

Medication Management and
CONTRAST MEDIA

Case Study **1**

from a Southeastern Academic Medical Center



Developed by ASHP Advantage

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ABSTRACT

At an academic medical center in the southeastern United States that annually performs over 70,000 radiology studies with contrast media, a review of procedures revealed a lack of compliance with Joint Commission standards for medication management of contrast media. New policies and procedures were implemented addressing the storage of medications in the radiology department and prospective review of medication orders for contrast media. The multidisciplinary review team also identified a need for enhanced monitoring for nephrogenic systemic fibrosis. The new policies and procedures included assignment of a licensed independent practitioner to all off-site imaging areas and modified storage requirements to comply with Joint Commission standards.

DISCLAIMER

The information contained in this document was obtained by interviewing pharmacist and 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 due to 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, or ASHP are not responsible for the continued currency of the information, for any errors or omissions, and/or 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.

In response to the Joint Commission's classification of contrast media as a medication, effective in 2004, this southeastern academic medical center convened a team of radiologists, radiology technologists, radiology nurses, and pharmacists to evaluate medication management practices in the radiology department and make changes in policies and procedures as necessary. The team was formed in July 2006. Its primary goal was to improve patient safety through compliance with Joint Commission standards. When nephrogenic systemic fibrosis (NSF) was recognized as a concern with gadolinium contrast agents, the team's focus was expanded to include prevention of contrast-induced NSF.

The Pharmacy and Radiology Departments

At the medical center's 924-bed hospital, inpatient services are provided by a central pharmacy and by several decentralized pharmacists. The pharmacy department (Table 1) uses technology to help reduce errors and improve patient care. Outpatient pharmacies serve the needs of ambulatory patients in four areas. Clinical pharmacy services are provided in a variety of practice specialties. A comprehensive drug information center supports the medical center. The department's staff of over 230 individuals provides services 24 hours a day, 7 days a week, 365 days a year.

TABLE 1

Pharmacy Department Profile

Inpatient Services

Central pharmacy
Decentralized in surgery, pediatrics, medicine, and operating room
Drug information center

Outpatient Services

Outpatient pharmacy
Cancer center
Children's Hospital
Ambulatory surgical center

Clinical Services

Cardiology
Critical care medicine
Hematology and oncology
Infectious disease
Internal medicine
Nutrition support
Organ and bone marrow transplantation
Pain management
Pediatrics
Surgery

Technology

Automated dispensing cabinets
Computerized prescriber order entry (CPOE)
Custom-designed adverse drug event monitoring software
Electronic patient medical record
Robotic dispensing
"Smart" intravenous pumps
Wireless campus with laptop availability

Personnel

Pharmacists	111
Pharmacy technicians	128
Pharmacy practice residents	4
Specialty Residents	1–4

TABLE 2

Proportion of Radiology Cases Using Contrast Media

Study	Cases/Year	No. Cases with Contrast	No. Cases without Contrast
MRI	28,500	16,000 (56%)	12,500 (44%)
CT	90,000	49,500 (55%)	40,500 (45%)
Interventional X-ray	7,566	5,641 (75%)	1,925 (25%)
GI	8,300	8,300 (100%)	0 (0%)
Total	134,366	79,441 (59%)	54,925 (41%)

The medical center has multiple radiology imaging groups: magnetic resonance (MRI), computed tomography (CT), interventional, ultrasound, diagnostic X-ray, gastrointestinal/genitourinary (GI/GU), nuclear medicine, pediatrics, and mammography. Areas in which contrast media are regularly used include MRI, CT, GI/GU imaging, and interventional radiology (Table 2); a majority of the procedures performed in these areas are for outpatients (70%). The radiology department serves multiple sites throughout the system. Services are provided 24 hours a day, 7 days a week, 365 days a year. Table 3 summarizes the department's imaging areas and staffing.

Medication Management in Radiology Prior to the Intervention

Contrast media are ordered by the radiology department and received in the central radiology storage room. Individual imaging areas (e.g., CT, MRI, IR, GI) order quantities to maintain an appropriate par level. The contrast media are stored in cabinets and on shelving that are not secured by lock and key. Staff in the CT and IR imaging areas move contrast media from storage to warmers on an as-needed basis. Table 4 lists the contrast products stored in the different imaging areas.

Radiology nurses order and pick up noncontrast medications from the pharmacy department once a week. These medications (Table 5) are stored in locked cabinets and drawers within the various imaging areas.

Before the Joint Commission’s classification of contrast media as medications and the subsequent formation of a multidisciplinary team to address the impact of this change on both the pharmacy and radiology departments, the two departments had rare opportunities to work together. Pharmacy was relatively unfamiliar with radiology practices and the use of contrast media, just as radiology was unfamiliar with pharmacy practices and Joint Commission medication management standards. Contact between the departments consisted of the radiology nurses’ weekly medication pickup from the central pharmacy and a pharmacy liaison program that provided oversight of medication storage and security.

