed by the experience or those who have dissociated in response to the experience. One study indicated that half of patients who experienced anesthesia awareness did not report it to their anesthesiologist because they had not seen him/her since the operation.[3]

Communication

Limiting OR conversation to what is clinically appropriate respects the dignity of every patient. Avoiding negative or derogatory comments about the patient's physical condition, prognosis, or appearance will ensure that inflammatory words/terms will not contribute to the patient's emotional distress if awareness occurs.[5] Some have recommended the use of auditory masking so that intraoperative remarks are not heard, but this does not address other awareness complaints, such as pain or paralysis.[3] In non-paralyzed patients, auditory masking might prevent a patient from moving in response to a verbal command – a test of anesthesia awareness.

Equipment Maintenance

- Involving clinical engineering and incorporating anesthesia machines, vaporizers, infusion pumps and other anesthesia-related equipment into a periodic preventive maintenance program, to ensure that equipment is functioning properly.[3,10,18]
- Meticulously checking the machine and ventilator before each administration of anesthesia.[3,5]
- Regularly checking flow meters, vaporizers, and level of anesthetic in the vaporizer intraoperatively.[3,10]
- Monitoring the levels of inspired/expired gases and inhalation agents.[3]
- Administering anesthetic infusions preferably through a dedicated line.[3]
- Using infusion pumps with volume and pressure alarms that are activated/audible.[3]

Education

Overall, the clinical literature indicates that healthcare personnel understanding of the existence and management of anesthesia awareness is poor or lacking.[3] Heightening awareness of the following will alert healthcare workers of this phenomenon: incidence, symptoms, sequelae, risk factors, interventions, and prevention/risk reduction. Conditions/drugs that affect the effectiveness of anesthesia or mask responses to inadequate anesthesia can be presented.[7] Skills can be developed to identify those at risk, intervene when awareness occurs, and to validate/empathize when awareness occurs.[5,10] Education and confirming competencies concerning the appropriate use and checking of all anesthesia-related equipment may reduce anesthesia awareness events associated with equipment.

Advising the patient to inform anesthesia providers about the anesthesia awareness experience and the factors that placed the patient at risk may improve planning for and risk reduction during future procedures.[3]

Protocols

Developing/reviewing and revising policies/protocols may effectively contribute to reducing or managing anesthesia awareness events.[18] Concepts to consider in such protocols include:

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Anesthesia Awareness (Continued)

- Education of clinical staff about anesthesia awareness and management of patients experiencing awareness.[7]
- Identification of patients at risk and discussion with such patients prior to surgery of the potential for awareness and prevention efforts.[7]
- Regular identification of anesthesia-related equipment.[7]
- Application of appropriate anesthesia monitoring techniques.[7]
- Postoperative follow-up of all patients, including children, who have received general anesthesia.[7]
- Mechanisms for referral/access for patients who are in need of counseling, support and effective treatment for mental distress or PTSD.[7,9]
- Reporting processes of such events both within and outside the healthcare organization.[5]
- Documentation of the patient complaint.[5]
- Investigation and reporting processes.[5]
- Evaluation of the outcome of the intervention.[5]
- Identification, analysis, and implementation of opportunities for improvement.
- Mechanisms/processes used to monitor patients for anesthesia awareness.[5]
- Specification of training requirements and competencies required of personnel who use anesthesia-related equipment.

