



GLOBAL VISION

Establishing a State-of-the-Art Diagnostic and Medical Imaging Center in Afghanistan: Achievements, Challenges, and Future Perspectives

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Abstract

Despite being an indispensable component of modern medicine and clinical practice, the radiology field is still underdeveloped and underappreciated in Afghanistan. The lack of adequate diagnostic and medical imaging centers (DMIC) poses an obstacle to timely diagnosis, as well as efficacious disease treatment and monitoring. This article details the experience of establishing a state-of-the-art DMIC in Herat, a province in western Afghanistan. Experiences from the conceptualization to the actualization phases of the establishment are presented. Challenges encountered throughout the process and ways to overcome them are illustrated. Future perspectives in providing evidence-based high-value imaging care in Afghanistan are discussed.

Conclusion: Establishing, maintaining and developing a diagnostic and medical imaging center in a low-income country is feasible, albeit challenging. Collaboration with multiple stakeholders is required to ensure sustainable radiology services and to expand the role of radiology in disease management.

Introduction

Equipped with a range of imaging modalities in its armamentarium, radiology plays an indispensable role in disease management. Imaging modalities with differing physical principles of varying complexity have created a virtual window into the human body, allowing better comprehension of structural and disease-related changes and ultimately assisting in disease management through timely diagnosis, staging, treatment, and monitoring. Unfortunately, the radiology field is immensely underdeveloped in Afghanistan.

The dire state of healthcare service in Afghanistan is commonly reported in international media. As stated in Article 52 of the 2004 Afghanistan constitution, “the state shall provide free preventative healthcare and treatment of diseases as well as medical facilities to all citizens in accordance with the provisions of the law” (1). Despite the constitution in place, persistent political instability and the resulting labile economy has led to an unresolved humanitarian crisis, hindering the provision of healthcare services in the country. The scope of health services in Afghanistan is defined by the Basic Package of Health Services (BPHS) and the Essential Package of Hospital Services (EPHS) (2)(3).

The EPHS is the key element in the development of the Afghan health system. It defines the services which should be offered at different types of public hospitals and therefore acts as a standard for the hospitals in Afghanistan. Diagnostic services listed in the EPHS are only limited to basic X-ray and ultrasound services across district, provincial,

and regional hospitals. Only in Kabul, the capital city of Afghanistan, are CT scans listed as one of the services at selected tertiary hospitals (3).

Not only are the diagnostic services limited to basic modalities, they are also fragmented, not well-coordinated, and insufficient to cover the country's needs. As a result, patients who require further advanced imaging services are required to travel to neighboring countries like Iran, Pakistan, Turkey, and India. This does not merely delay disease diagnosis and/or management, it also incurs additional cost and bureaucratic obstacles in obtaining a visa.

In view of the unmet need in the radiology field, our DMIC, the first state-of-the-art imaging center in Afghanistan, was established in 2020 in Herat, a province in western Afghanistan. The mission of our center is to provide standard and modern diagnostic services as well as to increase accessibility for the local community to quality and specialized medical diagnostic and imaging services. Apart from that, we aim to become a center for education and research by organizing various teaching activities, programs, and ultimately radiology conferences within Afghanistan. Finally, we aim to become a center for data collection and a database repository for medical research purposes.

The Establishment Process and Services Provided

Conceptualization and Exploration Phase

The idea of establishing a DMIC was spearheaded by a radiologist upon returning to Afghanistan after completion of his postgraduate specialization in the radiology field. He shared his ideas with other medical doctors to gauge interest for investment and collaboration. Subsequently, a joint venture was formed and the board of directors consisting of a radiologist, neuro-spine surgeons, an ophthalmologist, a neuropsychiatrist, an internist, an otolaryngologist, hospital managers, and a urologist was elected in 2018.

To solicit views from experts and explore the possibilities to establish the center, consultations with healthcare professionals from different fields, healthcare institutions,

and representatives from the medical imaging equipment suppliers were carried out extensively. Next, the board of directors proceeded with exploration of the resources that were available. Imaging equipment from different companies were reviewed to obtain a thorough knowledge regarding the latest equipment available in the market, its specifications and performance, and prices and installation requirements. Additionally, representatives from the joint venture participated in various international radiology conferences where valuable ideas were exchanged and practical insights were gained. A needs assessment was conducted in the same year. Information on the number of outbound patient referrals for radiological investigation purposes was obtained from public and private facilities within the region. Opinions on the need for establishment of a DMIC and the type of imaging modalities were sought after within the region where the data was collected. Data collection in the private sector was assisted by Afghanistan Private Hospitals Association. Following the needs assessment, the board of directors decided to proceed with actualization phase of the idea owing to the huge unmet needs in radiology in Afghanistan.

