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Patient Safety Tip of the Week

July 14, 2020

A Thesis on Intrahospital Transports

Intrahospital transports can be very hazardous for patients (see our many columns on the issue listed at the end of today's column). They are especially risky for critical care patients. Many of those transports are to the Radiology Suite or the MRI suite, areas we've also previously identified as being at high risk for patient safety issues. Lina Bergman, a PhD critical care nurse in Sweden, recently did a thesis on the hazards of intrahospital transports that adds to our understanding of the risks of these transports (Bergman 2020).

For the thesis, she and her research team analyzed almost 500 intrahospital transports of patients from 2 ICU's in a Swedish hospital, one a general/trauma ICU (18 beds) and the other a neurological ICU (8 beds). A typical transport team consisted of a minimum of 2 individuals but might have as many as 5 or more. A researcher or research assistant did observations during intrahospital transports and also performed semi-structured interviews with both intensive care staff (nurses and physicians) and patients.

She utilized a conceptual model based on the 5 components of the SEIPS (Systems Engineering Initiative for Patient Safety) model:

- Teamwork
- Transport-related tasks
- Tools and technologies
- Environment
- Organization

An item set was developed that, after several iterations, had a total 55 items among the 5 dimensions: teamwork (16), transport-related tasks (9), tools and technologies (12), environment (9), organization (9).

A total of 51 intrahospital transports over a 6-week period constituted the data sample. 62% of the transports were for CT scans. 80% of transported patients were on mechanical ventilation, 61% were receiving continuous sedation, and 51% were on vasopressors.

A total of 365 patient safety hazards were identified during these 51 intrahospital transports, with a median of **7 hazards per transport**. Broken down by category:

- Tools and technology (34%)
- Task hazards (23%)
- Team hazards (17%)
- Organizational hazards (13%)
- Environmental hazards (13%)

Examples of ineffective teamwork included loss of information between team members or tasks not being performed as intended. Examples of task hazards included interruptions and distractions during preparation for transport that resulted in skipped safety checks or prolonged preparation times. Examples of tools and technologies hazards included equipment errors, such as disconnection of tubes or lines, Problems with equipment and workplace design often led to workarounds.

Classifying by type of event found increased risk of harm (n=204), minor hazards (n=81), no harm (n-21), and observable adverse events (n-3).

Themes were grouped into 2 main categories:

1. Organizational, environmental, and technical requirements
2. Knowledge, skills, and competences needed

In the first category, poor equipment design and lack of technical solutions often resulted in hazards that led to equipment errors and equipment-related mishaps. Poor workplace design, both at the ICU and destination sites (and sites between) provided obstacles that had to be navigated around. Staff felt that the same equipment used in the ICU should be used during the transports. Moreover, poor overall hospital design was a significant contributing factor. For example, staff often felt that hospitals should have been designed such that radiology would be located near the ICU and avoiding the need for elevator transport.

In the second category, staff noted that knowledge and experience in performing transport-related functions and individual skills to anticipate and predict safety scenarios were important. Moreover, they recognized that the "**collective competence of the transport team**" was especially important. Only a third of interviewees said they used a checklist during the intrahospital transports, but 64% of these found use of the checklists helpful.

When the researchers assessed the opinions of nurses and physicians, they found a pattern we have seen previously – nurses wanted more interprofessional collaboration, whereas physicians were satisfied with the current status.

The researchers also interviewed patients and found they, in general, were very satisfied with the transports and trusted their caregivers. The healthcare professionals, on the other hand, found the transports to be demanding and sometimes unsafe.

The Bergman thesis does include a 24-item scale that can be used for evaluation of intrahospital transports of ICU patients. It can serve as a good quality improvement tool.

