

Medication Management and
CONTRAST MEDIA

Case Study **2**

from a Midwest Integrated
Academic Healthcare System



Developed by ASHP Advantage

Medication Management and Contrast Media Case Study from a Midwest Integrated Academic Healthcare System

ABSTRACT

At an integrated academic healthcare system in the midwestern United States that annually performs over 65,000 radiology studies with contrast media, a Joint Commission survey resulted in a citation of the healthcare system for noncompliance with medication management standard 4.10 as it related to pharmacist review of medication orders and contrast media. The institution was given 45 days to become compliant. The institution needed to change its policies and procedures in both pharmacy and radiology to include prospective review of contrast media orders by pharmacists. The multidisciplinary team tasked with bringing the healthcare system into compliance determined that the best way to implement pharmacist review of orders was by using the institution's robust technology to facilitate timely communication between pharmacy and radiology about contrast media orders and ensure prospective order review by pharmacy.

DISCLAIMER

The information contained in this document was obtained by interviewing a pharmacist and a radiologic technologist from the case study site. It is intended to provide readers with insight into what others have done to address the medication management standards as they apply to contrast media. The subject matter is constantly evolving, and is subject to the professional judgment and interpretation of the practitioner because of the uniqueness of each institution and the Joint Commission standards in effect at any given time. The writer, reviewers, editors, and ASHP have made reasonable efforts to ensure the accuracy and appropriateness of the information presented in this document. However, any reader of this information is advised that the writer, reviewers, editors, and ASHP are not responsible for the continued currency of the information, for any errors or omissions, and for any consequences arising from the use of the information in the document in any and all practice settings. Any reader of this document is cautioned that ASHP makes no representation, guarantee, or warranty, express or implied, as to the accuracy and appropriateness of the information contained in this document, and will bear no responsibility or liability for the results or consequences of its use.

At this integrated academic healthcare system in the Midwest, a Joint Commission survey in November 2005 went well except for issues relating to contrast media. The healthcare system was given 45 days to become compliant with standards for medication management in regard to contrast media. The healthcare system responded by appointing a pharmacy director from one of its hospitals to lead a collaborative effort among pharmacy and radiology departments across the system to develop and implement a plan for meeting the standards. The task was a challenge because there was not a well-established relationship between radiology and pharmacy in any of the system's facilities. Furthermore, members of the group were not in agreement that a problem existed beyond the Joint Commission citation.

This healthcare system includes three hospitals with a total of more than 800 beds; two are teaching hospitals with medical residents and one is a community hospital. The primary hospital supports extensive medical education and research programs. In addition, it is a recognized leader in implementing technology and improving processes to advance the safety and quality of patient care. The system's hospitals are the only ones in the state to have implemented the quality

and safety practices recommended by the Leapfrog Group for Patient Safety. The system also received recognition in a national publication as being one of the “most wired” healthcare organizations in the nation (an award given for information technology).

The Pharmacy and Radiology Departments

The pharmacy department provides a variety of services across the continuum of care. Inpatient services are provided by decentralized (unit-based) pharmacists. Medications are distributed through automated dispensing cabinets and centralized sterile product preparation. The department’s philosophy is that all pharmacists need to be in a position to promote pharmaceutical care by influencing drug therapy decisions, educating health care professionals and students, ensuring appropriate drug therapy outcomes, and educating patients to ensure positive outcomes of drug therapy. There are approximately 76 pharmacists and 75 technicians on staff. Pharmacy services are available 24 hours a day, 7 days a week, and 365 days a year in all three hospitals. Table 1 summarizes the health system’s pharmacy services and personnel.

All medications are obtained from automated dispensing cabinets (Pyxis) managed by the central pharmacies. Orders are created by physicians and nurses using a computerized prescriber order entry (CPOE) system of integrated order sets. The automated dispensing system interfaces with the healthcare system’s mainframe computer system (i.e., Epic) and allows the pharmacy department to review all orders from any hospital computer terminal. Once pharmacy clears a medication order, the medication can be obtained from Pyxis cabinets by authorized staff. Administration of medications is documented in the electronic medical record (EMR).

The healthcare system has multiple radiology imaging groups: magnetic resonance (MR), computed tomography (CT), interventional radiology (IR), ultrasound, breast imaging, general X-ray, and gastrointestinal/genitourinary (GI/GU). Imaging areas in which contrast media are regularly used include MR, CT, GI/GU, and IR. Approximately 66% of the studies performed in these areas are for outpatients, 21% for inpatients, and 13% for emergency room patients. The

TABLE 1
Pharmacy Department Profile

Inpatient

- Three central pharmacies (one in each hospital)
- Decentralized (unit-based) pharmacists
- Operating room satellite (in primary hospital only)
- Oncology centers (all three hospitals)

Outpatient

- Outpatient and retail pharmacies
- Oncology clinic pharmacies
- Anticoagulation clinic (run by pharmacists)

Clinical Services

- Cardiology, critical care medicine, infectious diseases, and pain management

Technology

- Automated dispensing cabinets
- Computerized prescriber order entry
- Electronic patient record
- “Smart” pumps
- Wireless campus with mobile terminals
- Bar code medication administration

Personnel

Pharmacists	76
Pharmacy technicians	75
Pharmacy oncology resident	1
Pharmacy practice residents	3
Pharmacy ambulatory care resident	1

radiology department includes some 89 CT and MR staff members. Services are provided 24 hours a day, 7 days a week, 365 days a year at the primary hospital and from 7 a.m. to 7 p.m. Monday through Friday in the other two institutions. Tables 2 through 4 summarize the department and the number and types of studies performed.

Medication Management in Radiology

Before the Joint Commission survey in late 2005, the radiology department did not use automated dispensing cabinets. Contrast media were ordered by radiology, received by pharmacy, and transferred to the radiology department on an

TABLE 2
Radiology Department Profile

Imaging Areas	
MR	5 sites, 8 scanners
CT	5 sites, 9 scanners
Interventional	3 sites, 5 labs
Personnel	
Radiologists (CT/MR)	21
Radiologic technologists	55
Nurses	13

as-needed basis. In the radiology department, contrast media were stored in supervised cabinets and Pyxis machines that functioned as a medication station. The Pyxis machines required staff to have an identification number to access medications, but access to medications is not contingent upon pharmacy review. Because of the rapid turnover of product, radiology did not routinely check for outdated products. Individual imaging areas (e.g., CT, MR) ordered contrast media to maintain an appropriate par level. Staff in the CT imaging areas moved contrast agents from storage and loaded them into injectors (contrast warmers were not used) as needed. Table 5 lists the contrast media that were stored in radiology.