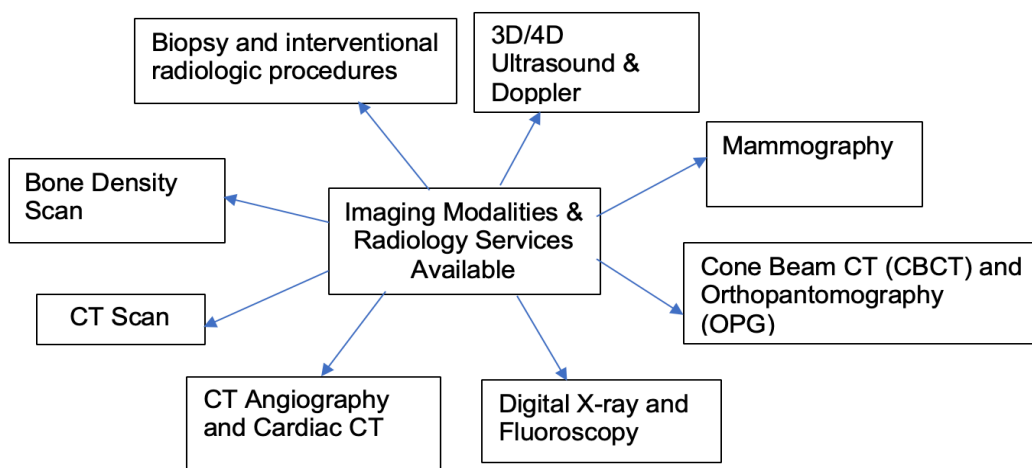
Actualization Phase

The actualization phase began in early 2019 with site selection and procurement, followed by the construction of the center in the city center of Herat. Staff recruitment and training were carried out at the same time. Diagnostic and medical imaging equipment was purchased and installed after the completion of the building. Standard operation procedure and guidelines were discussed and finalized. The center was built in congruence with the International Health Facility Guidelines (iHFG) (4). After a trial period, the center was officially inaugurated in August 2020.

Financing Model

The establishment of our DMIC was funded solely by private funds from the board of directors, consisting of healthcare professionals working in the public and/or private sector. The ongoing expenses of the center are funded by the collection of service charges from patients.

Figure 1. Imaging modalities and radiology available at our center.



Even though Afghanistan has a well-developed national health service — financed by donors and the government and managed by the Ministry of Public Health — healthcare services are limited to basic and essential services. Unlike many other countries, both social and private health insurance is non-existent in Afghanistan. Out-of-pocket expenditure comprises over three-quarters of the total health expenditure in Afghanistan. This situation is further aggravated by the fact that over one-third of the population lives below the poverty line (5). A profit-orientated modus operandi, therefore is not sustainable for our DMIC in the long run as the service charge imposed would not be affordable for the local population.

At our center, the service charges implemented for each investigation or service underwent several revisions to cater to the local population. Currently, service fees charged to the patients are kept to the minimum to cover the operational costs, which are device maintenance, staff remuneration, administrative costs, and consumables. For patients who cannot afford the services despite this relatively low cost, we utilize funds from the center's charity account. Funds from the account are donated in a regular basis by private donors, non-profit organizations, and international charity organizations.

This financing model is feasible in our setting as most funds are from healthcare professionals who share our aspiration to optimize patient care and improve access to quality healthcare. The indispensable role of radiology across medical and surgical fields is also a determining factor in getting the professional and monetary support from healthcare professionals working in different specialties.

Equipment, Radiology Services Provided, and IT support

The type of equipment to be acquired was decided based on the outcome of needs assessment as well as the professional inputs from the board of directors. As investors and healthcare professionals, they are interested in the acquisition of imaging modalities which can be utilized in their respective specialties. This enables them to practice and hone their skills in their home country and ultimately benefits the patients in terms of timely diagnosis and treatment.

Type of Equipment	Model
128-slide CT scanner	Toshiba Aquilion CX
16-Slide CT scanner	Siemens Somatom Sensation
MRI machine	Siemens Magnetom C! 0.35 T
Mammography machine	Planmed Sophie™ Claasic
CBCT scanner	Planmeca ProMax® 3D Plus
Radiography and Fluoroscopy system	GE Precision™ RXi
DEXA scanner	GE Hologic DXA system
Ultrasound machines	Siemens Acuson S2000 HELX

Table 1. Type and model of imaging modalities available.

