

# Impact of an in-house emergency radiologist on report turnaround time

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## ABSTRACT

**Background:** One of the many challenges facing emergency departments (EDs) across North America is timely access to emergency radiology services. Academic institutions, which are typically also regional referral centres, frequently require cross-sectional studies to be performed 24 hours a day with expedited final reports to accelerate patient care and ED flow.

**Objective:** The purpose of this study was to determine if the presence of an in-house radiologist, in addition to a radiology resident dedicated to the ED, had a significant impact on report turnaround time.

**Methods:** Preliminary and final report turnaround times, provided by the radiology resident and staff, respectively, for patients undergoing computed tomography or ultrasonography of their abdomen/pelvis in 2008 (before the implementation of emergency radiology in-house staff service) were compared to those performed during the same time frame in 2009 and 2010 (after staffing protocols were changed).

**Results:** A total of 1,624 reports were reviewed. Overall, there was no statistically significant decrease in the preliminary report turnaround times between 2008 and 2009 ( $p = 0.1102$ ), 2009 and 2010 ( $p = 0.6232$ ), or 2008 and 2010 ( $p = 0.0890$ ), although times consistently decreased from a median of 2.40 hours to 2.08 hours to 2.05 hours (2008 to 2009 to 2010). There was a statistically significant decrease in final report turnaround times between 2008 and 2009 ( $p < 0.0001$ ), 2009 and 2010 ( $p < 0.0011$ ), and 2008 and 2010 ( $p < 0.0001$ ). Median final report times decreased from 5.00 hours to 3.08 hours to 2.75 hours in 2008, 2009, and 2010, respectively. There was also a significant decrease in the time interval between preliminary and final reports between 2008 and 2009 ( $p < 0.0001$ ) and 2008 and 2010 ( $p < 0.0001$ ) but no significant change between 2009 and 2010 ( $p = 0.4144$ ).

**Conclusion:** Our results indicate that the presence of a dedicated ED radiologist significantly reduces final report turnaround time and thus may positively impact the time to ED patient disposition. Patient care is improved when attending radiologists are immediately available to read

complex films, both in terms of health care outcomes and regarding the need for repeat testing. Providing emergency physicians with accurate imaging findings as rapidly as possible facilitates effective and timely management and thus optimizes patient care.

## RÉSUMÉ

**Contexte:** L'une des nombreuses difficultés auxquelles font face les services des urgences (SU) partout en Amérique du Nord est l'accès rapide aux services de radiologie d'urgence. Les établissements universitaires, qui en général servent aussi de centres régionaux spécialisés, exigent souvent que des examens en coupe transversale soient effectués 24 h sur 24, suivis de la production rapide de rapports définitifs afin d'accélérer les soins aux patients et le roulement au SU.

**Objectif:** L'étude avait pour but de déterminer si la présence sur place d'un radiologiste, outre celle d'un résident en radiologie en service exclusif au SU, aurait une incidence importante sur le temps de production des rapports.

**Méthode:** Les temps de production des rapports préliminaires et définitifs, fournis par les résidents en radiologie et par le personnel, respectivement, concernant des patients ayant subi une tomodensitométrie ou une échographie abdominales ou pelviennes en 2008 (avant la dotation en personnel sur place en radiologie d'urgence) ont été comparés avec ceux enregistrés en 2009 et en 2010 (après les changements apportés aux protocoles de dotation en personnel).

**Résultats:** Au total, 1624 rapports ont été revus. Dans l'ensemble, il n'y a pas eu de diminution statistiquement significative du temps de production des rapports préliminaires entre 2008 et 2009 ( $p = 0.1102$ ), entre 2009 et 2010 ( $p = 0.6232$ ) et entre 2008 et 2010 ( $p = 0.0890$ ), malgré une diminution constante de ce temps de production, qui est passé d'une durée médiane de 2.40 heures à 2.08 heures, puis à 2.05 heures (2008 à 2009 à 2010). Par contre, une diminution statistiquement significative du temps de production des rapports définitifs a été relevée entre 2008 et 2009 ( $p < 0.0001$ ), entre 2009 et 2010 ( $p < 0.0011$ ) et entre 2008

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et 2010 ( $p < 0.0001$ ). La durée médiane de production des rapports définitifs est passée de 5.00 heures à 3.08 heures, puis à 2.75 heures en 2008, en 2009 et en 2010, respectivement. Une diminution importante de l'intervalle entre la production des rapports préliminaires et celle des rapports définitifs a également été observée entre 2008 et 2009 ( $p < 0.0001$ ) et entre 2008 et 2010 ( $p < 0.0001$ ), mais aucun changement important n'a été relevé entre 2009 et 2010 ( $p = 0.4144$ ).

