

An investigation into the extent of Lodox imaging usage in South Africa: Radiographer's perspective

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Abstract

Introduction Anecdotal evidence suggests that medical professionals in trauma units are requesting additional regional images using conventional x-ray systems, even after trauma patients have undergone full-body Lodox scans. Patients are then exposed to additional radiation, additional waiting times and an increased medical bill. This study aimed at investigating the extent to which Lodox systems were used in trauma units (n=28) in South Africa.

Method In this descriptive cross-sectional study, the researcher invited one radiographer from the 28 hospitals in South Africa that use Lodox systems. Radiographers who were most experienced in using the Lodox system completed an online questionnaire.

Results Twenty (71.43% n=20) out of twenty-eight radiographers responded. Most hospitals (90%, n=18) were referring patients for additional conventional x-ray images. Radiographers indicated that conventional x-rays were requested for the chest (27.80%, 10/36), the abdomen (16.67%, 6/36), the spine (13.89%, 5/36) and the extremities and skull (19.44%, 7/36). Additionally, radiographers reported using Lodox to perform procedures and examinations usually performed on conventional x-ray systems when conventional x-ray systems were not operational.

Conclusion Currently, it is not clear if the use of conventional x-ray imaging following Lodox is necessary, but the results suggest that the practice is commonplace, with healthcare workers in most hospitals (90%, n=18) requesting additional x-ray imaging. The researcher thus recommends that an imaging protocol for Lodox imaging systems should be developed to guide the referral of the patients for further imaging.

Introduction

Developed in the early 1990s, the Lodox[®] Statscan system was initially designed as an industrial tool for screening smuggled diamonds [1]. Due to its low ionising radiation, imaging speed and ability to produce a full body image in 13 seconds, the Lodox system has been adopted as an adjunct screening tool in trauma and emergency units for surveying foreign bodies and gross pathologies [2]. The Lodox system yields images of sufficient quality to exclude significant pathological features in trauma units [1, 2]. Lodox imaging of the chest, pelvis, spine, lumbosacral junction, cervicothoracic junction and long bones may even have the same quality or be superior to the quality of conventional x-ray systems [3]. Despite these observations, it was observed that healthcare professionals were continuing to request conventional x-ray images even after the patient had undergone a full body Lodox scan. These patients are being exposed to higher levels of ionising radiation compared to if only conventional or Lodox imaging was performed. Requesting additional imaging defeats the significant benefit of the Lodox system as a low dose imaging tool [4]. These patients would also spend longer periods of time in the emergency unit, which is also contrary to the intended purpose of the Lodox x-ray system [2]. The researchers investigated the extent to which patients, who had undergone full-body Lodox scanning, were

being referred for additional conventional x-rays. Researchers used an online questionnaire in surveying radiographers who practised at trauma units in South African hospitals.

Method

Research design, sample, recruitment and data collection

This was a descriptive cross-sectional study [5]. The researchers invited radiographers who worked in the 28 hospitals that use Lodox imaging system across South Africa(SA). Researchers purposively extended an invitation to the radiographer who was most experienced in Lodox imaging at each of the 28 hospitals.[6] Radiographers most experienced in Lodox imaging was selected hence purposive sampling was done [6] Before embarking on this study, the University of Pretoria Research Ethics Committee approved the study (486/2017). The ethics committees of the 20 hospitals that participated in the study also approved the study. All respondents signed a letter of consent before completing the online questionnaire. Confidentiality was maintained by withholding details of the hospitals and respondents [7]. The questionnaire comprised of two sections: Section A which gathered participants' demographic details and section B which surveyed patient referral and the application of Lodox imaging systems.

Data analysis

The researchers tested the adequacy of the data collection tool using Cronbach's Alpha of the Likert scale, and obtained a value of 0.85. Descriptive statistics were used to report frequencies and proportions for both demographic and non-demographic variables. Data were analysed using the Statistical Analysis System (SAS Version 9.4 (released by SAS Institute Cary, North Carolina in July 2013)).

Results

Of the 28 hospitals invited, experienced radiographers from 20 (71.4%, n=18) hospitals responded. Figure 1 displays the results of the patient referral for conventional x-ray imaging after Lodox imaging was performed.

At most of the hospitals (90%, n=18), patients were referred for conventional x-ray imaging after they had undergone a full-body Lodox scan. Most hospitals (75%, 15/20) were not using a regional dedicated programme for the Lodox imaging system.

Figure 2 displays the results of the body regions included in the requests for additional x-ray imaging after a Lodox scan was done.

