Quality Assurance in Scheduling Nuclear Medicine Examinations

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Quality assurance of patient care is not simply a matter of scintillation camera quality control, radiopharmaceutical quality control, or radioimmunoassay quality control. A patient's psychological and physical needs must be included in the overall quality control picture. With effective quality assurance for patient scheduling, a patient's anxiety can be alleviated, his physical needs can be met, and hospital cost-effectiveness can be maintained.

About five years ago I became interested in quality assurance for the patient in nuclear medicine. In particular I realized the need to confront the problems associated with coordinating nuclear medicine and radiology examinations. Through conversations with technologists, nurses, ward clerks, and radiology office personnel, I ascertained that many of the breakdowns in this area of quality assurance stemmed from the fact that most scheduling procedures were fairly haphazard. Such scheduling was not only causing operating inefficiencies but was adding to patient discomfort and hospital costs, as well.

I define nuclear medicine quality assurance for patient scheduling as the proper scheduling of examinations so that they are performed in the most expeditious manner, at the lowest cost, and with the least discomfort to the patient.

Common Scheduling Problems

Table 1 lists the most common problems encountered in attempting to schedule patient examinations properly; they were identified after many conversations with all the allied health personnel involved in a patient's care. As Table 1 indicates, problems with patient scheduling occur most frequently when a patient is scheduled for many radiology examinations, including barium enema, IVP, upper GI, small bowel, cholecystogram, etc. Further problems arise when physicians order examinations from other imaging modalities—a few nuclear medicine exams, a computerized tomography exam, and perhaps an ultrasound procedure. Additionally, a patient may be scheduled for procedures with other diagnostic service departments in the hospital, such as EEG, clinical laboratories, and physical therapy. Even more problems are created when, for example, a physician cancels an exam that has already been started. Or a physician may decide to take a patient to surgery or give him a weekend pass—without realizing the financial impact that will result or that the patient has received unproductive radiation.

TABLE 1.
Most Commonly Occurring Scheduling Problems

Orders not charted	Breakfast withheld unnecessarily
Orders are overlooked	Patient is unavailable (eating, bathing, out of room, etc.)
Requested exams are inconsistent with other exams scheduled	Transportation equipment not available
Orders are cancelled but not charted	Wrong patient transported
Orders are cancelled but nuclear medicine not notified	Conflict in schedule
Requisition is lost or delayed	No transport aide available
Requisition is overlooked	Patient arrival is not recognized
Specific requests of referring physician not noted	Patient not instructed
Prep is not carried out	Consent form not signed
Wrong prep is administered	Radiopharmaceutical administered to wrong patient
Patient is not informed of prep	Exam carried out on wrong patient

Above all, in our efforts with patient scheduling, we sometimes overlook the patient's right to maintain his individuality and identity. A patient's personal needs must take first priority; yet they are often denied or delayed during a long day of diagnostic examinations. If effective scheduling methods are carried out, these needs can be met without disrupting the scheduling system unduly.

How Scheduling Problems Occur

To update previously reported data (*1*), I randomly researched the radiology files to determine the frequency of simultaneously ordered radiology and nuclear medicine exams at my institution. The incidence of bone, liver, and gallium scans ordered for a patient also undergoing barium studies is approximately 25%. The inci-

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TABLE 2. Cost Components for Ordering and Performing a Barium Enema Examination*

	(Rate/5 min)	(Time of involvement/min)		(Cost)
Personnel				
Registered nurse—checks orders	$0.50	5		$0.50
LPN—administers prep	0.35	30		2.10
Ward clerk—initiates request	0.30	5		0.30
Messenger—delivers request	0.25	5		0.25
Patient escort—transports patient	0.25	40 (2 round trips)		2.00
Radiology office—processes paper work/file	0.35	10		0.70
			Subtotal	$ 5.85
Attending physician—orders exam	5.00	5		5.00
Radiologist—performs exam and interprets	5.00	30		30.00
			Subtotal	$35.00
Equipment and supplies+				
Initial prep kit				5.50
Requisition				0.20
Office Supplies				0.10
			Subtotal	$ 5.80
#Barium enema			Subtotal	$60.00
			Total+	$106.65

*Costs are approximate and will vary from institution to institution.
+Costs do not reflect indirect cost (i.e., overhead).

dence of these same exams ordered along with ultrasound and CT (body and head) procedures is approximately 12%. These data show a 12% increase in the frequency of these exams ordered simultaneously compared to previously reported data (*1*).