Bergman provides several practical recommendations for intrahospital transports, based on the research observations:

- Triage should be performed prior to the intrahospital transports, with assessment of competences of staff.
- Team roles and responsibilities should be standardized at the local ICU.
- Critically ill patients should be accompanied by at least 3 healthcare professionals, 2 of whom are nurses qualified in intensive care.
- A "team timeout" should be performed prior to departure from the ICU and, if needed, during the transport.
- Communication techniques, such as closed-loop communication) should be used during transports.
- When handoffs occur, use of a standardized format (such as SBAR) should be used.
- Other ICU duties should be handed over prior to preparing the patient for transport.
- Interruptions and distractions should be avoided during the preparation phase.
- A checklist for intrahospital transport to support task performance should be developed and implemented.
- Transport equipment should be easy to use and facilitate task performance.
- The transport team should be available to monitor the patient throught the transport.
- Continuous maintenance of equipment should minimize technical errors.
- Workplace design at both the ICU and destinations should be improved to minimize workarounds.
- Hospital settings should be planned or rebuilt to shorten transport routes (preferably with hallways reserved for staff).
- Transport routes should be mapped and displayed.
- Local maintenance should minimize environmental disturbances.
- Local guidelines for intrahospital transport should be developed.
- Staff education and training should address both technical and non-technical skills.
- Adequate staff and resources should be provided.

We really like her idea of a "**team timeout**" prior to departure from the ICU. We are a big fan of "huddles". This is an opportunity not only to say "Do we have everything we need?" and go over the "Ticket to Ride" checklist, but also to say "Are there any things we might anticipate?". That's also a good time to ask "Have we communicated with the receiving unit?". Hospital personnel on the receiving end also be familiar with the transport equipment and status of the patient. That brings us to another thing we'd emphasize: the need for an appropriate **handoff** prior to and following the transport. Let's say you are transporting a critically ill patient to the Radiology suite for a CT scan. You should discuss with the radiology nurse or radiology staff whether your patient is on oxygen, being ventilated, whether the patient will need sedation for the procedure, what

sorts of medications are running in various lines, etc. and discuss what events might be anticipated.

The Bergman thesis broke down the 365 safety hazards into 5 categories but did not provide individual description of each hazard. But you can go back to our October 22, 2013 Patient Safety Tip of the Week "How Safe Is Your Radiology Suite?" for a comprehensive discussion of all the things that can go wrong when a patient is sent to the radiology suite. That column and several others demonstrate a wide variety of hazards you might encounter during an intrahospital transport. We also refer you back to our August 25, 2015 Patient Safety Tip of the Week "Checklist for Intrahospital Transport" for discussion about the many factors contributing to incidents related to intrahospital transports. These include equipment failures, oxygenation issues, battery/power issues, and things like attention to patient hydration. And don't forget the problems that arise when sending diabetic patients off for substantial periods of time (what to do with their insulin, planning for meals, etc.).

In our August 25, 2015 Patient Safety Tip of the Week "Checklist for Intrahospital Transport" we noted problems maintaining adequate **oxygenation** are particularly a problem during transport of patients (within or outside of facilities). The Pennsylvania Patient Safety Authority highlighted this issue in a Patient Safety Advisory in 2005 "Continuity of Oxygen Therapy During Intrahospital Transport" (PPSA 2005b). They reviewed numerous reports to the Pennsylvania Patient Safety Reporting System (PA-PSRS) and looked at failure modes in the many steps involved in maintaining adequate oxygen therapy during transport. They noted that **oxygen therapy has been reported to be interrupted in as many as 55% of transports**. Failure modes identified included: failure to treat with oxygen when ordered, failure to initiate flow from the oxygen source, failure to connect the oxygen tubing to the source, failure to place the oxygen delivery device on the patient, and failure to anticipate the oxygen demand and provide an adequate supply throughout the transport. **Battery power failure** (see our February 4, 2014 Patient Safety Tip of the Week "But What If the Battery Runs Low?") is a potential risk. Not only do portable ventilators run on battery power but monitors and infusion pumps and possibly other equipment may also run on batteries.