**Conclusions:** Les résultats de l'étude indiquent que la présence d'un radiologiste en service exclusif au SU réduit de façon sensible le temps de production des rapports définitifs et, de ce fait, peut se répercuter favorablement sur

le temps écoulé avant de connaître les suites à donner aux patients au SU. La présence de radiologistes traitants, prêts à interpréter immédiatement des images compliquées se traduit par une amélioration des soins aux patients, en ce qui concerne tant les résultats cliniques que la nécessité d'autres examens. Le fait de présenter le plus rapidement possible aux urgentologues des résultats exacts d'examen par imagerie facilite une prise en charge prompte et efficace, et permet ainsi une optimisation des soins aux patients.

**Keywords:** emergency radiology, radiology services, report turnaround

One of the many challenges facing emergency departments (EDs) across North America is the availability of emergency radiology services.<sup>1</sup> Diagnostic imaging plays a major role in the management of the entire spectrum of ED patients by facilitating timely and accurate diagnoses. Appropriate use of emergency diagnostic imaging has been found to decrease patient admission rates, the duration of hospitalization, and unnecessary surgery.<sup>2,3</sup>

Canadians make approximately 16 million visits to the ED each year. In 2010–2011, the overall average length of stay in the ED was 4.4 hours in Canada; however, 31% of patients waited for 4 hours or more before being treated, and for 1 in 10 people, the wait was more than 8 hours.<sup>4</sup> In Ontario, the most recent data indicate that the average time spent in the ED is 14.0 hours for complex conditions and 4.8 hours for minor conditions.<sup>5</sup> As of March 2013, at our institution, the average time spent in the ED was 7.4 hours for complex conditions and 3.0 hours for minor conditions.<sup>6</sup> The reasons for the increasing number of ED visits are multifactorial in nature and relate to such things as our aging population, limited access to primary care, and an imbalance between health care demand and resources.<sup>7–9</sup> In the United States, it is estimated that up to 50% of ED patients undergo diagnostic imaging.<sup>2</sup> Emergency physicians rely on cross-sectioning imaging for decision making, and evidence suggests that delays in radiologic investigations contribute to prolonged ED length of stay.<sup>10</sup>

As radiology technology has evolved, emergency physicians, other specialists, and the public have concurrently changed their expectations.<sup>1</sup> As referral centres, academic institutions typically require cross-sectional imaging to be performed 24 hours a day, with expedited final reports. How the specialty of

radiology responds to this demand will have important implications, perhaps redefining the role of the radiologist. Cost and resource limitations must be balanced with service requirement but without compromising patient care.

The ongoing challenge is how to provide optimal ED radiology coverage. At teaching hospitals, radiology residents play a crucial role in maintaining adequate coverage, particularly outside normal hours of operation. The increasing demands for diagnostic imaging in evenings and nights present a challenge for EDs. As the volume and breadth of on-call imaging expand, the need for prompt preliminary reports has also increased. As ED patient volumes peak in the late afternoon and are sustained through the evenings, the demand for emergency radiology is concurrently increasing during off-hours. Debate remains ongoing regarding the pros and cons of 24-hour on-site coverage by radiology staff physicians.<sup>1,11</sup>

In 2009, a change in emergency radiologist coverage was implemented at our institution through the implementation of a new evening shift. The purpose of this study was to investigate if the presence of a dedicated radiologist, housed close to the ED and staffed with expanded hours, had a significant impact on preliminary and final report turnaround times. We hypothesized that the creation of the new evening shift would decrease both preliminary and final report turnaround times.