Figure 2 displays the frequency of the various regions for which conventional x-ray imaging was requested, the total of adult and paediatric chest examinations comprised of 36.11% (14/36) Additionally, imaging was also requested for extremities (25.00%); 9/36) and for spinal imaging (8.3%; 3/36). Other

parts that were requested and had one examination each (2,78%) were pelvis, post reduction images of fractured sites, skull, and trauma.

Figure 3 indicates the various imaging examinations performed at South African hospitals using the Lodox x-ray system.

The Lodox imaging system was routinely used for the following imaging examinations (n=36), chest (30.55%, 11/36) (This is the total of adult and paediatric chest examinations on the graph above); abdominal (16.67%, 6/36); spine (13.89%, 5/36); extremities (11.11%, 4/36) and both pelvis and skull (8.33%, 3/36). The Lodox system was also used for two fluoroscopic procedures, including angiography and cystography (both were 2.78%, 1/36).

Figure 4 displays the participating radiographers' opinions on using the Lodox imaging systems for non-trauma imaging examinations.

The respondents indicated that imaging with the Lodox system resulted in less exposure to ionising radiation (29.17%, 7/24); reduced imaging time (20.83%, 5/24), fewer manipulations of the patient and enhanced image quality (16.67%, 4/24). According to respondents, the Lodox system was sensitive to fractures and produced good quality images (4.17%, 1/24). Radiologists also used the Lodox imaging system when other imaging equipment was busy or non-operational (8.33%, 2/24).

Discussion

In this study, the researcher enquired to what extent patients were referred for additional conventional x-ray imaging following a full-body Lodox scan. In most hospitals (90%), trauma specialists would send patients for additional x-ray imaging of the chest.

The consequence of referring patients for additional x-ray imaging.

Sending patients for additional x-ray imaging after imaging with the Lodox system may defeat the purpose of using "low dose x-ray imaging" which is a key characteristic of the Lodox imaging system [1,8]. Ionising radiation is carcinogenic and excessive exposure is associated with genetic mutations [9,10]. Repetitive exposure to ionising radiation increases the chances of stochastic and deterministic effects of ionising radiation [10,11]. Due to the dangers of ionising radiation, both the European Commission and the International Atomic Energy Agency have emphasised that radiological procedures should be justified and appropriate, but unnecessary radiological examinations are still being requested [12]. Patients undergoing both Lodox and conventional x-ray imaging are exposed to almost double the radiation dose than when only one of the two systems would have been used [3,13]. Additional examinations may also have an effect on the patient's hospital bill. In public healthcare systems, over-servicing adds cost to the already expensive state healthcare system in SA [14].

Frequency of referral for additional x-ray imaging

In this study, additional x-ray imaging at trauma units was mostly requested for chest x-ray imaging, of which a small proportion was for paediatric patients. At trauma units, clinical signs, physical examination, vital signs, and oxygen saturation can identify high-risk patients without necessarily sending the patients for chest x-ray imaging [15]. Amirlak et al [16] described a case of a 76-year-old man who underwent both a Lodox scan and conventional x-ray imaging. Images of the chest revealed the same fractures for both examinations [16]. As argued by Daya et al, Lodox scans are known to produce superior images to conventional x-ray images, including the diagnosis of pneumothorax and lung contusion; mediastinal injuries such as a ruptured aorta, and pneumomediastinum; thoracic skeletal fractures; and peripheral bone lesions [3]. Daya et al [17] also emphasised the effectiveness of Lodox scans for diagnosing chest pathologies in children. Since Lodox imaging was introduced in 1999 [18], the Lodox system has improved in terms of hardware and software capabilities [1,2]. If Lodox images could be used for diagnostic purposes without the need for additional imaging, radiation doses, time spent on examining patients and hospital bills could be markedly reduced.

Additional application of Lodox x-ray system

In SA, radiographers are using the Lodox system to perform comprehensive imaging examinations (Figure 3). Previous research suggests that the Lodox system has the potential to replace conventional x-ray systems for routine applications [19,20]. The researcher found that a small proportion of trauma units (5/35) in SA were using Lodox as a reliable, alternative for conventional x-ray imaging to diagnose pathologies of the chest, abdomen, spine and extremities (Figure 3). Lodox scans have produced useful images of the whole spine [1], assisted to diagnose skull and facial fractures [21] and suspected wrist and ankle fractures [16]. In this study, South African radiographers reported using Lodox to evaluate pathologies of the skull (3/36) and for diagnosing pathologies of the extremities (3/36). The Lodox system has previously been used to diagnose paediatric tuberculosis in South Africa [17]. The findings from this study thus support an increased application of the Lodox system for adult and paediatric chest imaging.

