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Radiology after 5: Improvement in the Exercise of Emergency Radiology

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Abstract: ***Currently, the emergency radiology practiced around the world plays an important role in the number of studies performed each year in radiology departments. Most of them are performed outside of normal working hours (i.e,.during night shifts), initially interpreted by fellows and residents that are on duty, and subsequently reviewed by the attendant in charge of the shift or the corresponding section the following morning or remotely. However, the greatest number of interpretation errors occurs during these hours, which result in inadequate management and causes delays for patients in the emergency room. This is why the use of strategies to quantify the percentage of error in these studies has become very important, not only to provide statistics for individual departments, but also to formulate strategies to allow errors to be identified and diminished to improve patient care. The American College of Radiology (ACR®) has created a scoring system for these non-concordant findings and has provided guidelines for "admissible" error percentages. We conducted a retrospective, observational and descriptive study, in which we evaluated the percentage of non-concordances in the emergency studies in the Diagnostic Imaging Department. We describe the results obtained over a period of 15 months and describe the strategy that we implemented to analyze, socialize, and improve these results.***

Keywords: Quality control, radiology department, radiology report, concordance, improvement

1. Background

Radiology services are a cornerstone in the management of emergency patients not only for the timely diagnosis of urgent pathology, but also to provide fast and adequate management. Although emergency services operate 24 hours a day, 7 days a week and 365 days a year, the majority of the emergency department studies are performed outside of normal working hours. In the major cities, high complexity hospitals have training programs in radiology for graduate physicians (specialization/residents and sub specialization/ fellows). The shifts outside of normal working hours (at night or weekends) are mostly performed by these staff members that are in training; in a few hospitals, night shifts have an institutional radiologist that is present in person, but they are only available for consultation in difficult cases (1,2).

Multiple studies have shown that most interpretation errors occur outside normal working hours, which, in part, is related to the experience of the staff that is in charge and to the number of performed studies. These mistakes, the vast majority of which are not significant, are detected at the time of the review with the institutional radiologist the next morning or when the treating physician requests for a second review. In the literature, there are many publications that deal with this issue; it has been recommended that the term "error" is replaced by the term "discrepancy" or "no agreement" (3,4,5).

In recent years, strategies have been proposed to quantify and categorize these discrepancies according to their degree of pertinence and clinical relevance for the diagnosis and management of patients. The ACR® states that studies in radiology should be reviewed by two radiologists before giving the final report, a strategy that is called "RAD PEER" or "PEER REVIEW" (6). A scoring system of the non-concordant findings is proposed, which is divided into 3 categories (**Figure 1).** Furthermore each category is subdivided into clinically relevant or not (A and B respectively).

Figure 1. Current RADPEER ACR® scoring system
(Adapted from J Am Coll Radiol 2009;6:21-25)

Score	Meaning
1	Concur with interpretation
2	Difficult diagnosis, not ordinarily expected to be made
3	Diagnosis should be made most of the time
4	Diagnosis should be made almost every time-misinterpretation of findings

2. Materials and Methods

A retrospective, observational, and descriptive study was conducted, describing the improvement experience in emergency radiology practice based on the application of the RADPERR ACR® scoring system at the radiology department of our institution, between January 2016 and March 2017.

A document was designed to quantify the total number of studies performed during night and weekend shifts, organizing them according to the diagnostic modality (ultrasound, conventional radiography, computed tomography, magnetic resonance and interventional procedures) and the corresponding section (neuroradiology, chest, abdominal and musculoskeletal imaging). This format was completed for all cases that occurred during the shifts outside of normal working hours during the week (Monday to Friday from 5 pm to 8 am) and weekends (including holidays). The morning after the shift, the cases were analyzed by the attending radiologist (second look and approval), and the non-concordant cases were recorded in the document with the patient's data (for follow up), and classified according to the RADPEER ACR® scoring system; the clinically relevant findings were clarified in the radiological report, clinical history, and reported directly to the treating physician.

Each document was kept under lock by the department´s secretary, who also consolidated the information in excel spreadsheets for the monthly quantification of the total number of studies discriminated by concordance, modality

and by RADPEER ACR® score. On the last Tuesday of each month, the obtained data was socialized in a meeting with the radiology attendants, senior radiologist, fellows and residents of the department. In addition to the statistics of the total number of studies and the non-concordant studies, the most relevant cases where presented to provide feedback and highlight key points to reduce the occurrence of mistakes in the future. This work was carried out by the chief resident in conjunction with the head of the department.

3. Statistical Analysis

A complete and detailed review of the shift delivery documents during the study was carried out. The statistical analysis of the variables was performed in terms of distribution and percentages, discriminating according to the different diagnostic modalities, sections and RADPEER ACR® score.

4. Results

During the evaluation period, a total of 47661 studies were performed in the department outside of normal working hours, of which a discrepancy was found in 330 studies, corresponding to 0.69% (**Table 1**).