## **METHODS**

### **Study location**

This study took place at The Ottawa Hospital, a tertiary teaching and referral centre affiliated with the

University of Ottawa where radiology residents typically provide preliminary reports to emergency physicians while on call. Staff radiologists review the images and report their interpretations, including necessary changes in the final reports. This procedure is typical for teaching hospitals in Canada.

At The Ottawa Hospital, an extension of the radiology department is directly adjacent to the ED. The radiology reading area is physically present within the ED, in an area that also houses a computed tomographic (CT) scanner, a fluoroscopy unit, and an ultrasound machine dedicated for emergency diagnostic imaging. Prior to 2009, emergency radiologists at our institution were staffed during traditional working hours (8:00 am to 5:00 pm) to read CT scans and sonograms of the abdomen/pelvis and chest. All neurologic cases from the ED were read by the neuroradiologists, and reading of plain films was shared by the ED radiologists and subspecialist radiologists. Outside regular working hours, a resident dedicated to the ED and acute inpatient studies was available to provide preliminary reports for all cases. Two staff radiologists (a neuroradiologist and a body/chest radiologist) were available on call, typically from home, to review images or provide advice on the need and timing of investigations. The next morning, their reports were reviewed and finalized by the staff radiologists.

In 2009, our institution adopted a new model and began to staff a dedicated in-house body/chest radiologist with expanded hours from 6:45 am to 11:00 pm. This was done in an effort to decrease the final report turnaround time, a frequently used quality care metric.

### **Procedures and data collection**

Preliminary and final report times were retrospectively gathered and recorded for consecutive patients who underwent a CT scan or sonogram of their abdomen/pelvis between 6:45 am and 5:00 pm from September 1, 2008, to November 30, 2008 (446 cases), before the implementation of emergency radiology in-house staff services. The same procedure was performed for the same time frame in 2009 and 2010, after staffing protocols were changed. Report turnaround time was defined as the interval of time between image acquisition to report issued by a radiologist (preliminary) or case dictated by the attending radiologist (final). Preliminary report times were indicated by the resident

on call at the end of the report, and final report times were generated electronically at the time of dictation. The data were obtained from the Picture Archiving and Communication System (PACS) and entered into a computer database using an *Excel* spreadsheet (Microsoft). Report turnaround times were then automatically calculated using *Excel*. Data were processed using *SPSS Statistics* software (IBM, Armonk, NY). Research Ethics Board approval was obtained.

### **Statistical analysis**

The times from image acquisition to preliminary and final reports were calculated and compared between 2008, 2009, and 2010 using Kruskal-Wallis testing and Mann-Whitney tests for multiple comparisons. Using the Kolmogorov-Smirnov method, normality was tested for each category. Patients who were imaged exclusively with plain radiographs were excluded from the study as almost all such patients are discharged by the emergency physician prior to radiologist interpretation. Head CT scans were also excluded as only preliminary reports are provided by the residents for these, with a final report by the staff radiologists at a later time, usually the next day.

### **RESULTS**

A total of 1,624 cases were enrolled: 446 in 2008, 527 in 2009, and 651 in 2010 (Table 1). Assessment for normality revealed non-normally distributed data for 2008 through 2010. Median and interquartile ranges were generated for 2008, 2009, and 2010 for preliminary report time, final report time, and the time interval between preliminary and final reports. These results are provided numerically in Table 2 and graphically by box and whisker plots in Figure 1, Figure 2, and Figure 3.

The results of the primary analyses of comparisons between years are provided in Table 3, Table 4, and

**Table 1. Number of abdominal/pelvic US and CT studies performed by year**

Year	US	CT	Total
2008	216	230	446
2009	133	394	527
2010	259	392	651

CT = computed tomography; US = ultrasonography.

Table 2. Preliminary and final report turnaround times by year		
Year	Median (h)	Interquartile range (h)
2008		
Preliminary	2.40	1.43–3.92
Final	5.00	1.88–21.70
2009		
Preliminary	2.08	1.44–3.24
Final	3.08	1.97–3.50
2010		
Preliminary	2.05	1.38–3.20
Final	2.75	1.85–4.64

Table 5. Preliminary report time data indicated that 2008 turnaround times were greater than those in 2009, and 2009 was similar to 2010; however, no statistically significant difference was found by year ( $p = 0.1461$ ). Final report time data showed that 2008 turnaround times were significantly greater than those in 2009, which were greater than those in 2010 ( $p < 0.0001$ ). The time interval between preliminary and final report data revealed that the 2008 interval was significantly greater than the 2009 interval, which was similar to 2010 ( $p < 0.0001$ ).

