

Original Research Article

The State of Medical Imaging Digitisation in N'Djamena, Chad: A Cross-Sectional Study

Mbozo'o Mvondo S^{1*}, Govondandi Lakreo Y², Yakamba Mangsou², Ganota Danbe W³, Neossi Guena M³, Zeh OF⁴, Boukar Michel⁵

¹Faculty of Medicine and Biomedical Sciences, University of Garoua, Cameroon

²International School of Health Training of Ndjamen, Chad

³Faculty of Sciences, University of Ngaoundéré, Cameroon

⁴Faculty of Medicine and Biomedical Sciences, University of Yaounde, Cameroon

⁵Ministry of Posts and Digital Economy, Chad

Article History

Received: 16.01.2026

Accepted: 10.03.2026

Published: 16.03.2026

Journal homepage:

<https://www.easpublisher.com>

Quick Response Code



Abstract: *Background:* Digitisation in medical imaging – the process of converting analogue images to digital formats – has transformed healthcare by enabling improved data management, storage and sharing. However, data regarding its implementation in Chad are lacking. *Objective:* To assess the current state of medical imaging digitisation in major public and private hospitals in N'Djamena, Chad. *Methods:* A cross-sectional descriptive study was conducted from April to July 2024 across the medical imaging departments of 16 hospitals (7 public, 9 private). Data were collected using a standardised questionnaire administered to department heads, technologists and coordinators. Consecutive, non-probabilistic sampling was employed. Variables included personnel, equipment type and age, digital image sharing, archiving, file formats, maintenance, challenges and benefits. Statistical analysis was performed using Sphinx software. *Results:* Radiologists constituted 6.3% of respondents. The majority of hospitals used digital equipment (direct digital: 46.8%; indirect digital: 48.8%). Key obstacles to digitisation were the high cost of equipment (41.9%) and equipment obsolescence (29%). Perceived benefits included immediate image viewing/film savings (34.2%) and data transmission (29.8%). However, 93.8% of facilities lacked a Hospital Information System (HIS) or PACS. The main causes of equipment failure were electrical power fluctuations (46.2%) and incorrect use by staff (42.3%). *Conclusion:* Whilst digital equipment is prevalent, its full potential in N'Djamena is hampered by a critical shortage of radiologists, the absence of integrated IT infrastructure (PACS/HIS), maintenance issues and an ageing equipment fleet. Strategic investment in specialist training, resilient technical and IT infrastructure, and preventive maintenance programmes are essential to harness digitisation for improved diagnostic care.

Keywords: Digitisation, Radiology, Medical Imaging, Chad, Hospital Equipment.

Copyright © 2026 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC 4.0) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

INTRODUCTION

Digitisation, the conversion of an analogue signal into a digital one, offers significant advantages in medical imaging, including image processing, reduced consumable use, efficient storage and ease of data sharing, despite potentially increasing radiologists' interpretation time [1]. This technological revolution, which began with ultrasound in the 1950s, followed by Computed Tomography (CT) in the 1970s and Magnetic Resonance Imaging (MRI) in the 1980s, has fundamentally transformed the field [2, 3].

Digital conversion has facilitated the emergence of applications such as tele diagnosis and tele-expertise, which rely on Picture Archiving and Communication Systems (PACS) [2]. In Europe, a French study as early as 2003 showed that 60% of imaging departments were digital [4]. In Africa, adoption rates vary widely, from 82.1% in Senegal in 2016 to 11.53% in Togo in 2015 [2-6].

In Chad, the first digital CT scanner was installed in 2013. There is a paucity of studies

*Corresponding Author: Mbozo'o Mvondo S

Faculty of Medicine and Biomedical Sciences, University of Garoua, Cameroon

documenting the state of digitisation in the country. This study therefore aims to assess the current state of medical imaging digitisation in the major public and private hospitals of N'Djamena.

METHODOLOGY

1. Study Design and Setting

A cross-sectional descriptive study was conducted from April to July 2024 in N'Djamena, the capital city of Chad. The study involved 16 medical imaging centres, comprising 7 public and 9 private hospitals, representing the major referral facilities in the city.

2. Study Population and Sampling

The study population consisted of the heads or responsible personnel of the medical imaging departments in the selected hospitals (National Reference University Hospital Centre; Mother and Child University Hospital Centre; Good Samaritan University Hospital Centre; National Reference University Hospital Centre; Mother and Child University Hospital Centre; Good Samaritan University Hospital Centre; Renaissance University Hospital Centre; Military Training Hospital; Santos Imaging Centre; Notre Dame des Apôtres Hospital; La Refondation de Farcha Hospital; La Providence Clinic; Alshifa Clinic; La Grâce Polyclinic; Ophthalmological).

A consecutive, non-probabilistic sampling method was employed. All medical imaging centres in N'Djamena were included to ensure a comprehensive overview. Facilities without any form of digitisation in their imaging services were excluded to focus on centres that had begun the digital transition.