Radiology ordered floor stock medications (Table 6) from pharmacy, and radiology nurses obtained the medications from the central pharmacy. The medications were stored in supervised cabinets and Pyxis machines. Emergency medications were kept in lock boxes secured with plastic break tabs.

TABLE 3
Inpatient Radiology Studies by Imaging Area

Cases	MR	CT	Interventional X-Ray	GI	TOTAL
No. cases per year	4,288	23,247	2488	1263	27,535
No. cases with contrast (%)	3,437 (80)	10,578 (46)	Not available	1041*	14,015 (51)
No. cases without contrast (%)	851 (20)	12,669 (54)	not available	222	13,520 (49)

* Approximately 95% of these cases used a barium product and 5% used Gastrografin.

TABLE 4
Radiology Studies by Patient Type

Patient Type	Studies/Year	Studies with Contrast	Studies without Contrast
No. inpatient studies (%)	27,535	14,015 (51)	13,520 (49)
No. emergency room studies (%)	16,933	6,465 (38)	10,468 (62)
No. outpatient studies (%)	85,173	45,143 (53)	40,030 (47)
TOTAL	129,641	65,623 (51)	64,018 (49)

TABLE 5
Contrast Media Available in Imaging Areas

MRI
Magnevist (gadopentetate dimeglumine)
CT
Isovue 300 and 370 (iopamidol)
Visipaque (iodixanol)
CT Angiography
Visipaque (iodixanol)
Abdominal CT
Gastrografin (diatrizoate meglumine and diatrizoate sodium)
Urethrocytography
Cystografin (diatrizoate meglumine)
Interventional Radiology
Visipaque (iodixanol)
Isovue 300 (iopamidol)

TABLE 6
Noncontrast Medications Available in Radiology

- Diphenhydramine
- Lorazepam
- Methylprednisolone
- Adenosine
- Alteplase
- Atropine
- Bupivacaine
- Cefazolin
- Clopidogrel
- Diazepam
- Epinephrine
- Flumazenil
- Labetalol
- Lidocaine
- Metoprolol
- Naloxone
- Nitroglycerin
- Ondansetron
- Protamine

Medication errors and adverse reactions were reported via a Web-based Quantros automated system or by calling a hotline. The Quantros system is a standalone, real-time tracking and reporting system designed to involve the appropriate personnel (e.g., physicians, risk managers). The healthcare system identified no reports originating from radiology and no medication errors related to radiology, except for occasional reports of minor allergic reactions (e.g., pruritis, rash). The radiology department considered its practices to be safe.

Before contrast media were classified as medications by the Joint Commission, the relationship between the pharmacy and radiology departments was limited. The radiology department had asked pharmacy to review its protocols, and pharmacy had determined that they were appropriate. Otherwise, radiology's contact with pharmacy was limited to ordering and obtaining oral Gastrografin, which is prepared by the pharmacy department.

Assessing Medication Management for Contrast Media

The healthcare system assigned one of the three pharmacy directors the responsibility of bringing its institutions into compliance with Joint Commission medication management standards. This pharmacist led a collaborative effort that included input from the directors of radiology at all three hospitals, the assistant vice president of radiology, the other two directors of pharmacy, the radiologic technologist managers from each imaging area, and a representative from the information systems department. In the beginning, both pharmacy and radiology personnel were unsure what value pharmacy could provide, given the pharmacists' unfamiliarity with contrast media. The group met at least every 2 weeks from December 2005 through April 2006.

The team members' first step was to define what the Joint Commission expected them to implement by the end of the 45-day period. Since the institution was noncompliant only with medication management standard 4.10 (MM 4.10), which requires pharmacist review of medication orders, that was the focus of the team's efforts. Table 7 presents the team's findings in regard to the healthcare system's compliance with medication management standards related to contrast media.

TABLE 7
**Internal Assessment of Compliance with
 Joint Commission Standards for Contrast Media**

Standard (a)	Compliance (b)	Standard (a)	Compliance (b)
PC 5.10 Two patient identifiers	C	MM 3.20 Medication ordering	C
PC 13.20 Moderate sedation	C	<ul style="list-style-type: none"> ■ required elements ■ preprinted order review 	
NPSG 1 Time out process	C	MM 4.10 Pharmacist review of orders	NC
NPSG 2e Hand-off communications	C	MM 4.10 Safeguards for oral/rectal contrast	Not applicable
NPSG 3d Medication labeling	C	<ul style="list-style-type: none"> ■ practice guidelines approved by pharmacy and medical staff ■ medication retrieval by designated staff ■ appropriateness of medication reviewed by qualified health care professional ■ quality control for retrieval ■ pharmacist on call ■ retrospective sampling for review 	at time of survey
NPSG 8 Medication reconciliation	P	MM 4.80 Recall process	C
MM 1.10 Medication information available	C	MM 5.10 Medication administration	C
MM 2.10 Formulary process	C	MM 6.20 Reporting adverse drug events	C
MM 2.20 Storage of medications	C		
<ul style="list-style-type: none"> ■ only formulary drugs ■ temperature monitoring ■ medication security ■ narcotic control ■ periodic inspection 			

(a) PC = patient care standard; NPSG = national patient safety goal; MM = medication management standard.
 (b) C = compliant; P = partially compliant; N = noncompliant.

The team recommended implementing a system in which a pharmacist could review contrast media orders for all inpatient and emergency room patients before each imaging study. Although the group was uncomfortable with having one system for inpatients and another for outpatients, it did not seem feasible to include outpatients in the new plan because of the volume of outpatient studies and lack of timely access to information about outpatients.

The team reviewed radiology's current training manual and protocols in order to design a process

in which the computer systems could integrate pharmacist review of orders into the existing workflow without significantly delaying studies.

Before the November 2005 Joint Commission survey, workflow in the radiology departments was as follows:

1. The referring physician entered a request for an inpatient imaging study via the medical center's CPOE system. The physician selected the desired study from a list of predefined options (e.g., CT abdomen with contrast, CT abdomen without contrast) and answered

questions about the patient's pregnancy status, allergy history, and reason for the imaging study. During the ordering process, the CPOE system provided the patient's most recent (date-stamped) blood urea nitrogen (BUN) and serum creatinine (SCr) results. Imaging studies for outpatients were scheduled by calling the radiology central scheduling office. Clerical staff asked a series of questions specific to the type of study ordered (e.g., Is the patient allergic to iodine?), and the answers were entered into the Epic system. If the answer to any question was yes, the system prompted the clerical staff to contact the radiologic technologist, and a radiologist was consulted.