Monitoring

Vigilant application of current monitoring techniques/technologies can have a positive impact upon anesthesia safety and may also prevent or reduce anesthesia awareness.[18] The American Society of Anesthesiologists (ASA) has developed standards for basic anesthesia monitoring that include continual evaluation of the patient's oxygenation, ventilation, circulation, and temperature.[5,19] The American Association of Nurse Anesthetists (AANA) has standards for continuous monitoring of the same patient parameters, as well as for neuromuscular function/status and assessment of patient positioning.[20] In addition, gas monitoring can verify that proper levels of anesthetic gases are delivered or identify equipment failures/abnormalities in the gas delivery system.[5]

Indirect physiologic monitoring techniques are used to monitor for anesthesia awareness.[21] These signs include blood pressure, respiratory and heart rate, skeletal muscle relaxation, ocular movement and pupillary dilatation, and sweating.[1,3,7,8,21,22] In some countries the autonomic vegetative clinical signs are quantified as the PRST score (changes in blood pressure, heart rate, sweating, tear production).[23] One small study indicated that in 4 of 5 cases, blood pressure and heart rates substantially above resting levels were a clear indication of the patient returning to consciousness.[5]

However, autonomic responses may be unreliable in detecting level of consciousness.[3,5,10,23] For example, patients medicated with antihypertensive medications (such as beta blockers or calcium channel blockers) may not have hemodynamic responses to anesthesia awareness.[5,7] The use of muscle relaxants during general anesthesia will limit a patient's ability to move and communicate in response to awareness.[5] End-tidal monitoring of anesthetic gas concentrations also has been shown not to prevent anesthesia awareness in a prospective study.[10]

Voluntary movements, or movement responses to noxious stimuli, however, are one of the best clinical measures for detection wakefulness or potential wakefulness during surgery in non-paralyzed patients.[1,3,23] The isolated forearm technique (IFT) has been utilized over the past 25 years, and it has been regarded as a scientific "gold standard" for detecting cognitive function during relaxant anesthesia. However, it has not been used widely in the US.[2]

IFT involves the application of a blood pressure cuff/pneumatic tourniquet after induction of anesthesia. The cuff/tourniquet is placed on the arm opposite that in which neuromuscular blocking agents are to be injected, and it is inflated above systolic pressure. The cuff/tourniquet remains inflated until the relaxant drug is tissue-bound.[24] As a result, the forearm is not paralyzed. This allows the patient to move wrist and fingers if the anesthesia becomes too light.[24] The patient is asked to clench the fist as an assessment of responsiveness.[21] Prolonged monitoring is achieved by releasing the cuff and reinflating it later if/when further muscle relaxation is necessary. This cycle can be continued indefinitely when non-depolarizing muscle relaxants

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Anesthesia Awareness (Continued)

are used (such as atracurium or vercuronium), but not when pancuronium is used.[25]

This technique could be offered to persons with a history of anesthesia awareness. While it does not guarantee that awareness will not happen, it can ensure that the patient has a method of communication if the event recurs. The technique is cost-effective, and the required equipment is already available in the surgical services environment.[24]

Some manufacturers have developed devices that directly measure brain activity, rather than physiologic responses.[7,21] This technology is based on processed electroencephalogram (EEG) data or auditory evoked potentials. These devices include bispectral index (BIS), spectral edge frequency (SEF), median frequency (MF), mid-latency auditory evoked potentials (MLEAP or AEP), steady-state evoked potentials, and m-entropy.[1,2,10,21,23] These new methodologies may be less affected by medications usually administered during general anesthesia, thereby helping to detect and prevent anesthesia awareness in high-risk patients.[7] However, a sufficient body of independent evidence must be further developed to definitively determine the effectiveness of these monitors in the prevention and reduction of anesthesia awareness.[7,18,21]

Currently, neither the ASA or AANA have a standard for brain-wave monitoring. These organizations have constituted a joint scientific work force to conduct a critical review of the technology. Published, peer reviewed studies will be evaluated, and a report is expected to be available within the next year.[22] The JCAHO has indicated that, at this time, adequate evidence is not available to define the role of the technology in the prevention and detection of anesthesia awareness. However, additional information is expected to develop.[18]

If a facility is currently using, or is considering purchasing, level-of-consciousness monitors, users can be educated concerning the indications for and limitations of this technology.[5,18]

Resources on Anesthesia Awareness

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American Society of Anesthesiologists. Example of a policy on unintended intraoperative awareness. (members only) http://www.asahq.org/index.htm.

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