In response to the Joint Commission’s medication management standards, both departments worked together to improve the process for safe administration of contrast media and to prevent NSF. Their shared goals were to improve patient safety through compliance with Joint Commission standards while at the same time maintaining the patient convenience that was already built into the radiology system.

TABLE 3

Radiology Department Profile

Imaging Areas	
MRI	3 imaging sites, 9 scanners
CT	2 imaging sites, 9 scanners
Interventional	1 imaging site, 5 rooms
Personnel	
Radiologists	50
Radiologic technologists	215
Nurses	45
Strategic services associate	1

TABLE 4

Contrast Media Available in Imaging Areas

MRI

Magnevist (gadopentetate dimeglumine)^a
 MultiHance (gadobenate dimeglumine)
 ProHance (gadoteridol)

CT

Isovue 300 (iopamidol)
 Isovue 370 (for CTAs)

Interventional Radiology

Isovue 200
 Isovue 200M
 Isovue 300
 Renographin (diatrizoate meglumine and diatrizoate sodium)
 Visipaque (iodixanol)

^a Magnevist is packaged in a 100-mL multiuse vial. Upon opening a vial, the radiology technologist dates and initials it. In most cases, the entire vial is used within 24 hours of opening; if not, the remainder is discarded.

TABLE 5

Noncontrast Medications Used in Radiology

Chloral hydrate
 Diazepam (Valium)
 Diphenhydramine (Benadryl)
 Hydrocortisone
 Lorazepam (Ativan)
 Morphine
 Pentobarbital sodium (Nembutal)
 Ondansetron (Zofran)
 Prednisone
 Promethazine (Phenergan)

Assessing Medication Management for Contrast Media

In the fall of 2006, the multidisciplinary team aimed to assess medication management for contrast media, develop and implement a plan for safer use of these agents, and prevent NSF, thereby complying with Joint Commission standards.

The team consisted of the director of pharmacy, assistant director of pharmacy, chief technologists from the imaging areas (e.g., MRI, CT, X-ray), the radiology nursing manager, radiology strategic service associate, and several radiologists. The team members met monthly for four months.

Because of their concern about NSF, they formed a subcommittee to examine the issue more closely. This subcommittee consisted of the assistant director of pharmacy, four pharmacy residents, a radiologist, the strategic service associate, and a few chief radiology technologists.

The radiology department had considered its practices to be safe and had not experienced or documented any medication errors. For years, the department had focused on designing systems to prevent unnecessary delays in imaging studies and long wait times for patients.

One of the team's first actions was to outline workflow in the radiology department. Prior to January 29, 2007, the workflow was as follows:

1. The referring physician entered a request for an imaging study via the medical center's computerized prescriber order entry (CPOE) system for inpatients or called the radiology central scheduling office for outpatients.
2. The radiologist received the order and selected an imaging protocol appropriate for the patient's diagnosis and referring physician's request.
3. A paper order was sent to the radiology technologist. It consisted of the original referring physician's order attached to the imaging protocol form (Exhibit 1) completed by the radiologist. These procedures were completed 24 hours in advance of imaging studies for outpatients. Inpatient orders were processed as needed.
4. On the day of the procedure, the radiology technologist alerted the nurse when a patient requiring contrast media arrived in

the department. The nurse used questions on a contrast administration form to assess the patient. The nurse reviewed clinical data available in the patient's electronic medical record and performed an exam focused on the patient's history with contrast media, history of allergies to food and medications, history of hemolytic anemias, renal disease, and pregnancy. The nurse also assessed intravenous (i.v.) access. Upon completion of the assessment, the nurse signed the contrast administration form and passed it to the radiology technologist.

5. The technologist identifies the correct contrast media by using data from the imaging protocol form and detailed radiology protocol website. Next, the technologist selects the appropriate agent from the storage cabinet, checked the expiration date, drew up the contrast medium, and applied the label provided by the manufacturer to indicate the product type and concentration.

6. The technologist performs the study, administering contrast medium if allowed by the department's guidelines (i.e., oral and i.v. contrast). If the case called for action outside the guidelines, the technologist deferred to the nurse (e.g., to administer diphenhydramine for hives or lorazepam for anxiety).

The institution has an internal program through which radiology technologists are credentialed to prepare and administer contrast media. Depending on the imaging area in which they work, the technologists have been trained to prepare oral, rectal, and i.v. contrast media. All technologists can administer oral contrast, but MRI technologists can administer i.v. contrast media following specific departmental guidelines. The radiologist administers rectal contrast. All radiology nurses are allowed to administer i.v. and oral contrast media.

