COST ASSESSMENT OF COMPUTED RADIOGRAPHY TOWARDS CONVENTIONAL RADIOGRAPHY

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ABSTRACT

Introduction: With the expansion of the development of computer equipment and the improvement of software interfaces, there is also a sudden development of radiology without film, through computerized radiography (CR) systems. The CR system made it possible to improve the quality of the radiological image, and thus to make a more accurate and faster diagnosis.

Objective: To estimate the costs of computed radiography compared to conventional radiography.

Materials and methods: The analysis used data on the costs of radiological materials and existing radiological information systems from the plans and signed contracts for 2019 and 2022 in the Croatian Hospital "Dr. Fr. Mato Nikolić" Nova Bila.

Results: The costs of conventional radiology are exceptionally high, including the procurement of X-ray films, processing chemicals, and equipment maintenance. The analysis compares the number of procedures and the displayed costs for the hospital.

Conclusion: Computerized radiography is more cost-effective than conventional radiography due to reusable phosphor imaging plates and reduced chemical and film expenses.

Keywords: Diagnostic Imaging, Radiography, Cost-Effectiveness Analysis, Radiology Information Systems

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INTRODUCTION

In the last thirty years, digital radiology began to strongly develop thanks to the development and improvement of computer techniques. The advantages of computerization of radiological activities have been recognized worldwide for decades. The originator of the idea of a hospital without films was the American doctor Eliot Siegel. It took four years for him to realize his idea, and already in 1993 he was at the head of the first hospital without films in the World (1). The main goal of introducing filmless radiology was to avoid the loss of films. At that time, there were comments that the hospital had been without films before, because otherwise it was impossible to find them. The first hospital in the United Kingdom to introduce radiology without films in 1997 (2). The first radiology without films in the region was introduced in 2006 at the Banja Luka Clinical Center (3). The advantages of the computerization of radiology are the reduction of costs, the increase of productivity and the level of quality of the X-ray image. Instead of using conventional X-ray film to capture the image, computed radiography (CR) uses a recording plate (digital panel). This plate contains photosensitive storage phosphors, which retain the latent image. When the image plate is scanned by the laser beam in the digitizer, the latent image information is released as visible light. This light is captured and converted into a digital stream to compute a digital image. An additional image processing process called postprocessing is a procedure that enables the enlargement of certain anatomical details up to several times, as well as precise measurements, length and volume of different organs or pathological processes, which is important for planning further therapy (4). This compatibility with existing sources and imaging plate makes the transition from traditional film radiography to CR a fairly uncomplicated and inexpensive proposition. In a digital image, it is possible to distinguish 4000 shades of gray, while the human eye can distinguish about 50 shades. The basic features of every radiological digital image are spatial resolution and contrast (5).

Digital radiological images are archived in the picture archiving and communication system (PACS) and radiology information system (RIS). All communication is done in Digital Imaging and Communications in Medicine (DICOM) format (6). The PACS system is a system in which imaging devices, computers (workstations), servers and digital archives are connected. It serves for storing, searching, transferring, managing, distributing and displaying medical images (7). Electronic images and

messages are transmitted digitally through the PACS system, replacing the need for manual work. Via the Internet and Virtual Private Network channels, it is connected to other information systems in the health institution, institutions in the region and teleradiology (8). The RIS system serves for the reception and registration of patients, the storage of finished findings and the administrative management of the radiology department.

The objective of the study was to estimate the costs of computed radiography compared to conventional radiography.

MATERIALS AND METHODS

The analysis used data on the costs of radiological materials and existing radiological information systems from the plans and signed contracts for 2019 and 2022 in the Croatian Hospital "Dr. Fr. Mato Nikolić" Nova Bila. In our study, only descriptive cost analysis data is presented.

The cost analysis included consumables, which could be completely replaced by the computerization of the radiological activity. The analysis compared the number of procedures and the displayed costs for the hospital.

The source of information on the costs of consumables was obtained from the Hospital's Economic Affairs Service. Due to the limited availability of data on all costs for all hospital consumables, as well as the donations received, the analysis was done only for the most commonly used radiological consumables. Radiological consumables included in the analysis were the advantages of computed radiography. The collected data were entered into the Microsoft Excel program 2016, Microsoft corp., where appropriate functions and tools for data tabulation were used.

RESULTS

The conducted researchinto the impact of computerization in radiology on costs and efficiency, utilizing real data from our healthcare institution.

Below we present an estimate of the costs of conventional and computerized radiography (Table 1).

Table 1. - *The costs of conventional and computerized radiography*

Radiological consumables	Conventional radiography	Computed radiography
X-ray films (various sizes)	4500.84 EUR	0
Chemicals - fixer (X- Omat)	544.00 EUR	0
Chemicals - developer (X- Omat)	1001.09 EUR	0
Paper cartridges for X-ray films	15.56 EUR	0
DVB films for CT imaging	3644.65 EUR	0
DVD-R media (4.7GB)	0	8.31 EUR
CD-R media (700 MB)	0	32.74 EUR
Paper cover for CD/DVD	0	37.85 EUR
One-year rental of radiology image storage and communication system (PACS) extension	-	0
One-year RIS maintenance and user support service	-	0
Connecting radiology software applications	-	0
Total estimated costs / EUR	9697.08 EUR	78.90 EUR
Total estimated costs / EUR	9775.99 EUR	

DVB – Digital Versatile Broadcasting; DVD-R – Digital Versatile Disc Recordable; CD-R – Compact Disc Recordable; GB – Gigabytes; MB – Megabytes; RIS – Radiology Information System

DISCUSSION

Based on the results of our research, it is evident that the costs of conventional radiology are exceptionally high, including the procurement of X-ray films, processing chemicals, and equipment maintenance. These costs are significantly reduced through the use of digital technology. For instance, the costs of acquiring films, chemicals, and paper cartridges for X-ray films in digital radiology are zero, whereas in conventional radiology, these costs are substantial.