In our March 13, 2012 Patient Safety Tip of the Week "Medical Emergency Team Calls to Radiology" we noted a series of articles by Lora K. Ott and colleagues (Ott 2012, Ott 2011a, Ott 2011b) that looked at medical emergency team/rapid response team calls to the radiology suite and analyzed patient factors related to those calls. The percentages in the papers differ, presumably because the time frames for each were different, but the most recent paper appears to account for all the cases over a two-year time period so we'll use those statistics. The majority of the calls (60%) were for patients not from the ICU's and for almost half they occurred on the patient's first day in the hospital. The authors speculate that this could be due to several reasons: (1) ICU patients are recognized to be more at risk and are more likely to be accompanied to radiology by nursing staff (2) the subtler evolving signs of clinical deterioration may not have been appreciated in the patients from the general units who are not as closely monitored. The

majority had a Charlson comorbidity index equal to or greater than 4 and about a third each had nasal cannula oxygen, dyspnea, or tachycardia.

The nature of the events in the radiology suite were primarily cardiac in 41%, respiratory in 29%, and neurological in 25% and most required a higher level of care after the event. 44% of the calls involved patients undergoing CT scan and 22% MRI scanning. That should not be surprising, given our many prior articles on safety issues in the radiology suite. During either procedure the patient is relatively isolated from monitoring staff for periods of time. In addition, sedation may be used to facilitate completion of some of those studies. Dislodging of catheters, tubes and lines during transfer to the CT/MRI platforms could also play a role. Also, the nature of the underlying condition necessitating the CT or MRI scan may also predispose these patients to the types of deterioration seen. In one of the earlier papers (Ott 2011b) neurological causes of deterioration were more frequent so it's not surprising that many of these would have occurred during CT or MRI.

In one of the articles (Ott 2011b) peak time for such events was between 10 AM and noon. The authors ascribe this interesting temporal trend as most likely reflecting detection on morning rounds of symptoms and signs necessitating the diagnostic studies.

One of the most comprehensive review of incidents related to intrahospital transport came from the Australian Incident Monitoring Study in Critical Care, reported by researchers from Australia and Johns Hopkins (Beckmann 2004). They found 191 incidents related to intrahospital transport from 37 Australian ICU's between 1993 and 1999. Roughly a third (31%) of the incidents had serious adverse outcomes, with major physiological derangement in 15%, physical/psychological injury in 4%, death in 2%, and prolonged hospital stay in 4%. In addition, patient/family dissatisfaction occurred in 7%. The site to which the transport occurred was evenly split between the Radiology suite and the OR, with some transports to the ward, ER, or other sites.

They were able to categorize the incidents as equipment-related in 39% and related to patient/staff management issues in 61%. Overall, they identified 900 contributing factors, 46% of which were system factors and 54% human-based factors. Equipment related issues included problems with oxygen, battery/power supply, ventilators, monitors, drug delivery systems, etc. But, similar to the Bergman study, they also included things like problems with the hospital elevators. The patient/staff management issues mostly had to do with communication issues, airway management, vascular line management, monitoring, and positioning and set-up of equipment.

They did find a number of factors that seemed to prevent or limit harm to patients in the incidents. These included "rechecking equipment", "rechecking the patient", "prior experience", "use of the correct protocol", and "skilled assistance". These mitigating factors led the researchers to recommend potential use of checklists, protocols/guidelines for transport, and specific training for transport or use of specialized transport teams. They also stress the importance of adequate monitoring of the patient throughout. Some of the potential checklist items to include relate to oxygen supply, battery life, lines and

tubes, and capability of transferring patient between bed, stretcher and table. Preparation must include not only getting the patient and equipment ready but also liaising with the staff at the destination department.

The Beckmann study also demonstrates the value of having incident reporting that allows such drill-down and tracking of intrahospital transport incidents. That, in fact, is a metric we think should be part of an ICU quality and performance improvement program.

