Analysis of the Last Decade of Weekend Out-of-Hours CT Imaging: How Have Things Changed?

Abstract:
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Abstract
CT has become an invaluable diagnostic tool. The clinical applications and technological capacity of CT has continued to increase. There is an increasing demand for radiology services including during weekend on-call hours. The objective of this study was to assess the trend in weekend CT imaging requests over a ten-year period from 2001-2010. Electronic data was retrieved from the hospital Radiology Information System. In total 8530 CT scans were performed during weekend on-call hours. Over the decade weekend imaging grew from 466 to 1448 (210.7%) CT examinations. CT brain imaging accounted for 3944 of the total 8530 (46%) and this was a 126% increase. A ten-fold, eight-fold and three-fold increase occurred in CT thoracic, abdominal and pelvic imaging respectively. This increase reflects the growing demand for CT imaging in hospitals. The current study analyses the increase in CT imaging requests over a ten-year period. Results were subdivided by eight CT imaging categories. CT brain imaging accounted for the largest volume of CT examinations. A total of 3944 CT brains were therefore represented an area of significantly increasing demand and growth. Results were subdivided by eight CT categories. CT brain imaging accounted for the largest volume of CT examinations. A total of 3944 CT brains were calculated. CT imaging was grouped into eight categories (brain, abdomen, pelvis, spine, thorax, other, facial bones and joints). The growth and trend in each category per year over the study period was analysed.

Methods
In this retrospective analysis the trend in diagnostic CT imaging was assessed for a ten year period from January 2001 to December 2010. This included all requests for CT imaging for both adult and paediatric patients during weekend on-call hours. Electronic data was obtained from the hospital Radiology Information System (RIS). This included the type of CT imaging performed and the referral source. Referral source was either inpatient or from the emergency department. The total number of CT scans performed during the weekend on-call hours per year for the ten year period was calculated. CT imaging was grouped into eight categories (brain, abdomen, pelvis, spine, thorax, other, facial bones and joints). The growth and trend in each category per year over the study period was analysed.

Results
Overall a total of 8530 CT examinations were performed during weekend on-call hours from 2001-2010. The emergency department accounted for a total of 52.6% of referrals, compared to 47.4% for the inpatient group. There was a 210.7% increase in all weekend on-call CT imaging from 2001 to 2010. Weekend on-call CT imaging accounted for approximately 15% of all CT imaging however as the number of CT studies increased in all categories of conventional CT imaging this therefore represents an area of significantly increasing demand and growth. Results were subdivided by eight CT categories. CT brain imaging accounted for the largest volume of CT examinations. A total of 3944 CT brains were performed accounting for 46% of all imaging and increased by 142% over the decade. This increase in CT brain imaging is displayed graphically (Figure 1).

The seven remaining categories of CT imaging changed over time in keeping with this increase in CT brain imaging. Thoracic CT Imaging in 2001 was only 12 scans compared to 124 in 2010 this showed an overall 933.3% increase. CT abdominal and pelvic imaging increased from 17 to 157, a 920% increase. CT imaging of the spine grew from 4 scans to 23 scans, a 575% increase. The growth and in the eight categories of CT imaging is shown graphically (Figure 2). Figure 3 shows the total percentage of each modality for the decade of study.

Discussion
CT utilization has been growing steadily worldwide. According to the 2006 report of the United Scientific Committee on the Effects of Atomic Radiation, the average frequency of CT examinations in developed countries increased yearly from 6.1 per 1,000 population in the 1970s to 48 per 1,000 population in the period between 1991 to 1996. Statistics from the US and UK indicate a 20-fold and 12-fold increase in CT usage over the past two decades. Furthermore one US study concluded that the total radiology work load is increasing by 8% annually and while the number of radiologists in practice is increasing the CT work load increased by only approximately 1.5% annually leaving radiologists faced with managing a rapidly increasing work load.