2. The radiology department front desk received inpatient orders as paper requests or via the Epic system. The request was then added to the schedule by clerical staff via Radnet, which is the computer system used by radiology for billing and for recording the findings of imaging studies. Outpatients were often scheduled further in advance than inpatients, but time slots on each daily schedule were reserved for inpatient cases.
3. Radnet provided access to relevant information from the Epic system about patients scheduled to receive contrast media. At the start of each shift, radiologic technologists reviewed the laboratory information (i.e., BUN, SCr) for patients who were scheduled for an imaging study with contrast. Excessive BUN and SCr levels were reported to the ordering physician, who could decide to postpone the study, complete the study without contrast media, or consult with radiologists to determine the next step.
4. Patients with a previous reaction to contrast media or a notable allergy history were identified. The technologist reviewed the medical history with the patient to ensure that all information had been considered. All interviews were documented in Radnet and automatically copied to Epic.
5. The technologist conducted the study and administered contrast agents (orally, intravenously, or rectally). All premedication for inpatients was done on the patient care unit before the patient arrived in radiology. If the

study called for action outside departmental guidelines, the radiologic technologist needed help with intravenous access, or additional medications were ordered, nurses were available to assist.

6. Upon completion of the procedure, patients were discharged to the patient care unit or home, and the study findings—but not the billing information—were transferred from Radnet to Epic. Radiology reports documented that contrast was given but did not provide details (e.g., type and amount of contrast medium). Any patient reactions after the study were reported via the Quantros system.

After assessing the existing practices, the team determined the following:

- Protocols should be more specific with respect to dose and administration of contrast media. They should include the exact volume of each agent to give and the rate at which it should be given.
- The computer system should be used to notify pharmacy when an order for contrast media is written and to provide pharmacy with the necessary patient information.
- Pharmacists should be educated to conduct appropriate and timely review of patients scheduled to receive contrast media.
- Radiology could continue to access contrast media per the existing system. The new system would allow for pharmacy to review orders and intervene before doses were administered to patients, if necessary.
- Radiology should use estimated glomerular filtration rate (eGFR) when screening patients according to departmental policies and procedures for administration of gadolinium-based contrast media for MR studies.

Although there was no consensus that a problem existed, there was agreement that the healthcare system had to meet the Joint Commission requirements.

Plans for Improvement

A revised system was implemented as a pilot on February 15, 2006, and activated throughout the healthcare system on February 20, 2006. The

revised system includes updated protocols that provide specific guidance related to contrast media, an assessment form for pharmacists to use in reviewing radiology orders, an EMR alert to notify pharmacy of an order requiring pharmacist review, and an educational program to ensure that pharmacists are competent to review orders for contrast media. Figure 1 illustrates the revised workflow.

The revised radiology protocols specify the quantity of each contrast agent that should be administered and the rate at which it should be given (Exhibit 1). For patients scheduled for an MRI, eGFR is calculated to identify those whose renal function requires special consideration. The workflow for radiologic technologists did not change significantly, but they began using a screening process built into the computer system to document their review of patient-specific information before administration of contrast media (Exhibit 2). All patients now receive and complete a form (Exhibit 3) before their procedures, and the information is entered into the radiology computer system. The radiologic technologists respond to calls from pharmacy when there are concerns about a patient scheduled to receive contrast, and they obtain medications, including contrast media, from automated dispensing cabinets.

For patients scheduled for an MRI with contrast, radiologic technologists now follow a new policy (Exhibit 4) that includes use of the Modification of Diet in Renal Disease formula to calculate eGFR. BUN and SCr values are used to assess the renal function of patients receiving contrast for CT exams.

When an order for a contrast-enhanced procedure has been written, pharmacists are notified via the EMR “notification” feature, which is similar to an e-mail message. The notification has three states: pending, read, and done. Pharmacists assess the order and select an available response (examples shown in Table 8) or write their own note. If a pharmacist has concerns, he or she contacts the exam suite asking that the procedure be held. The procedure is then rescheduled for a later time when the pharmacist has had an opportunity to discuss the concerns with the ordering physician.

The team developed a primer for pharmacists; it was drafted by pharmacy and reviewed by

TABLE 8
Available Pharmacist Responses
in Computer System

I, RPh, have reviewed Patient's available clinical information for appropriateness of contrast media for this order.

I, RPh have reviewed the appropriateness of contrast media for _____. This was discussed with _____, and the following resultant steps were taken: _____.

radiology. A timely news story aired by National Public Radio added emphasis and was made available to staff as a PowerPoint presentation. All pharmacists from each facility reviewed the primer and learned to use a reference for assessing the appropriateness of contrast media for a given patient. The assessment form (Exhibit 5) guides pharmacists through verification of the dose, screening for allergies and interactions with other medications or laboratory tests, and screening for contraindications. Renal function is assessed by using the patient's BUN, SCr, and eGFR values. The contrast media order includes the latest BUN and SCr values, and the patient profile includes the eGFR that is calculated by the Epic system using the Cockcroft-Gault equation. The revised process did not include an assessment tool for verifying the competency of pharmacists, although the results of pharmacist review of orders were monitored regularly.

Outcomes

The reports automatically generated during the first 3 months after implementation of the new system indicated that all cases requiring an advance review by a pharmacist had been reviewed. Approximately 10% of the cases were considered emergent and did not require that a pharmacist review the orders in advance. Still, the system allowed for pharmacist review of 80% of the emergent cases before the procedure. Table 9 summarizes the results of the new contrast media order review process.

