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Evaluating the Availability of Radiological Diagnostic Imaging Equipment for Digital Imaging Informatics Systems in Tanzania's Health Facilities

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Abstract

Radiological digital imaging informatics is potential in enhancing healthcare delivery in resource-limited settings, particularly rural areas in developing countries. It enhances diagnostic precision, reduces unnecessary referrals, and facilitates access to expert's radiological advice. In Tanzania, access to radiological imaging services is limited, especially in rural areas due to the shortage of radiologists. This study examines the availability of radiological imaging equipment to support the adoption of digital imaging informatics systems. A mixed-method approach collected data from 56 radiographers in selected healthcare facilities, including; national, regional, and district hospitals, as well as community health centres. Findings reveal the presence of imaging systems like Digital Radiography (DR), Computed Radiography (CR), along with advanced modalities such as CT Scan and Magnetic Resonance Imaging (MRI.) This study underscores the importance of transitioning to digital imaging informatics to bridge the diagnostic gap in Tanzania's healthcare sector. By addressing existing challenges, the adoption of digital imaging informatics systems can contribute significantly to the realization of universal health coverage in Tanzania.

Keywords*: Digital imaging informatics, radiological equipment, healthcare facilities, Tanzania.*

Introduction

In developing countries, rural health facilities often lack expert knowledge to diagnose and treat some clinical cases correctly, resulting in referrals of patients to higher health systems. To reduce the quantity of needless referrals, radiological digital imaging informatics should provide expert with knowledge and advice at the point of care, both within and outside health facilities. In order to achieve this, proper functioning of diagnostic imaging equipment is required.

Digital imaging informatics systems are integral part to enhancing healthcare delivery and diagnostic precision. Globally, the shift from analogue to digital diagnostic imaging system has improved diagnostic capabilities and accessibility of radiological medical imaging (Siegel & Reiner, 2020; Chriss, 2015). Studies indicate that digital imaging informatics not only improves diagnostic accuracy but also accelerates workflow compared to traditional systems (Smith et al., 2020; Martinez & Villalba, 2020.). Additionally, digital systems support secure image storage and retrieval, reducing the risk of loss or damage to radiographs (Soroosh et al., 2019).

The government of the United Republic of Tanzania (URT) is committed to provide and ensure access to the improved medical care to its citizens by 2030, especially in rural areas in which the government is working hard to make radiology and imaging services accessible (URT-MoH,2022). Despite these efforts, the current literature point that Tanzania has a few medical Radiologists (a fewer than 122) who can interpret diagnostic medical imaging to serve a population of 61,741,120 (MoH, 2022; MOHCDGEC, 2021; NBS, 2022, Ngoya, 2016). Due to such a shortage of experts, patients in rural areas frequently get referrals to referral hospitals to receive health care. This situation further poses pressure on social services including healthcare sector, more particularly in a country like Tanzania which is experiencing a rapid population increase.

In a resource-limited setting, transitioning to digital systems faces challenges due to technological, proper medical imaging equipment and infrastructure constraints (Grover, 1997; Ngoya & Muhogora, 2016; URT MoH, 2022; WHO,2009; Ogunyemi & Raji, 2018). This paper examines the availability of Radiological medical imaging equipment in the selected healthcare facilities in Tanzania in order to adopt digital imaging informatics systems.

Methodology

This study used a mixed-method approach in order to provide a comprehensive analysis of the research study (Creswell, 2022). Structured questionnaires were used to collect quantitative data from 56 radiographers in the selected healthcare facilities in Tanzania. The study was carried out in the following health facilities; Muhimbili National Hospital (MNH), Muhimbili Orthopedic Institute (MOI) both serving as National referral hospitals located in Dar es Salaam. Others are Tumbi and Kitete Regional referral hospitals located in Coast and Tabora regions. In one hand, the Community health centers included; Busondo and Itobo, representing health facilities in rural areas. On the other hand, district hospitals with access to medical doctors were represented by Nzega district hospital.

These health care facilities were selected for their professional experience and expertise in health care, geographic representation, variation in healthcare settings (urban hospitals, rural clinics and infrastructural and technology set ups). This means that, MNH and MOI have the required experience and knowledge in implementing radiological imaging systems. The questionnaire assessed the availability of key radiological imaging equipment, including DR X-ray machines, CR X-ray systems, analogue X-ray machines, CT scanners, MRI scanners, and ultrasound machines. Qualitative data were also gathered from different Government reports, and policy documents.