7. Medication errors and adverse reactions were reported through the medical center's electronic safety reporting system (SRS). Adverse reactions such as hives were also documented in the electronic patient record.

TABLE 6

Compliance with Joint Commission Standards for Contrast Media

Standard (a)	Compliance (b)	Standard (a)	Compliance (b)
PC 5.10		MM 3.20	
Two patient identifiers	C	Medication ordering	N
		<ul style="list-style-type: none"> ■ required elements ■ preprinted order review 	
PC 13.20		MM 4.10	
Moderate sedation	C	Pharmacist review of orders	N
NPSG 1		MM 4.10	
Time out process	C	Safeguards for oral/rectal contrast	N
NPSG 2e		<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 	
NPSG 3d		MM 4.80	
Medication labeling	C	Recall process	C
NPSG 8		MM 5.10	
Medication reconciliation	C	Medication administration	C
MM 1.10		MM 6.20	
Medication information available	C	Reporting adverse drug events	C
MM 2.10			
Formulary process	C		
MM 2.20			
Storage of medications	N		
<ul style="list-style-type: none"> ■ only formulary drugs ■ temperature monitoring ■ medication security ■ narcotic control ■ periodic inspection 			

(a) PC = patient care standard; MM = medication management standard; NPSG = national patient safety goal.

(b) C = compliant; P = partially compliant; N = noncompliant.

An understanding of the workflow within the radiology department allowed the team to assess its compliance with the Joint Commission medication management standards for contrast media. The team found that the workflow was compliant with most of the standards (Table 6) but partially compliant or noncompliant with standards for storage of medications (MM 2.20), medication ordering (MM 3.20), and pharmacist review of medication orders (MM 4.10). The team also concluded that the process for assessing a patient's renal function and other risk factors could be improved.

Plans for Improvement

The team decided to implement a two-tier plan for improvement. A pilot program would gather data, assess educational needs, and drive the development of a long-term solution. At the same time, work would begin on the long-term solution, and when this was in place the pilot program would be discontinued.

PILOT PROGRAM

The pilot program began on January 29, 2007, and continued through April 27, 2007. Data on current practices were collected, and the educational

needs of both radiology and pharmacy personnel were assessed.

Pharmacy and radiology agreed to use the American College of Radiology^{1,2} definition of “direct supervision of a licensed independent practitioner (LIP)”; in those areas where an LIP was directly supervising, pharmacy was not required to conduct a prospective review of orders for contrast media. However, in the areas where an LIP was not available, pharmacy prospectively reviewed the medication orders for each patient who was to receive contrast media. The radiology department provided pharmacy with the list of patients scheduled for an imaging study with contrast on the following day (i.e., 24 hours in advance). The list included the patient’s name and medical record number and the telephone number of the corresponding radiology division.

Pharmacy practice residents reviewed these patients’ orders by using the patient’s electronic medical record and a medication risk factor assessment tool for contrast media (Exhibit 2). The review was designed to identify risk factors for adverse reactions, such as allergy history, renal function, and contraindicated medications. Originally, pharmacists attempted to contact the radiologist if they had concerns about a patient or were unable to complete the assessment because data were lacking. However, the radiologists were often unavailable at the time of the review. Therefore, pharmacists telephoned the radiologist only if the patient had a history of an anaphylactic reaction to contrast media or had end-stage renal disease. For other issues, such as incomplete patient data and renal impairment, the screening form was faxed to the radiology technologists for follow-up.

During the pilot program, renal function was assessed by pharmacists using an estimated creatinine clearance (CrCl) based on the Cockcroft-Gault equation, which was used by radiology to approximate estimated glomerular filtration rate (eGFR). Near the end of the pilot period, pharmacists provided radiology personnel with a CrCl nomogram so that they could estimate the CrCl using the patient’s serum creatinine, gender, and age (Exhibit 4). Radiology nurses and technologists used the CrCl to guide them through the imaging study protocol.

TABLE 7

Findings Requiring Intervention

Finding	Occurrences
Renal impairment	14 patients
End-stage renal disease	11 patients
History of relevant allergies	12 patients
No data available for review	37 patients
Incomplete data	72 patients

The process followed by the radiology nurses did not change substantially during the pilot program. They continued to follow the guidelines set forth by the American College of Radiology. However, work of the NSF subcommittee led to modification of the nurses’ contrast media history form and plans for improving patient assessment. The modified form (Exhibit 3) includes more in-depth questions about recent medical history (e.g., recent receipt of chemotherapy, renal disease, receipt of erythropoietin, severity of allergic reactions) and provides direction based on the results of the assessment (e.g., CrCl, renal disease, previous reaction to contrast media).