The type of equipment and radiology services available are provided in Table 1 and Figure 1 respectively. These include a number of modalities and services which were not available in Afghanistan prior to the establishment of the center. Among them, computed-tomography (CT)-guided and ultrasound-guided biopsy and interventional radiologic procedures at our center enable safe and accurate identification and confirmation of the cause of an anatomical abnormality. It also helps in detecting disease progression and guiding treatment choices when image-guided biopsies are carried out sequentially (6). During the initial phase of establishment, biopsy samples were sent to Iran due to the scarcity of pathology service within the region. Currently, biopsy samples are analyzed and reported in-house with the establishment of a pathology unit consisting of a pathologist and three lab technicians.

In contrast with conventional mammography which is more readily available throughout Afghanistan, digital mammography performs better in women with dense breasts and offers throughput and workflow advantages. In the realm of CT angiography and cardiac CT, the introduction of multi-slice CT scanners with a 128-slice system with its high spatial and temporal resolutions at our center enables evaluation of potential renal transplant donors. Within the field of cardiac imaging, multi-slice CT allows the acquisition of high-resolution three-dimensional cardiac images for allowing accurate coronary artery imaging (7).

Bone density scan (DEXA scan) is utilized to diagnose and assess the osteoporosis risk, a previously neglected health issue among the local population. Serious malnutrition, major Vitamin D deficiency, and reduced physical activity (particularly among the female population) are identified by a study by Zelenka et al. as some of the major factors of osteoporosis among the Afghan population (8).

Cone Beam CT and Orthopantomography are versatile and promising imaging modalities which can be applied in fields like implant dentistry, otolaryngology (ENT) exploration, orthopedics, and interventional radiology. In our center, CBCT is utilized in implant dentistry and ENT fields.

A ready-made PACS (picture archiving and communication system) is employed to store, manipulate, and distribute images. A DICOM (Digital Imaging and Communications in Medicine) viewer is also incorporated to the reporting workflow. Two IT staff are employed to manage IT workflow in our center. A hospital information system is also in place to cater for the administrative needs of the center. As Herat city is one of the main cities in the country, internet service is available and its stability, albeit not flawless, is adequate to support the integrated system in the center.

Staff Recruitment and Training

At the time of writing, the clinical support staff in the radiology department consists of two radiologists, a biomedical engineer, a medical physicist, and four technicians. The radiology technicians were trained in Afghanistan prior to employment. Prior to starting their work, they were sent to a DMIC in Iran for further training, particularly in CT, MRI, and CBCT fields. This was necessary

because locally trained technicians were lacking in exposure and experience in these fields. To ensure employee retention, employment agreements with a specified contract duration were signed between the institution and the personnel who received funded training. The other clinical staff received their qualification and training in their respective fields, mostly overseas, prior to employment. Our center values continuing professional education for all of our staff and is committed to facilitate it when there is a need.

In terms of remuneration, radiologists in civil service in Afghanistan are remunerated via a fixed monthly rate according to the National Technical Assistance (NTA) Salary Scale (9). In the private sector, radiologists are paid a fixed rate per case. Radiologists at our center are entitled a proportion of the service charges, which are kept to a minimum as discussed in previous section. To the best of our knowledge, their pay is lower compared to their counterparts in other private institutions.

Educational and Research Department

In congruence with the mission of our center, an educational and research department was set up following the official inauguration of our center. Provision of accessible and evidence-based continuous education to medical students, researchers, and doctors is the main aim of the department. Training programs, workshops, and lectures are planned and conducted throughout the year to cater to the educational needs of the local medical community.

Discussion

Challenges

One of the main challenges in establishing the medical imaging center is the lack of funding and support from the Afghan government. As discussed previously, EPHS focuses almost exclusively on the provision of basic imaging modalities like X-ray and ultrasound across different types of hospitals. As a result, it is almost impossible to obtain administrative and monetary support from the government for the development of advanced imaging modalities. This is also partly due to the lack of awareness among the medical community and the policy makers on the indispensable and emerging role of medical imaging in healthcare services. Based on World Health Organization (WHO) data, the density of MRI and CT units per million people in Afghanistan is just 0.1 and 0.2 units respectively. There is a lack of national policy on health technologies (medical devices). National standards or recommendation on the procurement of medical devices are also not available (10).

Due to financial restrictions, the idea of introducing multiple imaging modalities in stages was discussed during the conceptualization phase of the establishment process. Nevertheless, the notion was abandoned as the board members proceeded with the decision to offer all essential and latest imaging modalities at the launching of the center. This was in line with our aspiration to provide a one-stop state-of-the-art medical imaging facility. Although this inevitably led to difficulties in securing sufficient funds and

investment from multiple parties, numerous presentations and negotiations with investors and stakeholders enabled the formation of a joint venture, leading to project actualization in early 2019. Negotiations and collaborations with other public and private health facilities were carried out prior to launching of the center to ensure sustainability of the service.

