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**Increase in Utilization of Afterhours Medical Imaging:
A Study of Three Canadian Academic Centers**

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Abstract

Objectives: The objectives of our study were to assess trends in afterhours medical imaging utilization for emergency department (ED) and inpatient (IP) patient populations from 2006-2013, including analysis by modality and specialty and with adjustment for patient volume.

Methods: For this retrospective study, we reviewed the number of CT, MRI, and ultrasound studies performed for the ED and IP patients during the afterhours time period (5pm - 8am on weekdays and 24 hours on weekends and statutory holidays) from 2006-2013 at three different Canadian academic hospitals. We used the Jonckheere-Terpstra (JT) test to determine statistical significance of imaging and patient volume trends. A regression model was used to examine whether there was an increasing trend over time in the volume of imaging tests per 1000 patients.

Results: For all three sites from 2006-2013 during the afterhours time period: There was a statistically significant increasing trend in total medical imaging volume, which also held true when the volumes were assessed by modality and by specialty. There was a statistically significant increasing trend in ED and IP patient volume. When medical imaging volumes were adjusted for patient volumes, there was a statistically significant increasing trend in imaging being performed per patient.

Conclusion: Afterhours medical imaging volumes demonstrated a statistically significant increasing trend at all three sites from 2006-2013 when assessed by total volume, modality, and specialty. During the same time period and at all three sites, the ED and IP patient volumes also demonstrated a statistically significant increasing trend with more medical imaging, however, being performed per patient.

Résumé

Objet : L'étude avait pour objectif de dégager les tendances relatives à l'utilisation des services d'imagerie médicale en dehors des heures normales par le service d'urgence et les patients hospitalisés, de 2006 à 2013. Elle intégrait notamment une analyse en fonction de la modalité et du domaine de spécialité et un ajustement des résultats en fonction du volume de patients.

Méthodes : Dans le cadre de cette étude rétrospective, nous avons évalué le nombre d'examen par tomographie par ordinateur, imagerie par résonance magnétique et échographie qui ont été réalisés en dehors des heures normales de service (c'est-à-dire de 17h à 8h les jours de semaine, ainsi que toute la journée la fin de semaine et les jours fériés) chez les patients du service d'urgence et les patients hospitalisés de trois hôpitaux universitaires canadiens, de 2006 à 2013. Nous avons déterminé la signification statistique des tendances relatives au nombre d'examen d'imagerie et de patients au moyen du test de Jonckheere-Terpstra. Enfin, un modèle de régression a permis d'évaluer si une tendance à la hausse se dessinait au fil du temps à l'égard du nombre d'examen d'imagerie par 1000 patients.

Résultats : De 2006 à 2013, une tendance à la hausse statistiquement significative a été constatée, dans les trois établissements, à l'égard du nombre total d'examen d'imagerie médicale réalisés en dehors des heures normales de service. Cette tendance s'est également dégagée des examen répartis en fonction de la modalité et du domaine de spécialité. Une tendance à la hausse statistiquement significative a aussi caractérisé le nombre de patients vus par le service d'urgence et le nombre de patients hospitalisés. Enfin, l'ajustement du nombre d'examen

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d'imagerie médicale en fonction du nombre de patients a révélé une tendance à la hausse statistiquement significative dans le nombre d'examen d'imagerie par patient.

Conclusions : L'analyse en fonction du nombre total d'examen, de la modalité et du domaine de spécialité démontre que de 2006 à 2013, le nombre d'examen d'imagerie médicale réalisés en dehors des heures normales de service a augmenté de façon statistiquement significative au sein des trois établissements. Au cours de cette même période, bien que le nombre de patients vus par le service d'urgence et le nombre de patients hospitalisés aient également augmenté de façon statistiquement significative au sein des trois établissements, un plus grand nombre d'examen d'imagerie médicale ont été réalisés par patient.

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Key Words: Medical imaging; Radiology; Utilization trends; Afterhours; Emergency department; Volume

The manner in which patients are diagnosed and managed in a hospital setting is an evolving process.

Medical imaging has perhaps been one of the most influential factors in patient care over the recent years, particularly in the emergency department (ED). Many studies performed in a variety of healthcare settings in the United States demonstrate increasing usage of computed tomography (CT) during patient visits to the ED over the past 10 years [1–4]. No similar studies have been performed in the Canadian healthcare setting.

Given the complex implications of medical imaging use, including but not limited to cost, patient radiation, and effect on patient outcomes, we performed our study to determine whether there is a similar increasing trend of medical imaging volume in Canada.

We hypothesize that medical imaging has also been increasing at our institutions. While it is likely that patient volumes are also increasing, we hypothesize that there is a statistically significant increase in the amount of medical imaging being performed per patient.

Methods

Study Setting

This was an institutional review board–approved retrospective observational study. Data was collected from 3 university-affiliated Canadian academic teaching and research hospitals in the same city, referred to as Hospital A, B, and C, each with busy EDs.

Hospital A has 465 adult inpatient beds. It is a major neurosurgical center and is 1 of 2 Level I adult primary trauma centers in the city.

Hospital B has 471 adult inpatient beds. It specializes in solid organ transplant and cardiovascular medicine and surgery.

Hospital C has 272 adult inpatient beds and specializes in neuroscience and neurosurgery.

Data Collection

Imaging Studies

For each hospital, we collected volumes of imaging studies performed using a retrospective search from the institutional

radiology information system (Hospital A: Syngo Workflow SLR, version 32E, Siemens Medical Solutions USA, Inc, Malvern, PA; Hospital B and C: Coral Radiology Information System, Joint Department of Medical Imaging, Toronto, ON). The afterhours time period was defined as 5 PM–8 AM on weekdays and 24 hours on weekends and statutory holidays.

We chose to limit our evaluation to the on-call time period as it provides an additional educational point of consideration, given that the hospitals in our study are all academic centers. Trends in the volume of on-call medical imaging from 2006–2013 are a direct reflection of the changing workload for the on-call radiology resident as there was consistently single resident physician coverage afterhours for the years studied.

The volume of CT, magnetic resonance imaging (MRI), and ultrasound (US) studies that were performed during the afterhours time period for ED and inpatient (IP) groups were included. These completed studies were counted using a single unique identifier (accession number) as the unit of counting. Data was collected for each calendar year from January 1–December 31 from 2006–2013.

CT and MRI studies were characterized into body, chest, musculoskeletal (MSK), neuro, and spine.

Body included abdomen, (body) pelvis, and abdomen/pelvis studies.

Chest included thorax, breast, and cardiac studies.

MSK included extremity and (MSK) pelvis studies.

Neuro included head, head and neck, orbits, facial bones, and angiography studies.

Spine included cervical, thoracic, lumbar spine, and any combination thereof.

The volumes were subdivided into ED and IP as well as whether they occurred during the weekday or weekend on-call time period.

Radiographs and interventional radiology consultations were excluded from this study, as these are requested and interpreted independently from the resident on-call service.

Patient Volume

Decision support specialists at each hospital provided the ED and IP patient volumes. The number of patients that were registered in the ED as well as the number of hospital inpatients during the on-call time period were recorded, again by calendar year from 2006–2013.

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