Interestingly, South African radiologists also reported using Lodox for fluoroscopic procedures such as angiography and cystography (1/36). Using the Lodox x-ray system for follow-up imaging, taken at various intervals to evaluate pathophysiology [19] may significantly reduce radiation exposure for the patient [1,2]. Minimising radiation doses will also reduce the amount of radiation scatter and total radiation dose exposure to the patient and the personnel working in the procedure room [10]. Also, reducing radiation scatter could improve the quality of images [10]. Noteworthy is that Lodox systems have previously been used for angiography, where Computed Tomography scanning (CT scan) and fluoroscopic units were unavailable [21]. Additionally, Lodox x-ray imaging may be useful for visualising and placing catheters, to assist healthcare professionals to view the full-length and patency of the catheter [19]. It was also reported that the Lodox system allows the imaging professional to visualise the full length of contrast-enhanced blood vessels and the urinary system during fluoroscopic studies which is essential for efficient and effective diagnosis [22].

Why Lodox system was preferred for other examinations

This investigation enquired from radiographers about why they prefer the Lodox system for procedures other than routine full-body screening in trauma units. Radiographers were aware that Lodox systems emitted low amounts of ionising radiation compared to conventional x-ray systems (29.17%), which they consider as beneficial.

The Lodox system has been reported to use a third of the radiation used by conventional imaging system to obtain similar diagnostic information [16]. Another benefit was that patients require less manipulation when using Lodox. This was considered beneficial for patients who experience pain during manipulation of a body part for positioning. When using conventional x-ray systems, the patient must undergo separate imaging of various sections of the body, which is time-consuming, contributes to unnecessary radiation dose on the patient and compromises the quality of the images due to scattered radiation [10,22]. Using the Lodox system, an anterior-posterior projection of the skull can be obtained within 13 seconds, which is much faster than having to perform multiple, projections for various parts of the body separately [2]. It is not confirmed yet if the quality of the images would be similar to those obtained from conventional x-ray system. In this study, radiographers are for the opinion that (4.17%) Lodox system produced better quality images and its use can be increased. This is similar to the findings in other studies that Lodox imaging has the potential to replace conventional x-rays [2].

Conclusions And Recommendations

The Lodox system is being used in most trauma units in SA for rapid diagnosis in the trauma cases and as a backup when x-ray facilities are not available or too busy. South African radiographers using the Lodox system are positive, despite radiologists are not providing reports on emergency Lodox scans and several hospitals are routinely referring all patients for additional conventional x-ray imaging following Lodox scans. This may expose patients to higher doses of radiation, also patients taking longer time in radiology departments risks complicating the condition of the patient..Additionally, requesting for additional images must be in good faith where holistic analysis of non-maleficence and beneficence need to be balanced to avoid over-servicing and an idiosyncratic outcome. Additional conventional x-ray imaging also increases hospital costs. The researcher suggests that the diagnostic capacity and of Lodox images be further investigated to encourage trauma specialists to use the Lodox system as a diagnostic aid in the trauma room, rather than routinely referring all cases for additional conventional x-ray imaging. The rapid technological developments in Lodox imaging

Declarations

Conflict of interest

The authors declare that there is no conflict of interest binding the publication of this manuscript.