Findings

This section presents the results of the study on Evaluating the Availability of Radiological Diagnostic Imaging Equipment for Digital Imaging Informatics Systems in Tanzania's Health Facilities. The findings are presented in line with the research objectives as follow:

Availability of Medical Radiological Diagnostic Equipment

All 56 respondents (100%) reported the presence of radiological medical imaging equipment in their departments as shown in Table1.

Table 1: Availability of Radiological Equipment.

Equipment Availability	Frequency	Percentage (%)
Available equipment	56	100 %
Equipment that is not available	0	0%
Total	**56**	**100%**

Source: (Field data, August 2024)

Types of Available Radiological Equipment

The study revealed that 54 respondents (96.42%) of the health care facilities claimed to have DR X-ray machines, 27 (48.21%) of the health care facilities use CR X-ray machines. Meanwhile, 7(12.5%) still use analogue X-ray machines. Further findings indicate that 39 (69.64%) of the health care facilities have CT scanners, 32 (57.14%) have MRI scanners, and 56 (100%) have ultrasound machines. This is a positive indicator for digital imaging systems transformation.

Table 2: Types of Radiological Equipment in the selected Healthcare Facilities in Tanzania.

Types of available radiological medical equipment	Frequency of 56 (Radiographers)	Equivalent Percentage
Analogue X ray	7	12.5%
CR X ray	27	48.21%
DR X ray	54	96.42%
CT Scanner	39	69.64%
MRI Scanner	32	57.14%
Ultra sound	56	100

Source: (Field data, August 2024)

Discussion

This section highlights the critical role of Radiological diagnostic imaging equipment in the successful implementation and operation of digital imaging informatics systems. This section is setting the foundation for a detailed discussion of the study's findings and their implications on supporting radiological digital imaging systems in Tanzania`s healthcare facilities.

The findings indicate that Tanzanian healthcare facilities are prepared for transition to radiological digital imaging informatics systems. This readiness is evidenced by

the availability of essential digital-compatible imaging systems such as digital radiography (DR) X-ray machines, computed tomography (CT) scanners, magnetic resonance imaging (MRI) scanners, and ultrasound devices in several facilities. These systems provide a foundation for integration of digital imaging informatics as they are designed to facilitate the capturing, processing, storage, and transmission of high-quality diagnostic images. The presence of these modern imaging modalities reflects a crucial step towards bridging the diagnostic gap and enhancing healthcare delivery in both urban and rural settings.

The availability of such equipment also indicates that many healthcare facilities in Tanzania are making a significant move from traditional analogue imaging systems, which are more prone to inefficiencies and workflow limitations to the modern and digitized imaging systems. The adoption of digital systems not only ensures a quick- diagnostic processes but also improves image quality, enabling precise and timely clinical decisions (Kruse & Beane, 2018). Furthermore, digital imaging informatics platforms support secure storage, easy retrieval, and seamless sharing of imaging data, which is essential for collaborative diagnostics to ensure equitable access to digital informatics images across the varied healthcare facilities in the country.

Conclusion and Recommendations

This study highlights the potential of Tanzania's healthcare facilities to adopt Digital Imaging Informatics Systems, supported by the widespread of digital medical equipment such as Digital Radiography (DR) X-ray, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), and ultrasound machines. The presence of these technologies forms a strong foundation for transitioning from conventional imaging methods to fully integrated digital imaging systems, which can enhance diagnostic accuracy, storage efficiency, and remote access to medical images. However, to ensure a smooth transition and maximize the benefits of digital imaging, it is recommended that:

a) Procurement policies should discourage the acquisition of analogue X-ray machines in favour of digital alternatives. This will facilitate interoperability, improve image quality, and enhance efficiency in radiological workflows.

b) Capacity-building programmes should be implemented to train healthcare professionals on the use, maintenance, and management of digital imaging systems to ensure sustainable adoption.

c) Financial and technical support should be reinforced to equip rural and lower-tier hospitals with digital imaging technology, reducing disparities in healthcare access.

By addressing these aspects, Tanzania's healthcare facilities can achieve a fully digitized and interconnected medical imaging ecosystem, improving diagnostic capabilities, patient care, and healthcare efficiency.

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