Our March 31, 2020 Patient Safety Tip of the Week "Intrahospital Transport Issues in Children" looked at adverse events during intrahospital transport of critically ill children and highlighted a study by Haydar et al. (Haydar 2019). **Respiratory and airway events** were the **most common** type of adverse event. **Hypothermia** was common in infants. They also found instances of emergent tracheostomy, pneumothorax, and cardiac arrest. One transport-associated death was reported.

One hazard we had not commented upon often enough in intrahospital transports is **hypothermia**. We did discuss the risk of hypothermia in **inter**hospital transfers (see our October 30, 2018 Patient Safety Tip of the Week "Interhospital Transfers"). In our January 7, 2020 Patient Safety Tip of the Week "Even More Concerns About MRI Safety" we discussed a study that showed most children who undergo MRI while under anesthesia experience hypothermia at some point during the procedure (Cronin 2019). Children, particularly **infants**, are especially prone to hypothermia. Nevertheless, you should consider the possibility that your patient might develop hypothermia during a transport, particularly one that might be prolonged, and take appropriate steps to keep the patient warm.

Apparently only about a third of transports in the Bergman study used **checklists**. Planning for and implementing transports is greatly facilitated by use of the "**Ticket to Ride**" checklist. The original "Ticket to Ride" checklist was developed to ensure that patients being transported had adequate oxygen supplies, since some studies showed that over half of patients transported to sites like the radiology suite ran out of oxygen. But the "Ticket to Ride" checklist has been expanded to include many other considerations for events that might happen during and after a transport (see our many columns on "Ticket to Ride" listed below).

A "Ticket to Ride" checklist for a patient returning to a med/surg unit from the OR or PACU must include not only items pertinent to the procedure and recovery that just took place, but must also consider issues from before the surgery or procedure. For example, were certain medications withheld prior to the surgery? Do they need to be restarted? Is there physiologic monitoring that needs to be restarted?

In our August 25, 2015 Patient Safety Tip of the Week "Checklist for Intrahospital Transport" we discussed a checklist for intrahospital transport of critically ill patients developed by clinical researchers in the Netherlands (Brunsveld-Reinders 2015). When they prospectively monitored transports, they found that in 26% of 503 transports to Radiology one or more incidents occurred.

We refer you to the Netherlands study itself (Brunsveld-Reinders 2015) to actually see the checklist they created for intrahospital transports. The article also addresses transport team composition (which may vary depending upon whether the patient is ventilated or on pressors or inotropes) and education/training needs for members of the transport team. The equipment check prior to transport includes not only status of the oxygen supply and battery/power supplies but also considerations such as hydration before studies using radiographic contrast or whether equipment is MRI-compatible (eg. non-ferromagnetic materials, long enough IV lines, etc.) if the patient is going for an MRI. Medication and fluid status must be addressed prior to transport. And it is crucial that communication take place with the receiving department to ensure they are ready to accept the patient and whether any items such as informed consent are available. One often-overlooked item is ensuring that the transport route is clear and functional. We've seen unsafe transports take place because no one realized an elevator was out of service. They provide considerations for during transport, such as attention to equipment, monitoring, and medications/IV's. And post-transport they focus on ensuring proper equipment and line/tubing connections, resumption of feeding if applicable, turning on the humidifier on the ventilator, etc. They also stress the importance of reporting any incidents or events that may have happened during the transport.

The **Netherlands checklist took an average of 4.5 minutes per phase** (range 3 to 10 minutes). It was generally well accepted and one of the key factors in that was its integration with their electronic medical record.

A good "Ticket to Ride" type checklist for intrahospital transport should cover all three phases of transport: pre-transport, during-transport, and post-transport (Jarden 2010, Brunsveld-Reinders 2015). One question to include on the post-transport section of a "Ticket to Ride" checklist is "Are there any medications or monitoring that need to be restarted on this patient?".