FIGURE 1

Pharmacist Review of Orders for Contrast Media

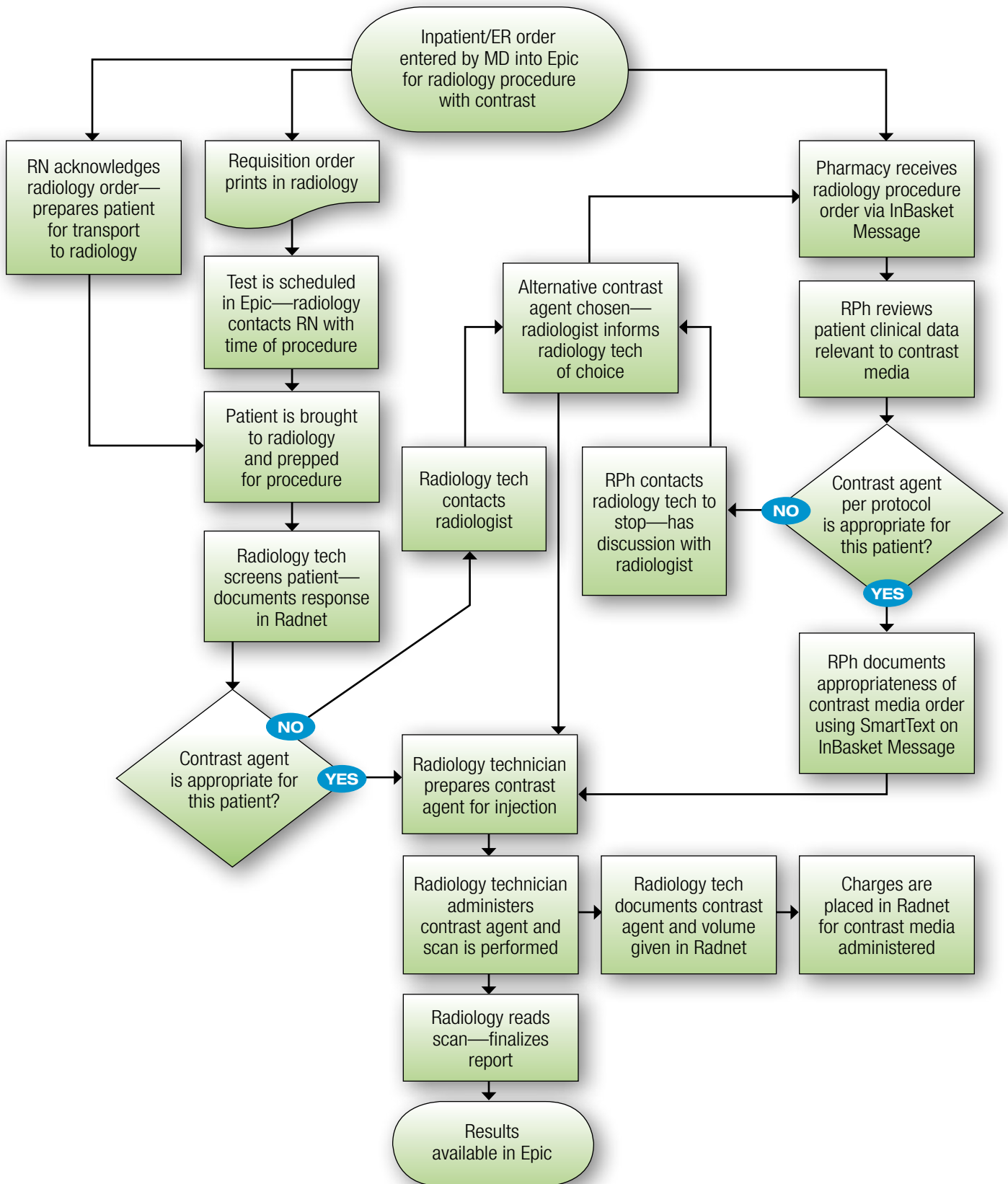


TABLE 9
Results of Pharmacy Review of Orders for Contrast Media

Variable	Mar 2006*	Apr 2006*	May 2006*	Jun 2006*	Oct 2006	Jan 2007	Feb 2007
No. orders for contrast media	NA	NA	NA	NA	1791	1713	1485
No. orders reviewed before administration	NA	NA	NA	NA	1218	1167	876
No. orders excluded from pharmacist review	10	4	9	5	1096	1101	870
No. reviewed before administration (%)	8 (80)	4 (100)	9 (100)	4 (80)	650 (59)	664 (60)	559 (64)
No. orders requiring pharmacist review	17	21	21	20	695	612	369
No. reviewed before contrast administration (%)	17 (100)	20 (95.2)	18 (85.7)	19 (95)	568 (81.7)	503 (82.2)	317 (85.9)

* During these time periods orders were spot checked because the reporting system was not fully developed to identify and report on all orders.

The Joint Commission accepted the new procedures, and the case study site is scheduled for its next review in calendar year 2008.

Conclusion

This site was one of the first healthcare systems to implement changes in response to the classification of contrast media as medications. The case illustrates some of the barriers that other institutions would later experience, such as disagreement with the changes in the medication management standards in relation to contrast media and reluctance to acknowledge that patient safety issues exist within radiology departments.

Despite medical literature documenting patient safety issues related to contrast media, it was generally accepted by this healthcare system and others that patients undergoing imaging studies were not experiencing adverse reactions to contrast media. However, upon evaluating its processes and revising them to comply with Joint Commission standards, this healthcare system discovered that some within the institution (e.g., nephrologists) were familiar with adverse events possibly related to imaging studies and the use of contrast media. One goal of the Joint Commission's changes in the medication management standards was to increase healthcare systems' awareness of

the potential patient safety issues associated with contrast media. That goal was met in this case study site.

The work at this institution occurred before several changes were made in the standards related to contrast media. In 2005, the Joint Commission excluded oral contrast agents from prospective review by pharmacists if safeguards were in place, and in 2006 it added rectal agents to that exclusion. In January 2007, the Joint Commission revised its requirement that a licensed independent practitioner had to remain with the patient during medication administration and allowed individual healthcare systems to define the role of a licensed independent practitioner in the direct supervision of patients for radiology alone.

Although this case study site did not include outpatient procedures in its policy revisions, the Joint Commission standards do not specifically exempt outpatients from medication management standard 4.10. Moreover, it is possible, if an order for intravenous contrast media for an outpatient was not reviewed by a pharmacist and the study was not conducted under the direct supervision of a licensed independent practitioner, that the institution could be cited by a Joint Commission surveyor. Practitioners should seek further clarification of this issue as it relates to their specific practice setting and imaging areas.