The costs for these procedures increase—unnecessarily—when the following happen:

- ☐ Exams are ordered out of proper sequence
- ☐ An improper exam is ordered and, possibly, performed
- ☐ An exam that has been started is cancelled.

Table 2 lists the cost components for ordering and performing a barium enema exam. Four primary categories are included: personnel, professional component charge, equipment and supplies and basic cost of the exam itself. (These costs are approximate and will vary from hospital to hospital.)

If a barium enema exam is performed out of sequence, for example, before a liver scan (Table 3), approximately $50.65 is added to the cost of the patient's care. A well-monitored and well-controlled scheduling system can eliminate such unnecessary costs and continue to provide quality health care. Over the past several years we have learned that barium in the intestines attenuates the low-energy nuclides used in nuclear medicine. Thus, when a barium study is performed *before* a nuclear medicine procedure, barium in the intestines will cause artifactual lesions to appear on the nuclear medicine images. If a bone scan is performed after a barium or upper GI study, barium will mask some lesions. As you

TABLE 3. Costs Incurred if Barium Enema Is Performed before Liver Scan

Second prep (equipment and personnel)	$11.65
KUB film (to insure barium clearance)	22.00
Radiologist's consult interpretation	5.00
Patient's time (based on cost/day)	12.00
Total	$50.65

TABLE 4. Cost Considerations When an Examination is Requested on Wrong Patient

Personnel		
Registered nurse—checks orders		$0.50
Ward clerk—initiates request		0.30
Messenger—delivers request		0.25
Patient escort—transports patient		2.00
Radiology office—process paper work/file		0.70
	Subtotal	$3.75
Equipment and Supplies		0.30
	Subtotal	$4.05
Examination (e.g., MUGA) performed as a result of error:		$150.00
Costs incurred for nuclear medicine equipment time to perform examination on correct patient:		$60/hr
	Total	$214.05

TABLE 5. Costs Incurred by Cancelling or Mis-scheduling a Study in Progress

Examples of radiopharmaceuticals	Cost/dose
I-125 fibrinogen	$ 85.
Gallium	75.
Bone-PYP	15.
Thallium-201	150.
Personnel costs to initiate exam (nursing staff and nuclear medicine technologist to inject patient)	6.75
Minimum cost	$21.75

can see, proper sequencing of different types of imaging procedures will eliminate "retakes," keep costs down, and even spare the patient unnecessary bowel preparations.

Table 4 shows the cost considerations for an exam requested for the wrong patient (i.e., a ward clerk makes an error in transcribing orders). If the error is noticed before the exam is performed, the cost is minor ($4.50). If, however, an exam is carried out on the wrong patient, several problems follow. The cost of the exam—which can be high, particularly if it is a nuclear cardiology procedure—cannot be charged to the patient and no reimbursement will be forthcoming. Further costs are incurred because the requested exam must be performed on the correct patient and this can amount to as much as $60/hour for operating nuclear imaging instrumentation alone.

Table 5 shows the costs incurred if a patient is injected for a nuclear medicine procedure but the exam is not carried out. The minimum cost of a cancelled exam in this case is about $22; when one of the more expensive radiopharmaceuticals has been administered, the cost of a cancelled exam can rise to as much as $150.