"Ticket to Ride" checklists also should be **customized** to reflect both patient-related factors and factors related to the destination or nature of the procedure the patient is being transported for. For example, on an ICU patient transport you probably don't need items for wandering risk or suicide risk that you would want on transporting a confused patient from a med/surg unit or a depressed patient on a behavioral health unit. And, while we recommend at item about risk of hypothermia for most patients, that item is extremely important to include on infants and young children. And your checklist would differ for a patient going to Radiology for simple radiographs compared to a patient who might need sedation for a CT scan or MRI scan.

One extremely important question is missing in the Bergman thesis: how many of the transports were indicated in the first place? Every time we do a root cause analysis (RCA) on an intrahospital transport that had an adverse event, the first question we ask is "**Was the transport indicated?**". Not uncommonly, we find that the indications for the test or procedure for which the transport was undertaken were "iffy" at best. One set of statistics we like to cite is that by Beckmann et al. (Beckmann 2004). They note that

studies suggest care plans were changed for patients after such transports in only 24-39% of cases. So, one really needs to consider how likely the imaging study (or other procedure the patient may be going for) is really likely to change patient management.

In our August 25, 2015 Patient Safety Tip of the Week "Checklist for Intrahospital Transport" we discussed "**the 5 W's**" of intrahospital transport (Day 2010). The first "W" is "**Why**" or "Why does the patient need to leave the ICU for the procedure?". Important questions to ask here are "Are there bedside alternatives for the procedure? And "Is the patient's condition stable?". If the patient is considered unstable, the next questions are "Is the transport for a lifesaving intervention?" and "Is the transport to a diagnostic test pivotal to decision for emergent plan?". Day's second "W" is "**Who**". This included both who is the patient and who will be caring for the patient and, importantly, will a handoff be required? The third "W" is "**What**" and refers to equipment, airway, ventilator support, circulatory support, and special considerations (eg. spine stability, intracranial pressure monitors, etc.). Under the fourth "W" for "**When**" Day discusses considerations about coordinating with the timing of the test or procedure (eg. fasting or withholding anticoagulants for procedures), renal protective protocols for contrast-using procedures, and collaborating with other healthcare providers. The last "W" is for "**Where**" which includes details about the route to be taken, issues regarding MRI safety if going for MRI, etc.

The majority of transports of ICU patients in the Bergman thesis were for CT scans. Our many columns on patient safety in the Radiology Suite or the MRI Suite (see lists below) stress that the incidents there are not usually related to the imaging study itself. Rather, these are patients with complex medical conditions, often unstable, who have multiple monitoring needs and may have multiple lines and tubes and are receiving multiple medications, oxygen, or other therapies. Given that so many ICU patient transports are for CT scanning, some hospitals have considered use of portable CT scans for this population. In our September 16, 2008 Patient Safety Tip of the Week "More on Radiology as a High Risk Area" we noted a study from the Cleveland Clinic that demonstrated the cost effectiveness of having a dedicated portable CT scanner to scan ICU patients.

It's worth reiterating many of the points in our August 25, 2015 Patient Safety Tip of the Week "Checklist for Intrahospital Transport". Most of the literature on the risks associated with intrahospital transport have dealt with critically ill patients. While incidents do occur during intrahospital transport of non-ICU patients, those from ICU's are the most vulnerable. The percentage of ICU patients needing such intrahospital transfer probably depends on a host of factors, such as nature of the patient population, imaging capabilities, etc. One study ((Van Velsen 2011) noted that about a third of ICU patients required intrahospital transports. The literature also suggests that the risk of incidents and adverse events during transports is also related to the time duration of the transport. Hence, events such as CT scanning tend to be associated with more incidents because they require more time (PPSA 2005). We'll also bet that the percentage of incidents related to transports to the MRI suite has been increasing as MRI scanning has superseded CT scanning for so many conditions.

The overall rate of incidents during intrahospital transports is difficult to glean from the literature. In our September 16, 2008 Patient Safety Tip of the Week "More on Radiology as a High Risk Area" we noted studies from the 1980's and 1990's that showed rates of transport incidents as high as 70%. A paper by Smith et al (Smith 1990) noted adverse events during 34% of all ICU transports but transport of ICU patients to the CT suite was associated with a 71% incidence of adverse events. Those high rates of transport incidents have probably diminished somewhat. Some authors had previously noted an incidence of 3.7% (Van Velsen 2011) but when they prospectively monitored transports (Brunsveld-Reinders 2015) they found that in 26% of 503 transports to Radiology one or more incidents occurred.