EXHIBIT 1

Revised Radiology Protocols Showing Dose and Administration Rate

EPIC / CDM	EXAM	IV CONTRAST	DOSE (mL)	RATE OF INJECTION mL/sec
A0773573	CT Abdomen (AAA/DISSECTION PROTOCOL)	ISOVUE 370	130	4
A0269035	CT Abdomen W & W/O Contrast	ISOVUE 370	130	3
A0269050	CT Abdomen W Contrast	ISOVUE 370	130	3
A0281550	CT Ankle W/O & W Contrast, (Right)	ISOVUE 300	100	2
A0281543	CT Ankle W/O & W Contrast, Left	ISOVUE 300	100	2
A0281535	CT Ankle With Contrast, (Right)	ISOVUE 300	100	2
A0281527	CT Ankle With Contrast, Left	ISOVUE 300	100	2
A0773753	CT Appendicitis Protocol	ISOVUE 370	130	3
A0269290	CT Cervical Spine W & W/O Contrast	ISOVUE 300	100	2
A0269274	CT Cervical Spine W Contrast	ISOVUE 300	100	2
A0773571	CT Chest (AAA/DISSECTION PROTOCOL)	ISOVUE 300	100	4
A0773570	CT Chest (PE PROTOCOL)	ISOVUE 300 / 370	100	4
A0269258	CT Chest W Contrast	ISOVUE 300	100	3
A0269241	CT Chest W/O & W Contrast	ISOVUE 300	100	2
A0281311	CT Elbow W/O & W Contrast, (Right)	ISOVUE 300	100	2
A0281303	CT Elbow W/O & W Contrast, Left	ISOVUE 300	100	2
A0281295	CT Elbow With Contrast, (Right)	ISOVUE 300	100	2
A0281287	CT Elbow With Contrast, Left	ISOVUE 300	100	2
A0269027	CT Head W Contrast	ISOVUE 300	100	2
A0269001	CT Head W/O & W Contrast	ISOVUE 300	100	2
A0281436	CT Hip W/O & W Contrast, (Right)	ISOVUE 370	130	2
A0281430	CT Hip W/O & W Contrast, Left	ISOVUE 370	130	2
A0281412	CT Hip With Contrast, (Right)	ISOVUE 370	130	2
A0281402	CT Hip With Contrast, Left	ISOVUE 370	130	2
A0279091	CT IAC W Contrast	ISOVUE 300	100	2
A0279117	CT IAC W/O & W Contrast	ISOVUE 300	100	2
A0281493	CT Knee W/O & W Contrast, (Right)	ISOVUE 300	100	2
A0281485	CT Knee W/O & W Contrast, Left	ISOVUE 300	100	2
A0281477	CT Knee With Contrast, (Right)	ISOVUE 300	100	2
A0281469	CT Knee With Contrast, Left	ISOVUE 300	100	2
A0279265	CT Low Ext W/O&W Cont, (RIGHT)	ISOVUE 300	100	2
A0279389	CT Low Ext W/O&W Cont, LEFT	ISOVUE 300	100	2
A0279257	CT Low Ext With Cont, (RIGHT)	ISOVUE 300	100	2
A0279391	CT Low Ext With Cont, LEFT	ISOVUE 300	100	2
A0269365	CT Lumbar Spine W Contrast	ISOVUE 370	100	2
A0269373	CT Lumbar Spine W/O & W Contrast	ISOVUE 300	100	2
A0269183	CT Neck (Soft Tissue) W Cont	ISOVUE 300	100	2
A0269191	CT Neck (Soft Tissue) W/O & W Cont	ISOVUE 300	100	2
A0269779	CT Orbit W Contrast	ISOVUE 300	100	2
A0269795	CT Orbit W/O & W Contrast	ISOVUE 300	100	2
A0773569	CT Pelvis (AAA/DISSECTION PROTOCOL)	ISOVUE 370	130	4

EPIC / CDM	EXAM	IV CONTRAST	DOSE (mL)	RATE OF INJECTION mL/sec
A0269498	CT Pelvis W Contrast	ISOVUE 370	130	4
A0269399	CT Pelvis W/O & W Contrast	ISOVUE 370	130	4
A0269084	CT Post Fossa W Contrast	ISOVUE 300	100	2
A0269068	CT Post Fossa W/O & W Contrast	ISOVUE 300	100	2
A0279034	CT Sella W Contrast	ISOVUE 300	100	2
A0279059	CT Sella W/O & W Contrast	ISOVUE 300	100	2
A0281238	CT Shoulder W/ Contrast, (Right)	ISOVUE 300	100	2
A0281220	CT Shoulder W/ Contrast, Left	ISOVUE 300	100	2
A0281253	CT Shoulder W/O & W Contrast, (Right)	ISOVUE 300	100	2
A0281246	CT Shoulder W/O & W Contrast, Left	ISOVUE 300	100	2
A0269159	CT Sinuses/MaxilloFacial W Cont	ISOVUE 300	100	2
A0269167	CT Sinuses/MaxilloFacial W/O&W Cont	ISOVUE 300	100	2
A0269340	CT Thoracic Spine W Contrast	ISOVUE 300	100	2
A0269357	CT Thoracic Spine W/O & W Contrast	ISOVUE 300	100	2
A0279232	CT Upp Ext W/O & W Contrast, (RIGHT)	ISOVUE 300	100	2
A0279396	CT Upp Ext W/O&W Cont, LEFT	ISOVUE 300	100	2
A0279387	CT Upp Ext With Cont, LEFT	ISOVUE 300	100	2
A0279224	CT Upp Ext With Contrast, (RIGHT)	ISOVUE 300	100	2
A0281378	CT Wrist W/O & W Contrast, (Right)	ISOVUE 300	100	2
A0281360	CT Wrist W/O & W Contrast, Left	ISOVUE 300	100	2
A0281352	CT Wrist With Contrast, (Right)	ISOVUE 300	100	2
A0281345	CT Wrist With Contrast, Left	ISOVUE 300	100	2
A0279364	CTA Abd Aort&life W/Ruo W/O&W Contrast	ISOVUE 370	150	5
A0279356	CTA Abdomen W/O & W Contrast	ISOVUE 370	130	5
A0773669	CTA Cardiac Angiography W/O & W Contrast	VISIPAQUE	130	5
A0279299	CTA Chest W/O & W Contrast	ISOVUE 370	150	5
A0279273	CTA Head W/O & W Contrast	ISOVUE 300	150	4
A0279349	CTA Low Ext W/O & W Cont, (RIGHT)	ISOVUE 370	130	5
A0279331	CTA Low Ext W/O & W Cont, LEFT	ISOVUE 370	130	5
A0279281	CTA Neck W/O & W Contrast	ISOVUE 300	150	4
A0279307	CTA Pelvis W/O & W Contrast	ISOVUE 370	130	5
A0279393	CTA Upp Ext W/O & W Cont, (RIGHT)	ISOVUE 370	150	4
A0279315	CTA Upp Ext W/O & W Cont, LEFT	ISOVUE 370	150	4
A0277392	MRA Abdomen W/O & W Contrast	MAGNEVIST	0.4 mL/kg	2
A0277384	MRA Abdomen With Contrast	MAGNEVIST	0.4 mL/kg	2
A0277491	MRA Chest W/O & W Contrast	MAGNEVIST	0.4 mL/kg	2
A0277475	MRA Chest With Contrast	MAGNEVIST	0.4 mL/kg	2
A0275545	MRA Head W/O & W Contrast	MAGNEVIST	0.4 mL/kg	2
A0275537	MRA Head With Contrast	MAGNEVIST	0.4 mL/kg	2
A0277525	MRA Lower Extremity W/O & W Contrast	MAGNEVIST	0.4 mL/kg	2
A0277509	MRA Lower Extremity With Contrast	MAGNEVIST	0.4 mL/kg	2
A0275560	MRA Neck W/O & W Contrast	MAGNEVIST	0.4 mL/kg	2
A0275552	MRA Neck With Contrast	MAGNEVIST	0.4 mL/kg	2
A0275912	MRA Pelvis W/O or W Contrast	MAGNEVIST	0.4 mL/kg	2