Overall, there was no significant decrease in the preliminary report turnaround times between 2008 and 2009 ( $p = 0.1102$ ), 2009 and 2010 ( $p = 0.6232$ ), or 2008 and 2010 ( $p = 0.0890$ ), although times consistently decreased from a median of 2.40 hours to 2.08 hours to 2.05 hours from 2008 through 2010, respectively. There was a significant decrease in final report turnaround times between 2008 and 2009 ( $p < 0.0001$ ), 2009 and 2010 ( $p < 0.0011$ ), and 2008 and 2010 ( $p < 0.0001$ ). Median final report times went from 5.00 hours to 3.08 hours to 2.75 hours from 2008 through 2010,

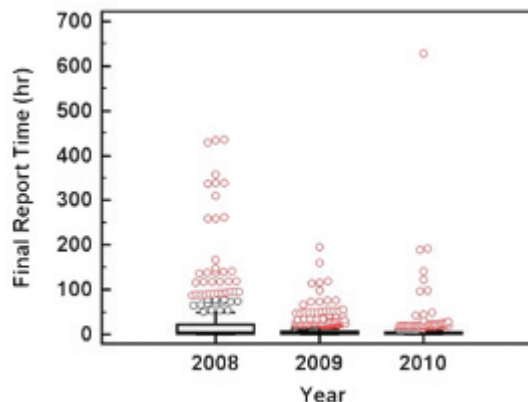


Figure 2. Final report turnaround times for 2008, 2009, and 2010.

respectively. There was also a significant decrease in the time interval between preliminary and final reports between 2008 and 2009 ( $p < 0.0001$ ) and 2008 and 2010 ( $p < 0.0001$ ) but no significant change between 2009 and 2010 ( $p = 0.4144$ ).

**DISCUSSION**

Providing optimal ED radiology coverage has increasingly become a challenge. Radiology departments face the difficult decision of how to staff the department appropriately after hours, and resident training must be balanced against service demands while maintaining optimal patient care. Our results suggest that the presence of an ED-dedicated staff radiologist decreases the time for emergency physicians to obtain final reports. In addition, our results suggest that having a staff radiologist present in the evenings speeds the time between preliminary and final reports, allowing more timely provision of report confirmation or

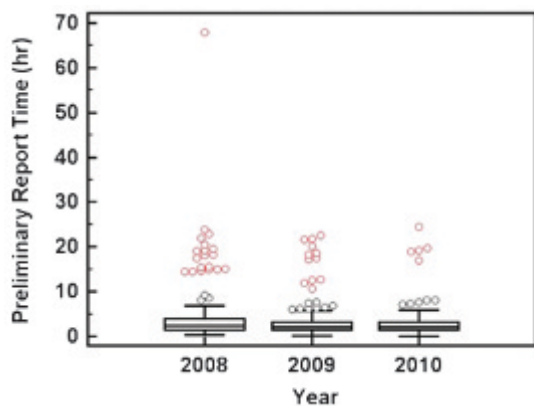


Figure 1. Preliminary report turnaround times for 2008, 2009, and 2010.

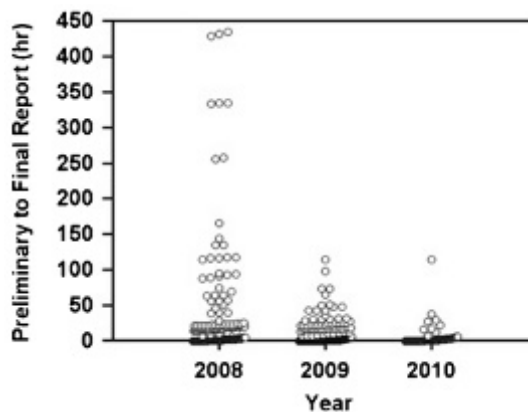


Figure 3. Time interval between preliminary and final reports for 2008, 2009, and 2010.