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Figures

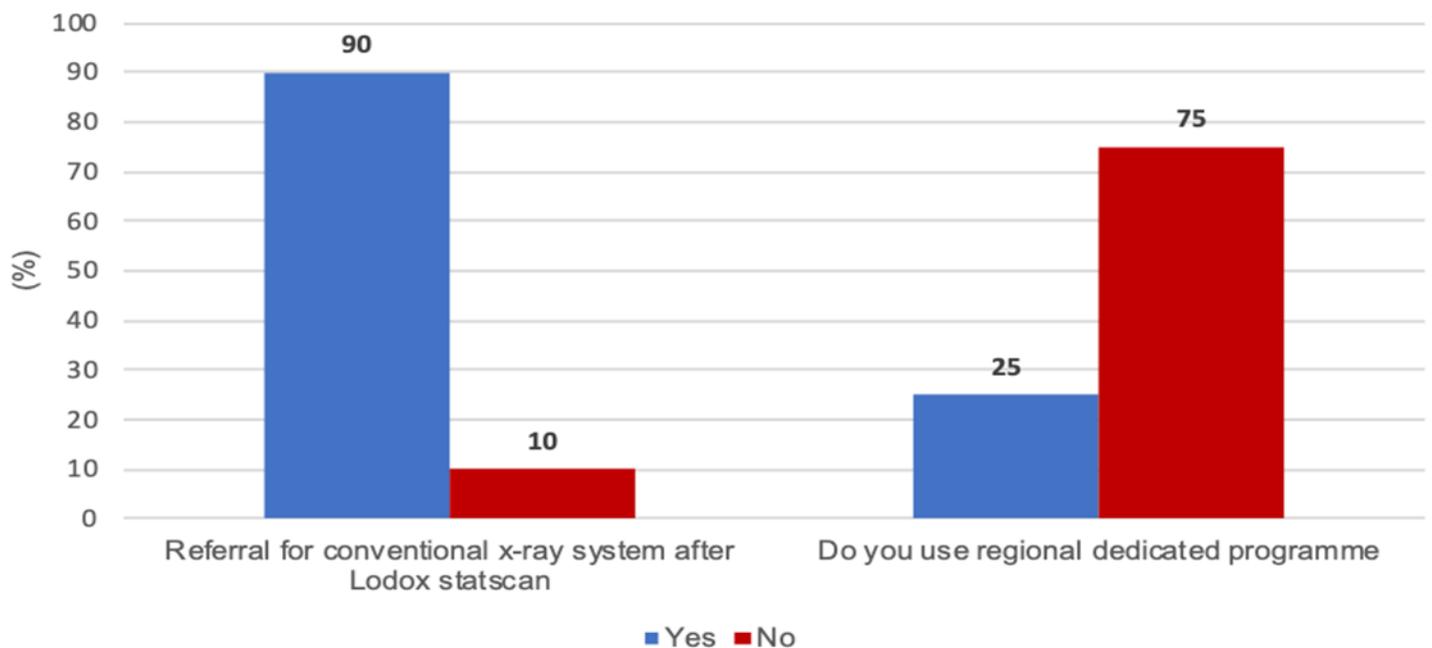


Figure 1

Patient referral for conventional x-ray imaging after Lodox imaging