During the pilot program the pharmacy department reviewed 328 orders, approximately 45 per day. Pharmacists took on average 2.5 minutes to complete each review. The radiology department noted no delays in its processing of patients attributable to the pharmacy review. There were a total of 53 interventions, of which 21 warranted a call to the radiologist. Thirty-two patient specific concerns were faxed to the radiology technologist. The most common issue identified by pharmacists (Table 7) was lack of data needed to complete the review.

LONG-TERM SOLUTIONS

The pilot program provided the in-depth analysis needed to improve assessment tools, protocols, and policies and procedures. The long-term solution involved assigning an LIP to each imaging area outside the medical center. This approach was chosen because it did not delay the processing of patients or add to clinicians’ workload. During the pilot program, the medical center made the organizational changes necessary to place an LIP

in all imaging sites. No personnel were added; the current staff was reorganized. Once LIPs were in place at all imaging sites, they were available to the radiology technologists and nurses to assess patients who were flagged for review, and determine the most appropriate use of contrast media. When LIPs were in place throughout the radiology offsite areas, the pharmacy screening performed during the pilot program was discontinued.

By April 1, 2007, every imaging site had an LIP responsible for direct supervision of contrast media administration. Upon receiving a request for imaging through the CPOE system, the LIP conducts an assessment to determine the most appropriate use of contrast media in each patient.

In addition, experience during the pilot program led the team to implement a more rigorous and protocol-driven patient assessment process for the radiology nurses and a more effective procedure for assessing renal function and using the data to guide practitioners to the safest practices. Practitioners were given tools for obtaining missing data quickly and accurately.

With the input of the center's medical laboratory, the outpatient imaging areas are piloting a point-of-care testing machine as a means of avoiding delays in procedures due to incomplete patient data (e.g., SCr). The machine enables radiology nurses to use a small blood sample (about two drops) to determine SCr within approximately 15 minutes. The serum creatinine clearance nomogram is then used to calculate estimated creatinine clearance (Exhibit 4).

Policy now dictates that all patients who are going to receive contrast agents be screened for renal and severe hepatic dysfunction. A serum creatinine (SCr) is obtained in the following situations:

- a. Patients over 60 years old without SCr in the past 30 days.
- b. Patients receiving chemotherapy or nephrotoxic drugs with no SCr since their last drug administration.
- c. Patients with known renal dysfunction.

New policies and procedures for both pharmacy and radiology have been finalized. For example, with input from nephrologists and dermatologists,

the NSF subcommittee developed a gadolinium policy (Exhibit 5) designed to increase patient safety and minimize the potential for NSF. The primary policy and procedure documents reside in the radiology department. Other departments defer to the radiology documentation in their own policies and procedures. For example, the pharmacy policies and procedures "Medication Orders Writing and Processing" reads, "Pharmacists review all orders for medications, except contrast media (see Radiology Policy X.X)."

EDUCATING STAFF

The learning curve for implementing changes proposed by the multidisciplinary team was significant. Most attending radiologists were aware of both the pilot program and the pending long-term changes, but often the radiology residents received just-in-time education about these programs. Although a multidisciplinary team was the driving force behind the new policies and procedures to ensure Joint Commission compliance, education of pharmacy, radiology, and other medical center personnel was conducted at the departmental level through existing meetings and communication channels. In the case of radiology, e-mail and other means were used to deliver information, since the center has personnel and imaging centers throughout the city.

OUTCOMES

Before the new programs, policies, and procedures were instituted, all data describing the rate of medication errors or outcomes associated with the administration of contrast media were collected through voluntary reports to the SRS. For the future, the Case Study site is promoting a non-punitive approach to collecting data about all errors or near misses. The goal is to evaluate the incidents from a systems approach so that they can identify points of risk and make necessary adjustments. A committee meets monthly to discuss SRS reporting specific to radiology. There are plans for a trigger system that will use computer technology and other factors to identify real-time data (e.g., compromised renal function, hives) so that the committee will not have to depend solely on voluntarily reported information. The long-term solution does not include retrospective review of orders that do not require review by an LIP.

Despite the increased monitoring, there have been no changes in staffing, case loads, or departmental costs. The current staff was reorganized to provide LIP coverage for all imaging sites. No changes in case load were noted despite the more intensive screening now done by the radiologists and radiology nurses. The process remains efficient and patient friendly.

All contrast media are now stored in secured closets or cabinets. Previously, not all the storage areas were secured. All warmers are now supplied with locks, or personnel are in those areas 24 hours a day for constant supervision. Contrast media are moved to the warmers as needed.

The Joint Commission visited the medical center in April 2007. Although the surveyors did not visit all imaging areas and made no specific comments on the new policies and procedures, they were satisfied with the center's approach.

Conclusion

Although Joint Commission standards provided the impetus for the pharmacy and radiology departments to evaluate practices at this medical center, it was the collaborative efforts of the two departments and a desire to improve patient safety and prevent NSF that led to the most significant changes in practice.