**Table 3. Preliminary report turnaround times (in hours) by year**

	2008*	2009*	2010*
Sample size	192	248	120
Lowest turnaround time	0.38	0.18	<u>0.02</u>
Highest turnaround time	67.91	22.57	24.43
Median turnaround time	2.40	2.08	2.05
95% CI for median	2.10–2.65	1.90–2.25	1.71–2.34
Interquartile range	1.43–3.92	1.44–3.24	1.38–3.21

\*2008 v. 2009,  $p = 0.1102$ ; 2009 v. 2010,  $p = 0.6232$ ; 2008 v. 2010,  $p = 0.0829$ .

discrepancy identification. We attempted to examine the impact of radiology turnaround time on time to patient disposition; however, this could not be determined given the limited, retrospective nature of our design. Patient disposition from the ED is a complex outcome impacted by many factors, ranging from hospital volume and acuity to boarding and in-patient census.<sup>7–9,12</sup>

Data obtained from our institution indicate that an increased number of CT scans and sonograms were performed annually after hours with every year post 2008, a finding consistent with the increasing nationwide trend of increasing demand for after-hours imaging. This may in part be a result of growing ED volumes and higher ED patient acuity. It was previously found that more imaging studies are being performed after hours, even in centres that do not have a staff radiologist present in the ED.<sup>13</sup> In 2009–2010, the Ontario Ministry of Health and Long-Term Care introduced a wait-time strategy based on pay for performance. This provided funding to hospitals that showed improvement in quality by shortening ED wait times. Given that diagnostic imaging report turnaround time is an integral component of most patients' total length of stay, the goal of discharging patients faster results in increased demand on the radiology department for rapid scan provision and interpretation.

**Table 4. Final report turnaround times (in hours) by year**

	2008*	2009*	2010*
Sample size	441	528	649
Lowest turnaround time	0.20	0.32	0.43
Highest turnaround time	436.27	195.70	628.48
Median turnaround time	5.00	3.08	2.75
95% CI for median	4.12–6.03	2.75–3.48	2.60–2.90
Interquartile range	1.88–21.71	1.98–6.56	1.85–4.64

\*2008 v. 2009,  $p < 0.0001$ ; 2009 v. 2010,  $p = 0.0011$ ; 2008 v. 2010,  $p < 0.0001$ .

**Table 5. Time interval (in hours) between preliminary and final reports by year**

	2008*	2009*	2010*
Sample size	186	248	101
Lowest interval	–6.00	–8.07	0.00
Highest interval	435.05	114.25	114.50
Median interval	5.37	1.02	1.25
95% CI for the median	2.80–15.28	0.77–1.52	0.80–1.75
Interquartile range	1.22–22.00	0.28–8.38	0.32–3.07

\*2008 v. 2009,  $p < 0.0001$ ; 2009 v. 2010,  $p = 0.4144$ ; 2008 v. 2010,  $p < 0.0001$ .

The results of this study indicate that preliminary report time did not significantly change when staff services were implemented. This is not surprising as radiology residents still usually preview all cases and provide preliminary reports, even when in-house staff radiologists are present. Typically, staff radiologists allow residents to review all cases and provide the preliminary interpretation before they themselves read the study. The overall median preliminary and final report turnaround times in 2010 we found of 2.05 hours and 2.75 hours, respectively, were faster than the reported averages in the United States. For example, one study from North Carolina published in 2010, after the implementation of voice recognition software, found that the final report turnaround time was 12.7 hours.<sup>12</sup>

EDs across Canada have been faced with the challenge of obtaining expedited diagnostic imaging reports outside regular working hours, through this accelerating and optimizing patient care. Our institution is one of the few centres in Canada that currently has evening staff radiology coverage, and our results indicate that the presence of a dedicated ED radiologist significantly reduces final report turnaround time and thus may positively impact the time to ED patient disposition. Patient care is improved when attending radiologists are immediately available to read complex films, both in terms of health care outcomes and regarding the need for repeat testing. Providing emergency physicians with accurate imaging findings as rapidly as possible facilitates effective and timely management and thus optimizes patient care.

**Competing interests:** None declared.

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