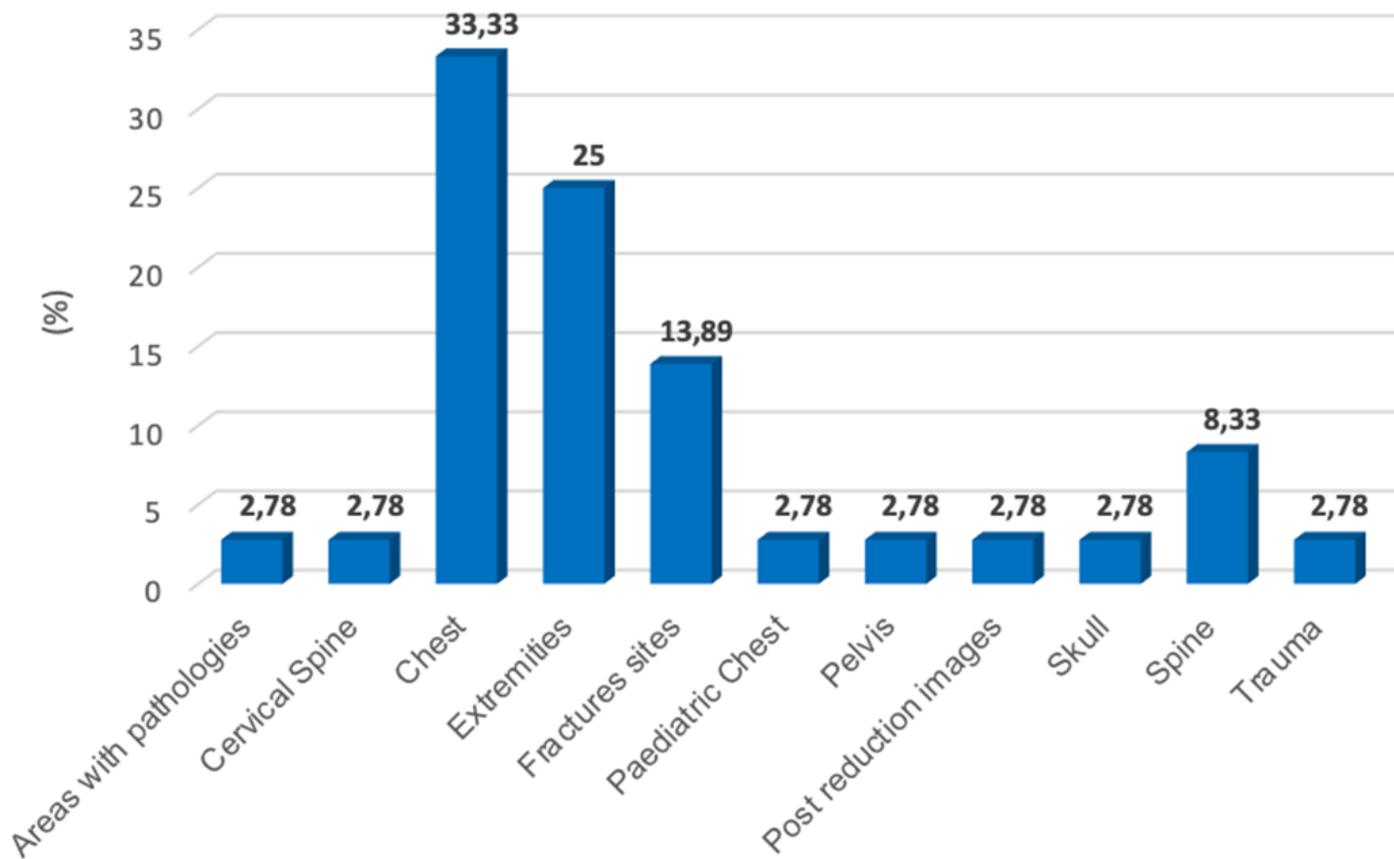


Figure 2

Body regions routinely referred for conventional x-rays following a full body Lodox scan.