Many clinical pathways advocate the use of CT imaging. CT brain imaging has transformed the management of stroke and non-contrast CT brain imaging is a critical element of stroke care pathways. This may in part, account for the demand of CT brain imaging which was observed at our institution. Furthermore, headache accounts for a large number of emergency department visits. CT imaging of emergency headache has become widespread leading to increased demand for brain CT scanning. The CT imaging means that the need for sedation or analgesia may be avoided particularly on-call when there is reduced anaesthetic cover available particularly in the paediatric population. The utilization of CT imaging is largely determined by the practices of referring clinicians. Changing clinical practices may represent, in part, increased growth in CT examinations. In the UK a significant increase in CT is postulated to be in part due to the use of CT as a primary tool for post-surgical diagnosis of acute appendicitis.

This may have influenced the three-fold rise at our institute in abdominal CT imaging. The ten-fold observed increase in thoracic CT may reflect changes in imaging for pulmonary embolism. One US study demonstrated increased trends in thoracic imaging over a decade with an increase in the ratio of CTs for pulmonary embolism per patient coupled with a decrease in the ratio of pulmonary angiogram and V/Q scans. It observed that CT is replacing more traditional techniques for diagnosing pulmonary embolism. CT is now also widely used for guiding lung biopsy.

This study focused on weekend on-call hours requests as CT imaging performed during this time is deemed urgent and unavoidable reflecting acute clinical emergencies such as trauma. The outcome of such CT imaging may immediately change patient management in keeping with best patient care. This is also the time when the radiology department has lowest

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staffing levels. Ever growing numbers of CT scans are requested during routine working hours and to facilitate this work load on many days of the week the radiology department has to extend the hours during which these scans are performed. This makes it difficult to determine whether scans were requested and performed during weekday on-call hours. Choosing the study period of weekend on-call hours avoids this, ensuring all scans are both ordered and performed during the weekend on-call hours. In our study one third of weekend on-call hours, selected for reasons as discussed above we have only assessed a small proportion of out-of-hours imaging as weekday scans were not assessed. Secondly the clinical indications for examinations were not available from electronic records and therefore, unavailable to this study. Our data was therefore not adjusted for disease severity nor did we look at the appropriateness of CT requests. The purpose of this study was not to evaluate the appropriateness of imaging practices or to determine which factors affect utilisation of imaging studies. We assessed trends only and did not analyse imaging patterns for specific clinical indications.

CT however is not without health-related risks. Physiological risks include contrast-induced nephropathy and potential allergic reactions including life threatening anaphylaxis. Long-term there is a risk of developing cancers. CT results in organ radiation doses that are typically 100 times larger than those from conventional radiological procedures such as x-rays. Longstanding controversy exits about the level of carcinogen risk attributable to low level ionising radiation. A linear dose-response relationship has been suggested between exposure to ionising radiation and the development of certain neoplasms. For a given exposure, radiation risks are greatest in young patients because of both generally in their organs and radioactively sensitive tissue. However even for high-dose radiological procedures when appropriately used the risk to the patient is small and the benefit/risk balance is generally in the patients favour. In many scenarios CT is the appropriate choice, but undoubtedly a significant proportion of scenarios where CT is not medically justifiable or where equally effective alternatives exist. Studies suggest that up to one third of CT imaging may fall into this category. Physicians are requesting increasing volumes of CT scans and should bear in mind the benefit-to-risk ratio balancing the highly context-dependent benefits of imaging against the patient-specific cumulative risks. We need to avoid potential over utilisation of imaging where imaging is requested and performed but is unlikely to improve patient outcome or aid clinical diagnosis or management. Such use of imaging results in unnecessary and avoidable radiation exposure without any clinical benefit to the patient.

Overall, the data shows that utilisation of CT during weekend on-call hours increased three-fold over the last decade. CT brain was the most common type of CT examination. This growth can be attributed various factors such as ageing populations, advances and availability of technology and that radiology is indicated in more clinical conditions. CT demand shows little sign of abating as diagnostic imaging has become an integral part of medical practice. CT is likely to continue to grow as technology progresses and other clinical applications emerge. It is hoped that this study and other similar studies will promote ongoing dialogue among radiologists, emergency room staff and other physicians, and indeed the public to slow the increase in CT usage and CT doses, without compromising patient care.

References