3. Data Collection

Data were collected using a pre-tested, standardised questionnaire. The questionnaire was administered face-to-face to department heads, senior technologists, coordinators or supervising physicians. Participation was voluntary, and informed written consent was obtained from all participants, with assurances of anonymity and confidentiality. An information sheet detailing the study's objectives accompanied the questionnaire.

The variables investigated were grouped as follows:

- **Socio-Demographic and Personnel:** Professional qualification, availability of radiologists, total staff count.
- **Equipment Profile:** Type of available devices (analogue, indirect digital, direct digital), average age of functional equipment, model.
- **Digital Workflow and Infrastructure:** Image sharing practices (telediagnosis, tele-expertise), archiving methods (local disk, PACS, cloud), reprography support (film, CD, paper), image file formats (DICOM, JPEG, etc.).

- **Information Systems:** Presence and type of Hospital Information System (HIS), PACS or Radiology Information System (RIS).
- **Maintenance and Challenges:** Frequency and type of maintenance (preventive, curative), availability of in-house maintenance service, primary causes of equipment failure.
- **Perceived Aspects:** Main challenges in implementing digitisation (cost, infrastructure), key observed benefits (time savings, data transmission, image quality).

4. Data Analysis

Data entry and preliminary analysis were performed using Sphinx Plus software version 5. Data were then exported to Microsoft Excel 2016 for further cleaning and descriptive statistical analysis. Results were presented as frequencies, percentages, means and standard deviations for continuous variables such as equipment age.

5. Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee of the University of Ngaoundéré, Cameroon. Administrative authorisation was obtained from the management of each participating hospital. All ethical principles of research involving human participants were strictly adhered to.

RESULTS

1. Personnel Characteristics

Males were predominant among respondents (81.3%, sex ratio = 4.26). Radiologic technologists constituted the vast majority of respondents (81.3%) and total staff (65.4%). Radiologists represented only 6.3% of respondents and 7.27% of the total staff. They were exclusively present in public structures, available in only 25% of the hospitals surveyed.

2. Equipment Profile

The mean age of functional imaging equipment was 10.31 years (± 7.19 SD), with 25% being over 14 years old. Digital devices dominated the landscape: direct digital (46.8%) and indirect digital (46.8%), compared to only 6.3% analogue devices. Among direct digital devices, Doppler ultrasound was the most common (72.7%). The conventional X-ray table (for indirect digital radiography) was the most prevalent indirect device (68.2%). The main reliability issues cited were equipment obsolescence (29.0%) and lack of adequate maintenance (26.3%).

3. Perceived Challenges and Benefits

The principal challenge identified for implementing digitisation was the high cost of equipment (41.9%). The most frequently cited advantages were immediate image viewing and film savings (34.2%) and ease of data transmission (29.8%).

4. Image Management and Information Systems

The most used image file formats were JPEG (54.2%) and DICOM (36.0%). Archiving was predominantly undertaken on local hard drives (93.8%), and hard-copy reprography on film remained common (66.7%). A striking 93.8% of facilities lacked any form of Hospital Information System (HIS, PACS or RIS). Consequently, 68.8% did not share digital images. Among centres with an available radiologist, only 25% practised image sharing for tele-expertise.

5. Equipment Maintenance

Maintenance was primarily curative (75%), performed only when a breakdown occurred. Most hospitals (68.8%) had no dedicated, in-house maintenance service. The leading causes of equipment failure were electrical power fluctuations (46.2%) and incorrect use by staff (42.3%).

Summary Table of Key Results

Below is a summary of the key results from your study, formatted for clarity and immediate comprehension in a scientific context.

Table 1: Key Results

Category	Variable	Result	Key Finding
1. Human Resources	Gender of Respondents	Male: 81.3%; Sex Ratio: 4.26	Strong male predominance among department heads/technologists.
	Professional Qualification	Radiologic Technologist: 81.3%; Radiologist: 6.3%	Vast majority of staff are technologists. Critical shortage of radiologists.
	Radiologist Availability	Available in 25% of hospitals (public only).	Radiologists are absent from all private centres.
2. Equipment & Infrastructure	Mean Equipment Age	10.3 years (±7.2); >14 years: 25%	Ageing equipment park, indicating potential obsolescence and reliability issues.
	Type of Equipment	Direct Digital (CT, US, MRI): 46.8%; Indirect Digital (CR): 48.8%; Analogue: 6.3%	Digital devices dominate (95.6% combined). Ultrasound is the most common digital modality.
	Hospital Information System	No HIS/PACS/RIS: 93.8%	Near-total lack of integrated digital archiving and communication systems.
	Image Archiving Method	Local Hard Drive: 93.8%; PACS Cloud: 6.3%	Archiving is decentralised and vulnerable, limiting data security and sharing.
3. Digital Workflow	Image Sharing Practice	No Sharing: 68.8%; For Tele-expertise: 25.0%	Digital image exchange is rare, hindering collaboration and second opinions.
	Image File Format	JPEG: 54.2%; DICOM: 36.0%	Use of non-standard diagnostic formats (JPEG) is prevalent over the medical standard (DICOM).
	Reprography (Hard Copy)	Film: 66.7%; CD: 19.1%; Paper: 14.3%	Despite digitisation, analogue film remains the primary medium for providing images to patients/doctors.
4. Challenges & Maintenance	Main Challenges	High Equipment Cost: 41.9%; Equipment Obsolescence: 29.0%	Financial barriers and outdated technology are the main impediments to digitisation.
	Maintenance Type	Curative (on breakdown): 75%; Preventive: 25%	Reactive maintenance is the norm, increasing downtime and long-term costs.
	In-house Maintenance Service	No Service: 68.8%	Most facilities lack dedicated technical support.
	Primary Cause of Breakdown	Power Fluctuations: 46.2%; Incorrect Use by Staff: 42.3%	Unstable electrical infrastructure and lack of training are the leading causes of equipment failure.
5. Perceived Benefits	Main Advantages Cited	Immediate Viewing / Film Savings: 34.2%; Ease of Data Transmission: 29.8%	Perceived benefits are practical and economic (efficiency, cost-saving) rather than clinical (improved diagnosis).