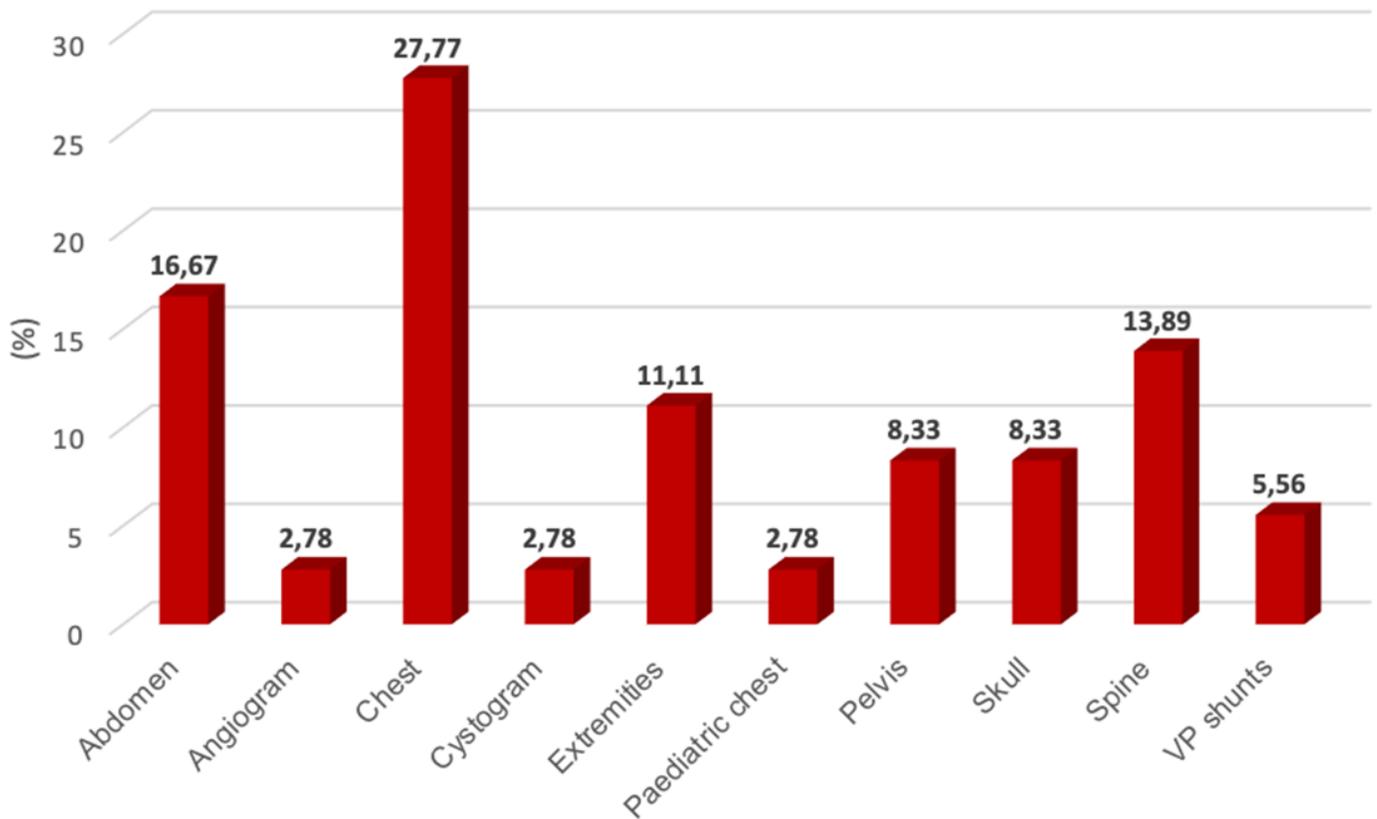


Figure 3

Imaging examinations performed at South African hospitals using the Lodox x-ray system.

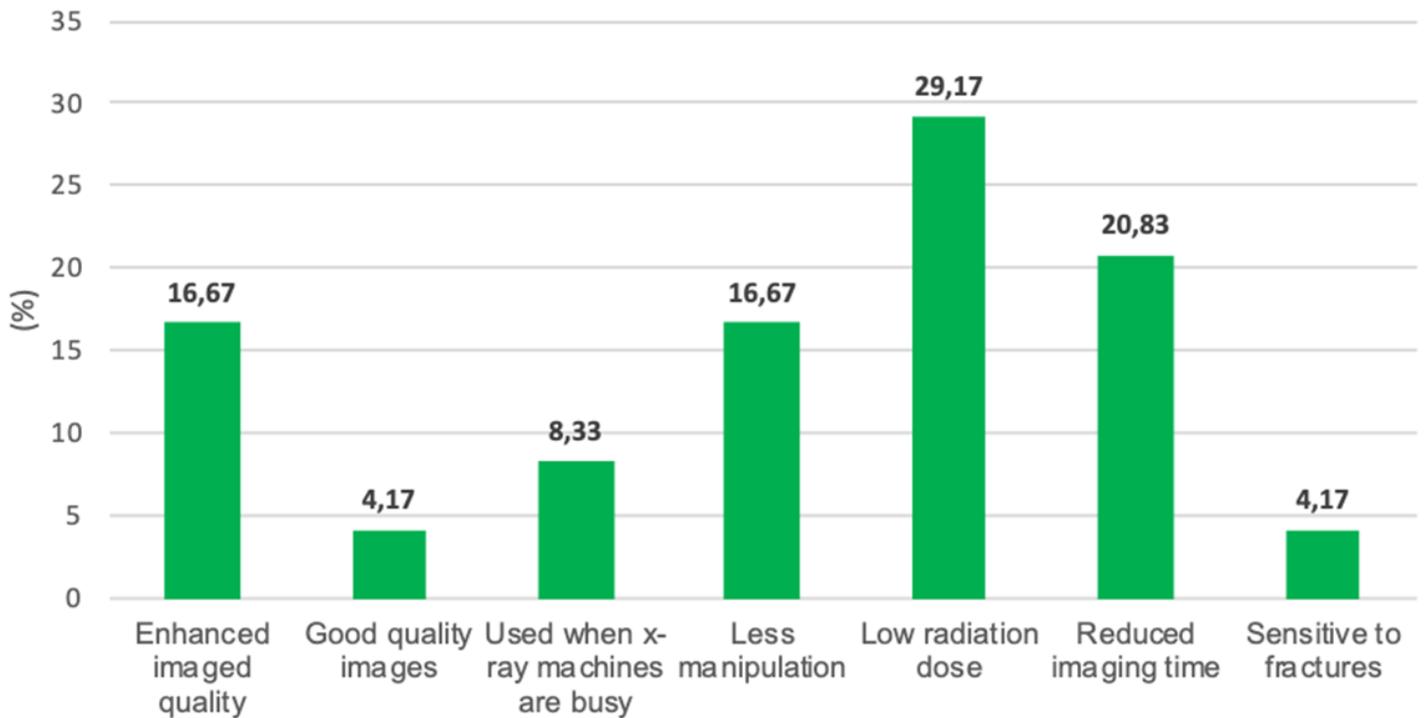


Figure 4