Another study (Parmentier-Decrucq 2013) found that 45.8% of 262 intrahospital transports were associated with adverse events. In 16.8% of all intrahospital transports the adverse event was considered serious for the patient. Risk factors were ventilation with positive end-expiratory pressure >6 cmH2O, sedation before transport, and fluid loading for intrahospital transports. Treatment modification before transport was also a risk factor identified.

Intrahospital transports have 3 phases: before, during, and **after**. Unfortunately, the "after" phase is often either neglected or poorly managed. A recent case presentation in the AORN Journal (AORN 2020) illustrates the latter. A 4 y.o. boy underwent intestinal surgery under general anesthesia. The procedure was uneventful, he was extubated in the OR, and sent to the PACU. Continuous pulse oximetry was ordered for 24 hours because of his age and long duration of surgery. Once stable in the PACU, he was transferred to the inpatient unit. Pulse oximetry was disconnected during the transport, which took about 10 minutes. Apparently, the only communication from the transporter was that the patient was now in a room. The receiving nurse had been told the procedure was uneventful and the patient stable, so she did not perform an evaluation right away. A few minutes later, she placed him on pulse oximetry and realized that he was markedly hypoxic. Oxygen was administered immediately but he became bradycardic and hypotensive and went into cardiac arrest. He was resuscitated but left with significant neurological damage as a result of hypoxic brain injury.

The discussion centered on several key issues. Obviously, communication issues were critical. Pulse oximetry was discontinued during the transport and was presumed to be started on arrival at the med/surg unit. Knowledge and skills clearly played a role as well. The transporter stated that although he thought the patient was having difficulty breathing during the transport, he did not voice his concern because he had been assured the boy was stable and was not confident in his own judgment. That reluctance to speak up also is a reflection on the safety culture of the hospital. And it illustrates another key component of intrahospital transfers – the patient must be assessed before and after the transport. And it notes that use of non-medical personnel for transports is still fairly widespread.

Intrahospital transports, whether involving critical care patients or others, need to be undertaken with considerable planning, communication, and teamwork. You need to ensure that you have systems in place to ensure the safety of the patients and tools like the "Ticket to Ride" checklists may facilitate safe transports. And don't forget there are **3 phases** to intrahospital transports – **before, during, and after** the transport.

Some of our prior columns on intrahospital transports and the "Ticket to Ride" concept:

- April 8, 2008 "Oxygen as a Medication"
- November 18, 2008 "Ticket to Ride: Checklist, Form, or Decision Scorecard?"
- August 11, 2009 "The Radiology Suite…Again!"
- March 13, 2012 "Medical Emergency Team Calls to Radiology"
- August 25, 2015 "Checklist for Intrahospital Transport"
- September 1, 2015 "Smarter Checklists"
- November 2016 "Oxygen Tank Monitoring"
- February 2018 "Oxygen Cylinders Back in the News"
- May 22, 2018 "Hazardous Intrahospital Transport"
- October 30, 2018 "Interhospital Transfers"
- March 31, 2020 "Intrahospital Transport Issues in Children"
- June 23, 2020 "Telemetry Incidents"

Some of our prior columns on patient safety issues in the radiology suite:

- October 16, 2007 "Radiology as a Site at High-Risk for Medication Errors"
- February 19, 2008 "MRI Safety"
- September 16, 2008 "More on Radiology as a High Risk Area"
- October 7, 2008 "Lessons from Falls....from Rehab Medicine"
- October 2008 "Preventing Infection in MRI"
- March 17, 2009 "More on MRI Safety"
- March 2009 "Risk of Burns during MRI Scans from Transdermal Drug Patches"
- August 11, 2009 "The Radiology Suite…Again!"
- January 2010 "Falls in the Radiology Suite"
- August 2010 "Sedation Costs for Pediatric MRI"
- January 25, 2011 "Procedural Sedation in Children"
- February 1, 2011 "MRI Safety Audit"
- October 25, 2011 "Renewed Focus on MRI Safety"
- March 13, 2012 "Medical Emergency Team Calls to Radiology"
- August 2012 "Newest MRI Hazard: Ingested Magnets"
- October 22, 2013 "How Safe Is Your Radiology Suite?"
- February 25, 2014 "Joint Commission Revised Diagnostic Imaging Requirements"
- July 2014 "New MRI Risks: for Staff!"
- July 1, 2014 "Interruptions and Radiologists"

- November 2014 "More Radiologist Interruptions"
- October 21, 2014 "The Fire Department and Your Hospital"
- June 23, 2015 "Again! Mistaking Antiseptic Solution for Radiographic Contrast"
- August 25, 2015 "Checklist for Intrahospital Transport"
- March 22, 2016 "Radiology Communication Errors May Surprise You"
- August 2016 "Guideline Update for Pediatric Sedation"
- October 2016 "MRI Safety: There's an App for That!"
- January 17, ,2017 "Pediatric MRI Safety"
- August 8, 2017 "Sedation for Pediatric MRI Rising"
- November 14, 2017 "Tracking C. diff to a CT Scanner"
- March 2018 "MRI Death a Reminder of Dangers"
- March 2018 "Cardiac Devices Safe During MRI But Spinners!?"
- April 2018 "Radiologists Get Fatigued, Too"
- May 2018 "Cost of Interrupting a Radiologist"
- November 2018 "OMG! Not My iPhone!"
- December 11, 2018 "Another NMBA Accident"
- April 2, 2019 "Unexpected Events During MRI"
- September 2019 "New MRI Hazard: Magnetic Eyelashes"
- October 15, 2019 "Lots More on MRI Safety"
- November 5, 2019 "A Near-Fatal MRI Incident"
- November 12, 2019 "Patient Photographs Again Help Radiologists"
- November 26, 2019 "Pennsylvania Law on Notifying Patients of Test Results"
- January 7, 2010 "Even More Concerns About MRI Safety"

Some of our prior columns on patient safety issues related to MRI:

- February 19, 2008 "MRI Safety"
- March 17, 2009 "More on MRI Safety"
- October 2008 "Preventing Infection in MRI"
- March 2009 "Risk of Burns during MRI Scans from Transdermal Drug Patches"
- January 25, 2011 "Procedural Sedation in Children"
- February 1, 2011 "MRI Safety Audit"
- October 25, 2011 "Renewed Focus on MRI Safety"
- August 2012 "Newest MRI Hazard: Ingested Magnets"
- October 22, 2013 "How Safe Is Your Radiology Suite?"
- October 21, 2014 "The Fire Department and Your Hospital"
- August 25, 2015 "Checklist for Intrahospital Transport"
- August 2016 "Guideline Update for Pediatric Sedation"
- October 2016 "MRI Safety: There's an App for That!"
- January 17, 2017 "Pediatric MRI Safety"
- August 8, 2017 "Sedation for Pediatric MRI Rising"
- March 2018 "MRI Death a Reminder of Dangers"
- March 2018 "Cardiac Devices Safe During MRI But Spinners!?"
- November 2018 "OMG! Not My iPhone!"

- April 2, 2019 "Unexpected Events During MRI"
- September 2019 "New MRI Hazard: Magnetic Eyelashes"
- October 15, 2019 "Lots More on MRI Safety"
- November 5, 2019 "A Near-Fatal MRI Incident"
- November 2019 "ECRI Institute's Top 10 Health Technology Hazards for 2020"
- January 7, 2010 "Even More Concerns About MRI Safety"
- March 2020 "Airway Emergencies in the MRI Suite"

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