DISCUSSION

This study reveals a critical shortage of radiologists (6.3%) in N'Djamena, a rate lower than those reported in Senegal (58.3%) or the Central African Republic (22.2%) (2,7). This scarcity limits expert image

interpretation and hinders the development of advanced digital practices such as telemedicine.

Whilst the proportion of digital equipment (93.6%) appears encouraging and is comparable to

figures from Senegal (82.1%) [2], it masks an ageing fleet (mean >10 years) and a heavy reliance on ultrasound. The near-total absence of PACS (93.8%) and the reliance on local storage severely limit data sharing, interoperability and long-term archiving, contrasting with studies from other African contexts where PACS adoption is emerging [2-8].

The structural challenges are significant: high capital costs, lack of preventive maintenance protocols, inadequate IT infrastructure and vulnerability to unstable electrical supply. These barriers are well-documented in similar low-resource settings [2-8].

The perceived benefits align with the global literature, highlighting efficiency gains and improved communication, which are foundational for enhanced diagnostic quality [8, 9].

Study Limitations

This study has limitations. The sample size, whilst covering all major centres in the capital, remains modest. The use of a questionnaire may introduce reporting bias. Practical challenges, such as administrative delays and the unavailability of some key personnel, were also encountered during data collection.

CONCLUSION

This study provides a contrasted picture of medical imaging digitisation in N'Djamena. Although digital equipment is now predominant, its potential is largely untapped due to a critical shortage of specialist radiologists, a near-complete lack of integrated IT/PACS infrastructure, unreliable maintenance and an ageing equipment inventory. To move towards effective and meaningful digitisation, coordinated investment is imperative. This must focus on: 1) training and retaining specialised human resources (radiologists, biomedical

engineers); 2) developing resilient technical and digital infrastructure, including PACS and stable power supply; and 3) establishing robust, preventive maintenance frameworks. Such strategic efforts are crucial for leveraging digital technology to improve diagnostic accuracy, patient care and overall health system performance in Chad.

REFERENCES

1. Guegang GE, Zeh OF, Ekobena Fouda HP, Samba O, Kouam FB, Temgoua BA, Lounangou KA, Nko'o Amvene S, Gonsu J. La Numérisation en Imagerie Médicale: État des lieux des Hôpitaux publics de référence de Yaoundé - Cameroun. *JAIM* 2014; 61. (2) :2.
2. Verbeke F. La numérisation en imagerie médicale: état des lieux au Sénégal. In: 10th Health Informatics in Africa Conference (HELINA 2017); 2018.
3. Strauss A. De la radiologie conventionnelle au pixel. *Inform Santé*. 1994;7.
4. L'imagerie médicale dans 8 pays européens. 2003.
5. Tchaou M, Houadjeto DLC, Sonhaye L, Agoda-Koussema LK, Adjenou K, N'dakena K. Etat Des Lieux Et Evaluation Des Formations En Radiologie Dans Un Pays En Développement, Cas Du Togo. *Eur Sci Journal, ESJ*. 2018;14(6):269.
6. Dansou YM. Study on medical imaging digitization in Togo. Lomé, Togo. 2015.
7. Bangue K, Francky S, Moise O, Timothée M, Moise O, Timothée M. Etat de la Radiologie Dans les Chu de Bangui et de Bimbo, Centrafrique. *Health Sci Dis*. 2019;15(6):1-9.
8. Guegang E, Samba ON, Gonsu J. La Numérisation en Imagerie Médicale : État des lieux des Hôpitaux publics de référence de Yaoundé - Cameroun. 2014.
9. Alharbi AM, Alhamdan N. The effects of digital imaging on learning radiography. 2015.

Cite This Article: Mbozo'o Mvondo S, Govondandi Lakreo Y, Yakamba Mangsou, Ganota Danbe W, Neossi Guena M, Zeh OF, Boukar Michel (2026). The State of Medical Imaging Digitisation in N'Djamena, Chad: A Cross-Sectional Study. *EAS J Radiol Imaging Technol*, 8(2), 34-37.