EPIC / CDM	EXAM	IV CONTRAST	DOSE (mL)	RATE OF INJECTION mL/sec
A0772085	MRA Pelvis With Contrast	MAGNEVIST	0.4 mL/kg	2
A0275362	MRA Spine W or W/O Contrast	MAGNEVIST	0.4 mL/kg	2
A0275743	MRA Upp Ext W/O or W Cont,(RIGHT)	MAGNEVIST	0.4 mL/kg	2
A0275915	MRA Upp Ext W/O or With Cont, LEFT	MAGNEVIST	0.4 mL/kg	2
A0275883	MRI Abdomen Scan W/O & W Contrast	MAGNEVIST	0.2 mL/kg	2
A0275875	MRI Abdomen Scan With Contrast	MAGNEVIST	0.2 mL/kg	2
A0277376	MRI Ankle W/O & W Contrast, (Right)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277368	MRI Ankle W/O & W Contrast, Left	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277350	MRI Ankle With Contrast, (Right)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277343	MRI Ankle With Contrast, Left	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0773715	MRI Brachial Plexus W/O & W Contrast	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0773713	MRI Brachial Plexus With Contrast	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275305	MRI Brain W & W/O Contrast	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275248	MRI Brain W Contrast	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277434	MRI Breast W/O & W Contrast, (RT)	MAGNEVIST	0.2 mL/kg	2
A0277467	MRI Breast W/O & W Contrast, Bilateral	MAGNEVIST	0.2 mL/kg	2
A0277410	MRI Breast W/O & W Contrast, LT	MAGNEVIST	0.2 mL/kg	2
A0277418	MRI Breast With Contrast, (RT)	MAGNEVIST	0.2 mL/kg	2
A0277442	MRI Breast With Contrast, Bilateral	MAGNEVIST	0.2 mL/kg	2
A0277400	MRI Breast With Contrast, LT	MAGNEVIST	0.2 mL/kg	2
A0275255	MRI Cervical Spine W Contrast	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275594	MRI Cervical Spine W/O & W Contrast	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275586	MRI Chest Scan W/O & W Contrast	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275578	MRI Chest Scan With Contrast	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277137	MRI Elbow W/O & W Contrast, (Right)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277129	MRI Elbow W/O & W Contrast, Left	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0276097	MRI Elbow With Contrast, (Right)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0276089	MRI Elbow With Contrast, Left	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277251	MRI Hip W/O & W Contrast, (Right)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277244	MRI Hip W/O & W Contrast, Left	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277236	MRI Hip With Contrast, (Right)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277228	MRI Hip With Contrast, Left	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277319	MRI Knee W/O & W Contrast, (Right)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277301	MRI Knee W/O & W Contrast, Left	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277293	MRI Knee With Contrast, (Right)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277285	MRI Knee With Contrast, Left	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275818	MRI Low Ext Joint W/O&W Cont, LEFT	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275842	MRI Low Ext Joint W/O&W Cont,(RIGHT)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275800	MRI Low Ext Joint With Cont, LEFT	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275834	MRI Low Ext Joint With Cont,(RIGHT)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275933	MRI Low Ext N-Jo W/O&W Cont, LEFT	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275792	MRI Low Ext N-Jo W/O&W Cont,(RIGHT)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275768	MRI Low Ext N-Jo With Cont, LEFT	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275784	MRI Low Ext N-Jo With Cont,(RIGHT)	MAGNEVIST	0.2 mL/kg	Slow IV Push

EPIC / CDM	EXAM	IV CONTRAST	DOSE (mL)	RATE OF INJECTION mL/sec
A0275271	MRI Lumbar Spine W Contrast	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275610	MRI Lumbar Spine W/O & W Contrast	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275529	MRI Orbit, Face, Neck Scan W/O&W Contr	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275511	MRI Orbit, Face, Neck Scan With Cont	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275636	MRI Pelvis W/O & W Contrast	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275949	MRI Pelvis Scan With Contrast	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0276055	MRI Shoulder W/O & W Contrast, (Right)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275990	MRI Shoulder W/O & W Contrast, Left	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275966	MRI Shoulder With Contrast, (Right)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275974	MRI Shoulder With Contrast, Left	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275263	MRI Thoracic Spine W Contrast	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275602	MRI Thoracic Spine W/O & W Contrast	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275701	MRI Upp Ext Joint W/O&W Cont, LEFT	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275735	MRI Upp Ext Joint W/O&W Cont,(RIGHT)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275693	MRI Upp Ext Joint With Cont, LEFT	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275727	MRI Upp Ext Joint With Cont,(RIGHT)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275955	MRI Upp Ext N-Jo W/O&W Cont, LEFT	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275685	MRI Upp Ext N-Jo W/O&W Cont,(RIGHT)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275651	MRI Upp Ext N-Jo With Cont, LEFT	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0275677	MRI Upp Ext Non-Jo With Cont,(RIGHT)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277194	MRI Wrist W/O & W Contrast, (Right)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277186	MRI Wrist W/O & W Contrast, Left	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277178	MRI Wrist With Contrast, (Right)	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0277160	MRI Wrist With Contrast, Left	MAGNEVIST	0.2 mL/kg	Slow IV Push
A0261909	FL IVP	ISOVUE 300	50mL	Bolus
A0262485	FL Urethrocystography	CYSTOGRAMIN	300mL	Urethral infusion

EXHIBIT 2

Form Used by Radiologic Technologists to Screen Patients before MRI

	Data	Last Updated By	Updated DT/TM
Patient History:			
FOR FEMALE PATIENT ONLY:			
Is there any chance you might be pregnant?	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Last menstrual period:			
Are you currently breast feeding?	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Any kidney disease?	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Cardiac pacemaker?	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Additional preliminary/wet reading			
History of sickle cell anemia?	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Surgical clips?	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Dental bridge, dentures?	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Hearing aides?	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Clips?	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Aneurysm clips	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Intracranial bypass clips	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Coronary bypass clips	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Renal transplant clips	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Other vascular clips	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Prosthesis?	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Middle ear prosthesis	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Orbital prosthesis	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Cardiac valve prosthesis	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Artificial limb/joint prosthesis	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Other (please specify)			
Bullet or bullet fragments	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Metal worker, grinder, welder	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Biosimulator	<input type="checkbox"/> YES <input type="checkbox"/> NO		
IUD	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Diaphragm	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Heart disease?	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Extremity or spinal brace (metal implants in spine)	<input type="checkbox"/> YES <input type="checkbox"/> NO		
Contrast and Dosage?	<input type="checkbox"/> YES <input type="checkbox"/> NO		
IV contrast (type and dosage in mL):			
Sedation given?	<input type="checkbox"/> YES <input type="checkbox"/> NO		