References

1. American College of Radiology. ACR Practice Guideline for the Use of Intravascular Contrast Media. www.acr.org/SecondaryMainMenuCategories/quality_safety/guidelines/GeneralDiagnosticRadiology.aspx (accessed 2007 Aug 27).
2. American College of Radiology. JCAHO approves interim provisions to medication management standard 4.10, encourages comments. www.acr.org/SecondaryMainMenuCategories/NewsPublications/Featured-Categories/CurrentACRNews/archive/...Doc193.aspx (accessed 2007 Aug 27).

Imaging Order Form

Routine Brain

(all brains inc. diffusion)

- Adult (+ contrast)
- Adult (w/o contrast)
- Adult Stroke
- Pediatric (+ contrast)
- Pediatric (w/o contrast)
- Brain / Pituitary
- Brain / Orbits
- IAC or Ltd. IAC
- Cochlear Patency
- Bell's Palsy
- Spectroscopy
- Radiosurgery
- MS
- Neuro Neck

Brain Tumor

- Routine Tumor
- Preoperative Tumor (incl Sag T1+c)
- Double Perfusion MAB
- EMD
- DCE
- GSK

Seizures

- Adult
- Pediatric
- Febrile Seizure

Options

- Perfusion Imaging
- TENSOR
- GRE for susceptibility

Stereotactics

- Routine
- Stealth—3mm
- Functional (preop) (postop)
- Brain Lab

Neuro Vascular

- MRA Neck—2dtof
- CEMRA
- MRA Head—3dtof
- MRV
- CSF Flow Study
- 2d / 3d PC Flow Dir____ Venc ____

Spines

- Intradural (includes contrast)
Cervical Thoracic Lumbar
- Extradural (no contrast)
Orthogonal
Cervical Thoracic Lumbar
- Lumbar Spine HNP w/angled
Axials
- Cervical Spine Trauma
- Cervical Spine HNP
- Tethered Cord (incl. T8-S1)
- R/O Drop Mets
Cervical Thoracic Lumbar
- R/O Bone Mets
Cervical Thoracic Lumbar
- R/O Cord Compression
Cervical Thoracic Lumbar

Pediatric Protocols

- Peds TMJ (inc. contrast)
- Gaucher's
- Iron Concentration Liver
- Hemangioma—MD to provide
Area of Interest & Slice thickness

Vascular

- DVT—lower ext
- Central Vein—upper ext.
- Renal MRA
- Mesenteric MRA
- Chest MRA (above diaphragm)
- Upper Aorta
- Lower Ext. Runoff
- Abdominal Aorta
(below diaphragm)

Bone

- Ankle
- Tumor Protocol
- Foot (foot only to incl
1st row of tarsals)
- Plantar Plate (usually single
toe only)
- Knee
- Hip (unilateral only)
- Hip Arthrogram
- Pelvis—AVN (bilateral)
- Pelvis—R/O Mets (bilateral)
- Pelvis—FX (bilateral)
- Brachial Plexus
- Sacral Plexus
- Wrist or Wrist Arthrogram
- Elbow or Elbow Arthrogram
- Shoulder or Shoulder Arthrogram
- Cervical, Thoracic, Lumbar Spine
- TMJ

Abdominal

- Routine Liver
- Portal Vein Liver
- Pre-Transplant Liver
- Abdomen/Pelvis
- Pancreas
- Pancreas/MRCP
- MRCP only
- MRCP Secretin
- Adrenal
- 2D Renal
- Renal Staging