Solutions

While there are obviously many solutions to the many problems of proper patient scheduling, I offer one that works well for my institution. I believe that *communication* and *education* are the two most important factors to insure good patient scheduling. Communication and education allow health care workers to become more

TABLE 6. Nuclear Medicine Examinations Guide

Examination	Patient prep	Necessary time to perform exam	Special instructions
Cisternography	Signed consent for lumbar puncture (L.P.)	30 min initially for L.P. Patient to return to Nuclear Medicine at 2, 4, 24, and 48 hr post-L.P. Allow 45 min for imaging during each of the above return times	Patient should remain recumbent at least 12 hr post L.P. Allow 2 days for receipt of radiopharmaceutical
Brain scan	None	Allow 15 min for initial vascular flow study (injection) Patient is returned to nuclear medicine 2 hr later for static imaging Allow 45 min for static imaging	None
Lung scan/ Perfusion	None	45 min	Usually performed with ventilation lung scan
Heart/ myocardial (infarct and imaging)	None	Patient is injected in early morning; allow 5 min Patient returns to nuclear medicine in 3 hr for imaging; allow 45 min	None

TABLE 7. Computerized Tomography Examinations Guide

	Patient prep	Necessary time to perform exam	Special instructions
Head (noncontrast)	None	40 min	None
Body (noncontrast)	None	40 min	Must be performed before barium enema exam

TABLE 8. Radiology Examinations Guide

	Patient prep	Necessary time to perform exam	Special instructions
Skull series	None	20 min	None
IVP	12 noon: eat light liquid meal 6 p.m: take Fleet phospho-soda 6:30 p.m: eat light liquid meal 9:30 p.m: before retiring, take all four Fleet bisacodyl tablets At least 1 hr before exam, administer 10-mg suppository		
Myelogram	Analgesics or narcotics as ordered Liquid breakfast and lunch	1 hr	Get signed permission form Examination usually done in afternoon Patient should not raise head above shoulders for 12 hr after L.P.

familiar with the duties and responsibilities of others in the health care system. If the nursing staff has been educated about nuclear medicine and other diagnostic and therapeutic exams, the foundation for good patient scheduling has been built. Likewise, nuclear medicine must be aware of nursing procedures and the procedures of other diagnostic modalities. We must make a total commitment to educate one another in terms of policies, procedures, and the potential problems that can occur in health care management. We must broaden our scope. Does your department feel that it is the only one in the hospital and that nuclear medicine must get its work done regardless of staffing considerations, facility limitations, and other departments and nursing floors? If it does, patient scheduling problems are sure to result.

I have been involved in in-service nursing education for about ten years now. My initial interest in providing this education resulted from recognizing the scheduling problems that were coming into existence as nuclear medicine began to emerge as a major field in the health care arena.

The problems are the same today as they were ten years ago. I am amazed at the number of veteran nurses who know how to prep a patient for a gallium scan but do not know what the exam is, how long it takes, or what is involved. Many nurses have never seen the completed exam films or the diagnostic information that is obtained. Some do not realize how important it is for them to prep patients properly. Likewise, many technologists do not know how important it is for them to monitor a patient's IV or oxygen regulator or to handle a patient recently returned from surgery with extra care. Tables 6, 7, and 8 are examples of information that can be distributed to nursing staff so that they might learn something about diagnostic exams. The information in these tables can be augmented by each imaging department and then disseminated to everyone in the hospital.

Once educational and procedural information has been conveyed, constant communication is imperative. Protocols for exams may change, an exam may be cancelled, or the status of a patient's health may change; these are examples of information that must be communicated in a timely and appropriate manner. Further, this type of information must be concisely and definitively written, easy to read, and accessible to all departments.

If possible, you might use a computer to schedule exams and disseminate information to other health workers. I proposed using computers for these purposes four years ago at a national medical meeting. At that time my enthusiasm for and interest in using computers for these purposes was merely a dream; today it still is but to a lesser extent. However, pressures are continuously being applied by government agencies, Professional Service Review Organizations, and others to reduce the patient's hospital stay (and subsequently, reduce hospital costs). Patient scheduling via computers could help to achieve these goals. Since we are now using computers in nuclear medicine to acquire and manipulate data, obtain better resolution in images, store radiopharmaceutical administration accountability information, and perform many other functions, why aren't we using computers to schedule patient exams? I believe that an effective, computerized, hospital-wide nuclear medicine scheduling system could eliminate as much as 40% of the scheduling problems we now encounter on a daily basis.