Form Used by Radiologic Technologists to Screen Patients before CT

	Data	Last Updated By	Updated DT/TM
Patient History:			
FOR FEMALE PATIENT ONLY: Is there any chance you might be pregnant? <input type="checkbox"/> YES <input type="checkbox"/> NO Last menstrual period:			
Ever received iodinated contrast? <input type="checkbox"/> YES <input type="checkbox"/> NO			
Previous reaction to contrast? <input type="checkbox"/> YES <input type="checkbox"/> NO			
Allergies/Hayfever? <input type="checkbox"/> YES <input type="checkbox"/> NO Drug/medications:			
Asthma/Lung Disease? <input type="checkbox"/> YES <input type="checkbox"/> NO Extrinsic—Outwardly included <input type="checkbox"/> YES <input type="checkbox"/> NO COPD <input type="checkbox"/> YES <input type="checkbox"/> NO Other—please specify:			
Do you have Kidney disease? <input type="checkbox"/> YES <input type="checkbox"/> NO Acute <input type="checkbox"/> YES <input type="checkbox"/> NO Impaired function <input type="checkbox"/> YES <input type="checkbox"/> NO Hypertension/High blood pressure <input type="checkbox"/> YES <input type="checkbox"/> NO Other—please specify:			
Diabetes? <input type="checkbox"/> YES <input type="checkbox"/> NO Insulin dependent <input type="checkbox"/> YES <input type="checkbox"/> NO Non-Insulin dependent <input type="checkbox"/> YES <input type="checkbox"/> NO Taking diabetes related medication? <input type="checkbox"/> YES <input type="checkbox"/> NO If so, CONSULT W/ RADIOLOGIST			
History of sickle cell anemia? <input type="checkbox"/> YES <input type="checkbox"/> NO			
General debilitation? <input type="checkbox"/> YES <input type="checkbox"/> NO			
Other disease? <input type="checkbox"/> YES <input type="checkbox"/> NO (Multiple Myeloma, Strokes, Cancer)			
Contrast and Dosage? <input type="checkbox"/> YES <input type="checkbox"/> NO Oral contrast (Type and dosage in ml): IV contrast (Type and dosage in ml):			

Screening Forms

MRI PRE-EXAMINATION SCREENING FORM

Patient Name _____ DOB: ___/___/___ Height: _____ Weight: _____

Allergies: _____

Reason for MRI and/or Symptoms: _____

For Female Patients: Date of last menstrual period: ___/___/___

To the best of your ability, please list all your **current** medications (prescriptions, over-the-counter medications, eye drops, herbal supplements, and vitamins). If more space is needed, please use the back of this page.

Drug Name	Dose	How do you take it?	How often?	Last dose taken (Date/Time)

YES	NO	PLEASE COMPLETE THE FOLLOWING CHECKLIST
		Are you pregnant, possibly pregnant, or breast feeding?
		Do you have any kidney problems?
		Have you had surgery in the area being scanned?
		Have you ever been a machinist, welder, or metal worker?
		Have you ever been injured by a metallic object or foreign body (e.g., bullet, shrapnel)?
		Do you have any breathing problems, motion disorder, or claustrophobia?
		Do you have anemia or any disease that affects your blood?

YES	NO	DO YOU HAVE ANY OF THE FOLLOWING ITEMS IN OR ON YOUR BODY?
		Cardiac pacemaker, pacer wires, defibrillator
		Implanted cardioverter defibrillator (ICD)
		Surgical staples, clips, or metallic sutures
		Dentures or partial plates
		Hearing aid (remove before entering MRI room)
		Brain/aneurysm clip
		Any type of prosthesis (heart valve, eye, hip, knee, etc.)
		Any metallic fragment or foreign body
		Neurostimulators (brain, spine, bone, etc.)
		Insulin or other infusion pump
		Magnetically activated implant or device
		IUD, diaphragm, or pessary
		Internal electrodes or wires
		Ear or eye implant, spring, or wires
		Metallic stent, filter, or coil
		Shunt (spinal or intraventricular)
		Joint replacement (hip, knee, etc.)
		Bone/joint pin, screw, nail, wire, plate, etc.
		Body-piercing jewelry, tattoos
		Medication patch (nicotine, nitroglycerine)
		Medication dressing with silver (Mepilex Ag)

* Not a part of the patient's medical record. Please use the radiology computer system as the official EMR.

CT/IVP PRE-EXAMINATION SCREENING FORM

Patient Name _____ DOB: ___/___/___ Height: _____ Weight: _____

Any Allergies: _____

Reason for your exam: _____

To the best of your ability, please list all your **current** medications (prescriptions, over-the-counter medications, eye drops, herbal supplements, and vitamins).

Drug Name	Dose	How do you take it?	How often?	Last dose taken (Date/Time)

YES	NO	PLEASE COMPLETE THE FOLLOWING QUESTIONS
		<i>For female patients only:</i> Is there a chance you might be pregnant? Date of last menstrual period: ___/___/___
		Have you ever had IV or oral contrast? <i>If yes</i> , please note any allergies/problems here:
		Do you have seasonal allergies or allergies to any medicines or foods? <i>If yes</i> , please explain:

YES	NO	DO YOU HAVE ANY OF THE FOLLOWING?
		Asthma or hay fever/lung disease
		Kidney problems (kidney problems include kidney failure, dialysis, transplant, and/or only one kidney)
		High blood pressure
		Diabetes— <i>If yes</i> , does your medicine contain metformin (Glucophage, Glucophage XR, Actoplus Met, Riomet, Fortamet, Metaglip, Avandamet, Glucovance)? <input type="checkbox"/> Yes <input type="checkbox"/> No
		Sickle cell disease
		Multiple myeloma (blood cancer)
		Adrenal gland tumors or pheochromocytoma
		Heart problem or heart failure— <i>If yes</i> , please explain:
		Liver disease/cirrhosis

* Not a part of the patient’s medical record. Please use the radiology computer system as the official EMR.

Gadolinium-Based Contrast Media Administration

I. POLICY

The organization has implemented guidelines to be used for all patients before receiving gadolinium-based contrast media in any dose. This is in response to recent FDA warnings about the association between gadolinium-based contrast media (Omniscan, Magnevist, OptiMARK) with nephrogenic systemic fibrosis/nephrogenic fibrosing dermopathy (NSF/NFD). The guidelines ensure the appropriate and safe use of gadolinium-based contrast media during diagnostic and therapeutic imaging procedures. These guidelines will remain in effect until more definitive information is available on the relationship between gadolinium and NSF/NFD.