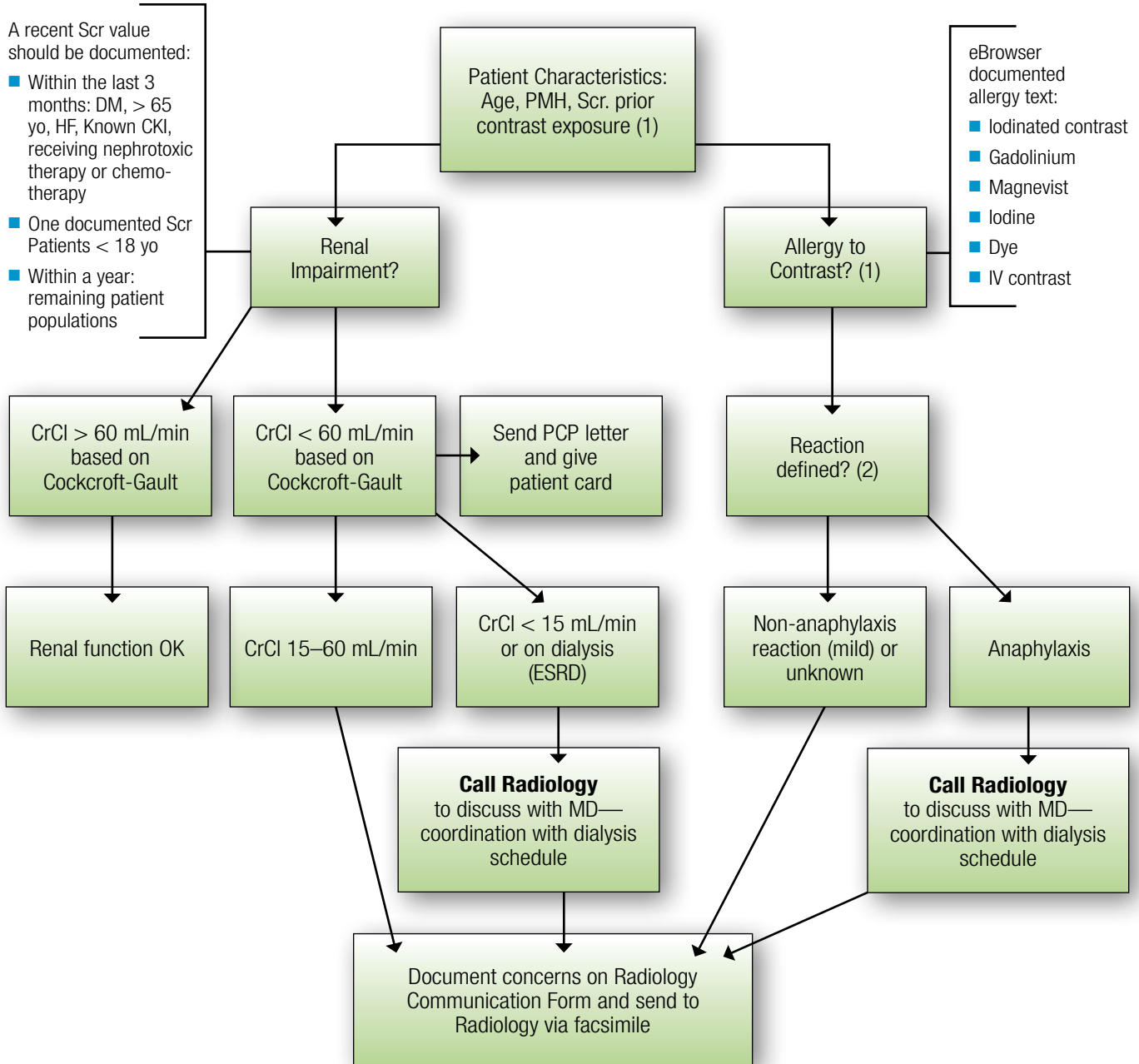
Pelvis

- Female Pelvis
- Pre-Embo Female Pelvis
- Pelvic Floor
- Urethrogram
- Male Pelvis
- Prostate
- Peri-Rectal Abscess

Medication Risk Factor Assessment Tool

Pharmacist Review of MRI Contrast Media Orders

February 11, 2007



(1) If a patient does not have sufficient documented information to review the contrast order, write the patient's information on the Radiology Communication Form and send to Radiology via facsimile.

(2) Patients with reported allergy to contrast and a past medical history of asthma or various allergies are at increased risk of adverse reaction, with reaction rates of high as 3.7%

Patients that have had a previous reaction to a gadolinium-containing contrast agent are at 8 times higher risk of an adverse event if challenged often times, the second reaction is more severe

Patients that have had a previous reaction to an iodinated contrast agent are at 2.3–3.7 times higher risk of an adverse event upon exposure to a gadolinium-containing agent

DM: Diabetes Mellitus

HF: Heart Failure

CKI: Chronic Kidney Insufficiency

Scr: Serum Creatinine

PCP: Primary Care Practitioner

ESRD: End Stage Renal Disease

PMH: Past Medical History

EXHIBIT 3

Intravenous Contrast Media History—Radiology

DOB: ___/___/___ Age: _____

Exam: MRI MRA

DX: _____

Area to be scanned: _____

SCr: _____ Wt: _____
Date of last lab: _____
CrCl: >60 45–60 30–45
 15–30 <15

Y N (check appropriate box)

- Adverse food or drug reactions List: _____
- Asthma or allergic rhinitis? Mild Moderate Severe
- Recent Chemotherapy: Date: _____ Meds: _____
- Sickle Cell Disease or other Hemolytic Anemias? (Circle Diagnosis)
- Patient educated about possible side effects of IV Contrast Media
- Have you had an MRI with intravenous contrast in the last 3 months?**
- Prior MRI contrast media reaction? If Yes, Describe Reaction:** _____
- Renal Disease:** Transplant Nephrectomy Peritoneal Dialysis Hemodialysis: Freq: _____
- DNR**
- Liver transplant: awaiting or received?**
- Pregnant? LMP**

Emergent study—patient cannot communicate for him/herself.