Many documents point out that relying on information systems can lead to a loss of attention and concentration of employees in relation to the flow of data, control of procedures and the very implementation of procedures (10). Typical errors in the use of information systems include lack of complete documentation in the database, inconsistencies in multiple databases, lack of manual verification of computer operations and calculations, and lack of appropriate procedures for verification and quality control (11).

Although the advantage of "paperless" operation of information systems due to

space saving is highlighted, some researchers point to the weaknesses of the system. For example, in some countries, the keeping of paper documentation and its preservation is still regulated by law. Trust in data storage in electronic form has not been fully achieved (12).

As far as radiology is concerned, the modernization and implementation of information technologies depends on the devices. It is recommended to replace devices older than ten years, while devices older than five years can be upgraded with software (13). Economic problems in Europe make it difficult to implement IT technologies in radiology, and a percentage of equipment of different ages is recommended in order to maintain the quality of work (14). Close cooperation of all involved entities in development and management for proactive, long-term, systematically based strategies and infrastructure will enable a sustainable future of quality radiology (15).

The benefits of computed radiography are: storing the amount of X-ray action on the phosphor of the digital plate has an extremely wide dynamic range. This gives a high tolerance to different exposure conditions and greater freedom in choosing the exposure dose. As a result, the need for repeated exposures is drastically reduced,drastic reduction of the radiation dose for the patient and professionally exposed staff,reduced time required for the procedure - TAT (Turn Around Time),speeding up radiological interpretations in emergency cases (teleradiology),the possibility of networking institutions and all devices,flexible phosphor plates that can be reused up to 10,000 times (9).

One study has reported that CR increased mean number of examinations by 12% compared to conventional radiography. The same study has found that the time for the radiogram to get ready for interpretation shortened by 77% in CR compared to conventional (16).

We expected to find a higher radiographic quality score in CR group owing to the ability of the manipulation of the digital data, acquisition of a wide dynamic range, and a higher spatial resolution compared to conventional radiography (17,18).

Two studies reported that CR (phosphorus cassette) radiograms assess mediastinal structures and peripheral lung fields with a higher score compared with conventional radiograms (19). Van Soldt et al. reported a better image quality with CR compared to conventional radiography (20).

Despite the obvious advantages of digital X-ray imaging, there is a lack of clarity around the associated ethical and legal issues. Whether the current law applies to

telemedicine in the same way as it applies to other medical specialties remains controversial (9).

We can say that the prices of conventional and digital technology services were approximate, but due to the lack of complete data on the service, there will be no research method.

It is important to note that the services of installation, rental and expansion of the system for storage and communication of radiological images (PACS), maintenance services of user support (RIS) and connection of radiology software applications are borne by the Government of the Canton of Central Bosnia, so the hospital has no additional costs from that side.

CONCLUSION

Computerized radiography is more cost-effective than conventional radiography due to reusable phosphor imaging plates and reduced chemical and film expenses.The decision to switch from conventional to computed radiography should be made on the basis of cost savings and improved productivity, looking at the long term. From the results of the cost analysis, we can conclude that the existing information systems and digitization they replace conventional radiology, and are economically justified - they bring significant savings.

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PROCJENA TROŠKOVA KOMPJUTERIZIRANE RADIOGRAFIJE PREMA KONVENCIONALNOJ RADIOGRAFIJI

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SAŽETAK

Uvod: Ekspanzijom razvoja računalne opreme i usavršavanjem softverskih sučelja dolazi i do naglog razvoja radiologije bez filma, kroz sustave računalne radiografije. Sustav računalne radiografije omogućio je poboljšanje kvalitete radiološke slike, a time i točniju i bržu dijagnozu.

Cilj: Procijeniti troškove računalne radiografije u usporedbi s konvencionalnom radiografijom.

Materijali i metode: U analizi su korišteni podaci o troškovima radioloških materijala i postojećih radioloških informacijskih sustava iz planova i potpisanih ugovora za 2019. i 2022. godinu u Hrvatskoj bolnici "Dr. fra Mato Nikolić" Nova Bila.

Rezultati: Troškovi konvencionalne radiologije iznimno su visoki, uključujući nabavu rendgenskih filmova, kemikalija za obradu i održavanje opreme. Analiza uspoređuje broj postupaka i prikazanih troškova za bolnicu.

Zaključak: Računalna radiografija isplativija je od konvencionalne radiografije zbog fosfornih ploča za višekratnu upotrebu i smanjenih troškova kemikalija i filma.

Ključne riječi: slikovna dijagnostika, radiografija, analiza isplativosti, radiološki informacijski sustavi

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