II. SCOPE

Personnel: Professional staff and referring physicians and their representatives

III. DEFINITIONS

Estimated Glomerular Filtration Rate (eGFR): The eGFR by the Modification of Diet in Renal Disease (MDRD) formula* is based on serum creatinine, age, sex, and ethnicity.

NSF/NFD: Nephrogenic systemic fibrosis/nephrogenic fibrosing dermopathy, which is a rare, irreversible, and often fatal multisystem disorder characterized by collagen deposition in the skin and organs resulting in thickening and hardening of the skin and joints leading to immobility. It was first described in 2000. The number of people with the disorder has grown to a reported 215 worldwide according to an international NSF registry at Yale University (New Haven, Connecticut.) An ongoing survey of some of these patients revealed that 95% (n = ~100) had been exposed to a gadolinium chelate 2 to 3 hours before the onset of NSF/NFD. Of 57 cases reported to FDA, most were associated with Omniscan, but both Magnevist and OptiMARK have been implicated as well. Currently, the only known way to stabilize disease progression is through rapid correction of renal function by surgical or medical means. (Kuo PH, Kanal E, Abu-Alfa AK, Cowper SE. Gadolinium-based MR contrast agents and nephrogenic systemic fibrosis. *Radiology*. 2007;242(3): 647-9.)

IV. PROCEDURE

Action	Responsibility
A. Evaluation of Patient Prior to Administration of Gadolinium	
1. Patients who have normal renal function determined by history or who are at low risk for renal insufficiency may have gadolinium administered per routine institutional protocol <i>without</i> obtaining serum creatinine.	Radiology technicians/ radiology management
2. For patients with known renal problems, or at moderate to high risk for renal insufficiency; follow the protocol (refer to B & C).	Radiology technicians/ radiology management
<i>Note:</i> Patients are considered moderate to high risk if one or more of the following applies:	
<ul style="list-style-type: none"> - age over 65 - diabetic - hypertensive - prior abnormal creatinine clearance - family history of kidney disease 	

B. Baseline Creatinine

1. Estimated glomerular filtration rate (eGFR): All patients considered moderate to high risk for renal insufficiency and who are to receive gadolinium-based contrast media must have a baseline creatinine drawn within 60 days prior to administration/procedure.
2. Using the baseline creatinine, eGFR will be calculated.
3. If the creatinine was drawn at an outside facility, the results are to be brought to the performing facility the date of exam.

C. Protocol for Safe Administration of Gadolinium

Action	Responsibility
1. If the eGFR is <30 mL/min/1.73m ² , then the review and approval of either the radiologist and/or the referring physician will be required with regard to the risk to benefit ratio of the exam performed with gadolinium.	
2. If the eGFR is >30 mL/min/1.73m ² , then the technologist may proceed with the exam.	Radiology technician
3. If the eGFR is <30 and it is determined that gadolinium is needed, informed consent will be obtained from the patient or patient's legal representative by a radiologist or nephrologist.	Radiologist or nephrologist
4. Consent will be signed by the patient or patient's legal representative and witnessed by personnel.	Radiologist or nephrologist
5. Patients on hemodialysis are to be dialyzed within 18 hours after gadolinium administration.	Nephrology/ hemodialysis department
6. For patients on peritoneal dialysis, the use of gadolinium should be carefully considered. If the need for a gadolinium-based exam outweighs its potential risk, then it should be administered only after consultation with nephrology, who will determine the patient's case-specific post-gadolinium dialysis protocol. The patient or legal representative will be informed of risks, benefits, and alternatives before the exam is performed.	Nephrologist, radiologist, and ordering physician

V. **ATTACHMENT:** N/A

VI. **DISTRIBUTION:** Hospital and medical group

VII. **POLICY RESPONSIBILITY:**

AVP, Radiology Services

In Coordination With:
Nephrology Division
Patient Care Services
Professional Staff
Radiology Department
Pharmacy & Therapeutics
Committee

VIII. REFERENCES:

Internal

External

None

Kuo PH, Kanal E, Abu-Alfa AK, Cowper SE. Gadolinium-based MR contrast agents and nephrogenic systemic fibrosis. *Radiology*. 2007; 242(3): 647-9.

IX. REVISION:

The organization reserves the right to unilaterally revise, modify, review, or alter the terms and conditions of the policy within the constraints of law, with or without reasonable notice.

X. APPROVAL:

_____	President, Professional Staff	_____
Signature	Title	Date
_____	Chief Nursing Officer	_____
Signature	Title	Date
_____	Chairman, Radiology	_____
Signature	Title	Date
_____	AVP, Radiology	_____
Signature	Title	Date

XI. DATES:

Origination: _____ Last Review: _____ Next Review: _____

Pharmacist Reference for Assessing Contrast Media Orders

Check patient profile for the following:

- Drug interactions
- Dose
 - Per protocol
 - Weight-based (current weight should be on file)
- Allergies
 - History of anaphylaxis
 - Shellfish allergy
 - Hypersensitivity to iodine
- Past medical history
 - Diabetes—must establish renal function
 - Heart failure—must establish renal function
 - Asthma—history of anaphylaxis
- Interactions
 - Discontinue nephrotoxic medications
 - NSAIDs
 - Diuretics
 - ACE inhibitors
 - Aminoglycosides
 - Metformin—hold day of procedure and 48 hr post
 - May discontinue beta-blockers if h/o anaphylaxis

Contrast Media Summary

Variable	Iopamidol (Isovue)	Iodixanol (Visipaque)	Gadopentetate Dimeglumine (Magnevist)	Diatrizoate Meglumine and Diatrizoate Sodium (Gastrografin)	Diatrizoate Meglumine (Cystografin)
Category	Nonionic low osmolar	Nonionic iso-osmolar	Nonionic low osmolar	Ionic high osmolar	Ionic high osmolar
Dose	<ul style="list-style-type: none"> ■ Isovue 300: 100 mL at 2 mL/sec ■ Isovue 370: 130–150 mL at 2–3 mL/sec 	100–130 mL at 4–5 mL/sec	0.2–0.4 mL/kg at 2 mL/sec or Slow hand injection	60–100 mL orally	300 mL drip
Interactions	<ul style="list-style-type: none"> ■ Metformin ■ Thioridazine 	<ul style="list-style-type: none"> ■ Metformin 	<ul style="list-style-type: none"> ■ Any medication that can cause renal impairment or suggest that renal impairment might exist 	<ul style="list-style-type: none"> ■ Diltiazem ■ Metformin ■ Propranolol 	<ul style="list-style-type: none"> ■ Diltiazem ■ Metformin ■ Propranolol