If Yes to any bolded question, contact Radiologist or Practitioner Designee, and document below.

- Dr. _____ pager # _____ has been made aware of patient's medical hx.
Name: First _____ Last _____
- Radiologist declined contrast

IV DATA (Check appropriate answers)

Status: Existing (less than 20 hours) Started in department by: _____
Gauge: 16 18 20 22 24 Central Line Port
Side: Right Left
Site: Jugular Subclavian Upper Arm Antecubital Fossa Forearm
 Wrist Hand Portacath Hickman Other _____

CONTRAST MEDIA AGENT INJECTED (Check appropriate answers)

Type: Magnevist ProHance MultiHance Other _____
Volume: _____ milliliter(s) Time: _____ Injected By: _____

COMPLICATIONS:

None
Reaction: Hives Wheezing Mild Moderate Other _____
Infiltration: Minor Major
Severity: Mild Moderate Severe **Reaction noted in eBrowser**

COMMENTS:

Signature: _____ Time: _____ Pager/phone # _____

Estimated Creatinine Clearance Nomogram

Male Creatinine Clearance Table

SCr	Age																
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-100
0.5-0.7	205	197	188	180	172	163	155	147	138	130	73	68	63	58	53	48	43
0.8-1.0	137	131	126	120	114	109	103	98	92	87	73	68	63	58	53	48	43
1.1-1.3	103	98	94	90	86	82	78	73	69	65	61	57	53	48	44	40	36
1.4-1.6	82	79	75	72	69	65	62	59	55	52	49	45	42	39	35	32	29
1.7-1.9	68	66	63	60	57	54	52	49	46	43	41	38	35	32	29	27	24
2.0-2.2	59	56	54	51	49	47	44	42	40	37	35	32	30	28	25	23	20
2.3-2.5	51	49	47	45	43	41	39	37	35	33	30	28	26	24	22	20	18
2.6-2.8	46	44	42	40	38	36	34	33	31	29	27	25	23	21	20	18	16
2.9-3.1	41	39	38	36	34	33	31	29	28	26	24	23	21	19	18	16	14
3.2-3.4	37	36	34	33	31	30	28	27	25	24	22	21	19	18	16	15	13
3.5-3.7	34	33	31	30	29	27	26	24	23	22	20	19	18	16	15	13	12
3.8-4.0	32	30	29	28	26	25	24	23	21	20	19	17	16	15	14	12	11
> 4.0	29	28	27	26	25	23	22	21	20	19	17	16	15	14	13	11	10

If Estimated CrCl is below line, patient is at increased risk for Nephrogenic Systemic Fibrosis

Female Creatinine Clearance Table

SCr	Age																
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-100
0.5-0.7	174	167	160	153	146	139	132	125	118	111	62	58	54	49	45	41	37
0.8-1.0	116	111	107	102	97	93	88	83	78	74	62	58	54	49	45	41	37
1.1-1.3	87	84	80	77	73	69	66	62	59	55	52	48	45	41	38	34	30
1.4-1.6	70	67	64	61	58	56	53	50	47	44	41	39	36	33	30	27	24
1.7-1.9	58	56	53	51	49	46	44	42	39	37	34	32	30	27	25	23	20
2.0-2.2	50	48	46	44	42	40	38	36	34	32	30	28	26	23	21	19	17
2.3-2.5	44	42	40	38	36	35	33	31	29	28	26	24	22	21	19	17	15
2.6-2.8	39	37	36	34	32	31	29	28	26	25	23	21	20	18	17	15	14
2.9-3.1	35	33	32	31	29	28	26	25	24	22	21	19	18	16	15	14	12
3.2-3.4	32	30	29	28	27	25	24	23	21	20	19	18	16	15	14	12	11
3.5-3.7	29	28	27	26	24	23	22	21	20	18	17	16	15	14	13	11	10
3.8-4.0	27	26	25	24	22	21	20	19	18	17	16	15	14	13	12	10	9
> 4.0	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9

If Estimated CrCl is below line, patient is at increased risk for Nephrogenic Systemic Fibrosis

Medical Center's Policy for Gadolinium Contrast Use in Radiology

06/15/07

I. Basic Considerations

A. Gadolinium Contrast Use

Gadolinium contrast agents are medications that can be administered relatively safely. Patients without renal disease or with stage 1 or stage 2 chronic renal disease do not require additional screening. Patients with stage 3 or worse renal disease (CrCl under 60 mL/min/1.73 m²) need additional screening and careful consideration prior to contrast administration. Patients with severe hepatic dysfunction or a liver transplant and those under the age of 1 year also need additional evaluation.