Table 1: Number of studies performed in our radiology department, discriminated by concordant and non-concordant results

	Month	Total number of studies	Concordant	%	Non-concordant	%
2016	January	2953	2926	99.08	27	0.91
	February	3014	2993	99.3	21	0.69
	March	3359	3340	99.43	19	0.56
	April	2923	2911	99.58	12	0.41
	May	3000	2975	99.16	25	0.83
	June	3339	3311	99.16	28	0.83
	July	3085	3062	99.25	23	0.74
	August	3014	2994	99.33	20	0.66
	September	3126	3096	99.04	30	0.95
	October	3480	3452	99.19	28	0.8
	November	3014	2991	99.23	23	0.76
	December	3024	3002	99.27	22	0.72
2017	January	3292	3274	99.45	18	0.54
	February	3168	3149	99.4	19	0.59
	March	3870	3854	99.58	16	0.41
Total studies		47661	47330	99.3	331	0.69

The percentage of non-concordance was not related to the number of studies conducted during the month, because it was found that the lowest percentage of non-concordance (0.41%) occurred during the month that more studies were carried out (March 2017), and the highest percentage of non-concordance (0.95%) occurred during a month with an average number of studies (September 2016).

In terms of modality, there were 207 non-concordances for CT, 32 for US and 91 for CR, corresponding to 62.72%, 9.69% and 27.57% respectively. Of the CT non-concordances, the majority were found in the abdominal imaging section (51.21%), followed by neuroradiology (29.95%), chest imaging (14%) and finally MSK (4.83%). In US, they were also mostly from the abdomen section (75%), followed by MSK (21.87%) and chest (3.12%); in neuroradiology no interpretation errors were found in US. For the CR modality, the majority of errors were in chest imaging (54.94%) and MSK (32.96%), followed by neuroradiology (6.59%) and abdomen (5.49%) (**Table 2).**

With respect to the specific section, the majority of non-concordances were found in the abdominal imaging section (40.91%), followed by chest (24.01%), neuroradiology (20.61%) and finally MSK (14.24%).

Table 2: Non-concordant studies according to modality and section

	CT		US		CR	
	Total	%	Total	%	Total	%
Abdominal	106	51.21	24	75	5	5.49
Neuroradiology	62	29.95	0	0	6	6.59
MSK	10	4.83	7	21.87	30	32.96
Chest	29	14	1	3.12	50	54.94
Total	29	62.72	50	9.69	1	27.57

These discrepancies were also classified according to the RADPEER ACR® scoring system by an attending radiologist at a second review. The vast majority (33.03%) were category 3B, followed by 3A (32.12%), 4B (14.24%), 2A (1121%), 4A (5.15%) and finally 2B (4.24%). Most of the discrepancies that were classified to be in categories 2A, 2B, 3A, 3B and 4B were CT studies of the abdominal imaging section; for category 4A, the majority were from CT studies but of the neuroradiology section (**Table 3**).

Table 3: Classification according to RADPEER ACR® scoring system

Category	**Total**
2A	37
2B	14
3A	106
3B	109
4A	17
4B	47
Total	**330**

5. Discussion and Conclusions

By quantifying the studies carried out during night shifts, it was possible to identify the percentage of non-agreement at our department in an objective manner, as well as the studies and sections in which interpretation errors were most common. During the study period, a total percentage of non-agreement of 0.69% was obtained at our department, which was below the acceptable level suggested by the ACR® and by the Joint Commission International for a radiology department (6,7).

In our case, the percentage of non-agreement was not related to the number of studies conducted during the month, because the lowest percentage was obtained during the month in which more studies were performed, and the highest percentage was obtained during a month in which an average number of studies were performed. The majority of non-concordant studies were for the CT and CR modalities. The majority of misinterpretations were made in abdominal imaging (both CT and US), followed by chest imaging (mostly CR), neuroradiology (mainly in CT), and MSK

(mostly CR). Conferring the RADPEER ACR® scoring system, the vast majority of discrepancies were classified in category 3B, for which the diagnosis should be made most of the time and were clinically relevant; in all cases, they were clarified in the radiology report and the treating physician was directly informed (8).

Based on these findings, it was possible to implement a monthly meeting for their socialization, where emphasis was made on key points to help us to reduce the amount of errors in subsequent analysis. These meetings have allowed us to reduce the number of non-agreements to date, but we have also strengthened the team work within our department, thus ensuring the continuous improvement of our service and the service we provide to our patients.

We present a practical and simple methodology that can be implemented by other radiology services at university and private hospitals to internally evaluate and improve their services and contribute to a better practice of emergency radiology. In this way, the rate of re-calls and the number of undescribed or misinterpreted findings of the studies for the emergency services outside of normal working hours could be reduced, thus decreasing the delay in correct patient care and contributing to a decrease in the expenses in the healthcare system.

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