Conclusions

Of course, an effective scheduling system can be accomplished in nuclear medicine without the use of a computer. This takes the efforts of supervisors, technologists, and clerical scheduling staff. These efforts begin with the supervisor providing scheduling personnel with descriptions of all types of diagnostic imaging modalities—and including in this information the length of time required to perform each different exam, the preparations the patient must receive, and any special considerations to bear in mind. Most importantly, all personnel involved with scheduling must be informed about exams that interfere with one another and the proper sequence for certain types of exams. An imaging department must inform other imag-

TABLE 9. Coordinated Daily Patient Schedule

Patient	Exam	Time	Other Exams	Time
Radiology schedule				
Doe, John	Barium enema	9:00 a.m.	Liver scan	8:00 a.m.
White, Peter	IVP	7:30 a.m.	CT Renal	7:00 a.m.
			Renal ultrasound	8:30 a.m.
Jones, Mae	Skull series	10:00 a.m.	CT scan (head)	9:00 a.m.
Nuclear medicine schedule				
Doe, John	Liver scan	8:00 a.m.	Barium enema	9:00 a.m.
Black, Sylvia	Bone scan	7:30 inj.	None	
		10:30 imaging		
CT schedule				
Jones, Mae	Head	9:00 a.m.	Skull series	10:00 a.m.
White, Peter	Renal	7:00 a.m.	IVP	7:30 a.m.
			Ultrasound	8:30 a.m.
Ultrasound schedule				
White, Peter	Renal	8:30 a.m.	CT Renal	7:00 a.m.
			IVP	7:30 a.m.

TABLE 10. Nuclear Medicine Examination Checklist

A nuclear medicine examination is not complete or successful if you fail to complete any item on this checklist.
—Did you greet patient, smile, and introduce yourself?
—Did you introduce physician to patient?
—Did you make patient as comfortable as possible?
—Did you drape patient properly?
—Did you treat patient like you would like to be treated?
—Did you explain the examination to the patient?
—Did you explain why he had to wait?
—Did you explain the reason for follow-up films?
—Did you clean the room, arrange accessories, and change linens after each patient?
—Did you provide for good image resolution by placing the detector as close as possible to the organ of interest?
—Did you perform the procedure according to the preset time/count?
—Did you use proper positioning techniques?
—Did you have a kind word for your patient when examination was completed?
—Did you leave the patient with the feeling that you cared?
—Were you proud of the quality of the films that you took?

ing departments and subgroups within its own department as to what exams a patient is having in its department—and vice versa. Table 9 shows how to accomplish this.

A total hospital-wide scheduling system can also be introduced; however, it requires great effort and it would be most practical in an institution that already has an order-entry computer. Such a system can actually schedule a patient's day, thus maximizing throughput and minimizing a patient's hospital stay. Further, it allows nurses access to exam times and routine and special preparations for each patient via CRT terminals on the hospital floors.

Regardless of the scheduling system you implement, you must first identify the problems and categorize them according to frequency of occurance and importance. The financial impacts of scheduling problems and their effects on the patient must also be determined. It is necessary to re-evaluate current scheduling methods, if any exist, and establish a new system tailored to your department's needs.

Nuclear medicine technologists have a tremendous responsibility to maintain quality assurance in patient care. An effective and efficient scheduling system is mandatory in order to provide this care. Finally, a patient's exam does not end with implementation of a well-thought-out scheduling system. A quality exam must then be performed. Table 10 is offered as a checklist to maintain quality assurance of patient care throughout the exam.

References

1. Wells LD, Rhodes BA. Quality assurance in patient care. In *Quality Control in Nuclear Medicine*, Rhodes BA, ed, St. Louis, CV Mosby, 1977:96-117.