B. Patient Screening and Serum Creatinine

All patients to whom contrast agents are to be administered will be screened for renal and severe hepatic dysfunction. A serum creatinine concentration (SCr) will be obtained for the following patients:

- Those over 60 years of age without an SCr in the past 30 days.
- Those receiving chemotherapy or nephrotoxic drugs without an SCr their last drug administration.
- Those with known renal dysfunction.

C. Contrast Record Keeping

The contrast agent and amount of contrast given to every patient should be included in the radiology report and the nursing sheet documenting contrast history. This information should be attached to the patient exam in PACS.

D. Cumulative Gadolinium Dose

Administration of gadolinium contrast within the past 3 months should be considered in the risk–benefit assessment, especially for stage 4 and stage 5 chronic kidney disease.

E. Nephrogenic Systemic Fibrosis (NSF)

Patients with NSF or suspected NSF should not receive gadolinium contrast agents.

Gadolinium Contrast Use in Patients with Kidney Disease

II. Mild Stage 3 Chronic Kidney Disease (CrCl greater than 45 mL/min/1.73 m²)

No restrictions, but the need for contrast use should be reconsidered.

III. Advanced Stage 3 Chronic Kidney Disease (CrCl 30–45 mL/min/1.73 m²)

The following procedure should be followed:

- If the patient's poor renal function is temporary, consideration should be given to delaying the contrasted portion of the study.
- The study should be monitored and the need to administer gadolinium should be confirmed after review of the noncontrast portion of the study.
- If contrast is deemed necessary by the appropriate radiologist, then the smallest effective dose of gadobenate dimeglumine (MultiHance, Bracco Diagnostics Inc.) should be administered.

Note: Because of the improved relaxivity of gadobenate dimeglumine, a dosage one half that of other agents (or a reduced dosage appropriate for the application) should be considered. For example, if a study required 0.1 mmol/kg of Gd-DTPA, then 0.05 mmol/kg of gadobenate dimeglumine would be used (i.e., 10 mL instead 20 mL as the maximum single dose).

- The radiologist should state in the report that contrast was deemed necessary and was administered after review of the noncontrast portion of the study.

IV. Stage 4 Chronic Kidney Disease (CrCl 15–30 mL/min/1.73 m²)

Gadolinium administration should be avoided if at all possible. If, after assessment of the potential risks and benefits, the radiologist believes that gadolinium administration is indicated, the following procedures should be followed:

- a. If the patient's poor renal function is temporary, consideration should be given to delaying the contrasted portion of the study.
 - b. The case should be discussed with the referring physician.
 - c. The procedure, including the potential risk of NSF and the benefits of gadolinium administration, should be discussed with the patient. The patient must give written informed consent for the contrast administration. The act of obtaining consent should be included in the report.
 - d. A specific order from the radiologist for the contrast administration should be written and signed.
 - e. The study should be monitored, and the need to administer gadolinium should be confirmed after review of the noncontrast portion of the study.
 - f. The smallest effective dose of gadobenate dimeglumine (MultiHance, Bracco Diagnostics Inc.) should be administered. See section III.
 - g. Nephrology should be consulted about possible dialysis for patients not currently on dialysis. For patients on dialysis, the timing of the MRI study and subsequent immediate dialysis should be arranged prior to the start of the study.
- V. Stage 5 Chronic Kidney Disease (CrCl less than 15 mL/min/1.73 m²)**
Gadolinium use should be avoided unless no reasonable alternative imaging study exists and a noncontrast MRI does not provide sufficient information. If gadolinium is used, the procedures outlined above for stage 4 disease are to be followed.

Summary of Gadolinium Use Policy

(X = Needed Action)

Chronic Kidney Disease Stage Creatinine Clearance (CrCl) in mL/min/1.73 m ²	1 or 2 >60	3 Mild 45–60	3 Adv 30–45	4 15–30	5 <15
Document contrast agent and amount	X	X	X	X	X
Radiologist review of contrast screening form		X	X	X	X
Radiologist review of serum creatinine concentration and eGFR		X	X	X	X
Review clinical indication for contrast		X	X	X	X
Consider 3-month total cumulative gadolinium dose		X	X	X	X
Review noncontrast MRI exam; then use contrast only if needed			X	X	X
Consider delay if in acute phase of renal failure			X	X	X
Use half (reduced) dose MultiHance as contrast agent			X	X	X
Document contrast needed after noncontrast MRI on report			X	X	X
Avoid contrast use if possible				X	X
Discuss with referring attending physician				X	X
Nephrology consult prior to contrast exam				X	X
Radiologist signed order for contrast				X	X
Get informed consent and document on report				X	X
Contrast prohibited unless no alternative					X