Another major obstacle to be overcome throughout the establishment process was the lack of trained healthcare workers. At the time of writing, radiology and its related courses are not offered as a field of study at either the undergraduate and postgraduate level in Afghan tertiary education institutions. Prospective and aspiring radiologists, radiographers, and medical engineers are required to obtain their specialized training in other countries. Even though the female health workforce in Afghanistan has been steadily increasing over the last few decades (11), the promising trend was abruptly overturned by the deterioration in women's and girls' rights to work and to receive education following the recent political upheaval. This further complicates the effort to improve healthcare service and health outcomes. Due to the critical shortage of locally trained workforce, the center had to employ qualified personnel from overseas and this inevitably resulted in higher cost and difficulties in administration processes. For certain positions, employed staff are sent to other countries from time to time for further training and to keep them up to date with the latest clinical practice guidelines and recommendations.

Apart from that, the maintenance of the medical imaging modalities also posed a major challenge. Even though an onsite biomedical engineer oversees imaging device maintenance, suppliers and companies specializing in imaging equipment do not have an operational branch and therefore have no representatives in Afghanistan due to political and economic instability. In addition to provision of continuous training to current staff, a contract was negotiated and signed with the respective imaging equipment suppliers. It ensures the provision of remote technical support from the suppliers.

During the initial phase of operation, the number of patients and referrals received from other private and public healthcare institutions were less than our expectations. This was mainly due to the lack of awareness and exposure among the local medical community on the central role of radiology services in disease diagnosis and management. This was overcome by the organization of regular lectures, talks, and educational activities to highlight the emerging role of radiology in various medical disciplines. Our DMIC complements other public and private healthcare facilities within the region as they do not provide extensive service in radiology. Patients who require routine, elective, or non-emergency investigations are referred to our center from public and private facilities by using conventional referral letters. They can walk-in to our center at their convenience. In life-saving or emergency situations, inter-facility ambulance transportation is employed.

The above-mentioned challenges were made even greater with the emergence of Covid-19 as a global pandemic in

2020. Besides causing further collapse of the healthcare system in a country with already underdeveloped health services, the pandemic also hindered the collaboration efforts and administrative processes with local and international agencies. Fortunately, albeit with some delays, the center was successfully inaugurated in August 2020 with unwavering dedication from the board members and continuous support from the employees.

Future Perspectives

Establishing and running the center is just the first step in our commitment towards excellence in healthcare services, education, and research in the radiology field. To ensure sustainability of the services provided, the center will have to collaborate constructively with all stakeholders, including private and public health centers, government, advocates, and industry. The lack of imaging services is not restricted to western Afghanistan (the current location of our center) but rather a common problem throughout the country. If sufficient funds can be secured in the future through funding from various parties, we aspire to establish several centers with similar magnitude throughout Afghanistan. Continuous support from the international community is of paramount importance for maintaining the provision of essential health services and minimizing the impacts of the long-standing humanitarian crisis in Afghanistan.

In terms of diagnostic and imaging services, there is a plan to venture into preventive medicine. In recent years, preventive medicine has emerged as one of the most exciting and promising fields of medicine. Early detection of diseases and ability to combine imaging findings with other risk factors to yield more individualized care programs are both made possible with new tools and technologies. For example, the importance of regular mammograms for breast cancer screening can be promoted among the local population to mitigate the increasing cases of breast cancer in the country. According to the Global Cancer Observatory, breast cancer accounted for 29.7% of all cancers in women in the country in 2018 (12). Preventive medicine in breast cancer is a worthwhile cause to pursue, particularly in Afghanistan where a comprehensive therapeutic service in oncology is still severely lacking and breast cancer related mortality is relatively high (13). Meanwhile in the cardiology field, CT imaging is an essential component of a comprehensive cardiovascular risk assessment and serves as a gatekeeper to invasive catheterization procedures.

With the rising global diagnoses of cancer, the gap between radiotherapy supply and demand has widened, especially in low-income countries. Radiotherapy is an indispensable cancer treatment in both the curative and palliative setting. Afghanistan has the highest age standardized rate (ASR) of incidence for cancer as well as of mortality among countries in South Asia. Unfortunately, there is currently no radiotherapy unit or center in western Afghanistan (14). Therefore, to expand radiology services in radiotherapy is one of the future targets of our team.

On the other hand, it is hoped that the range of imaging modalities offered at our center could indirectly galvanize the development and advancement of other medical disciplines within the region. For example, the availability of CT angiography facilitates safe, rapid, and relatively non-invasive evaluation of potential renal transplant donors. This could encourage more surgeons to subspecialize in renal transplantation as the risks and complications associated with the harvesting process are reduced and the chances for a successful outcome are greatly improved with the aid of cutting-edge technology. Besides, in the era of precision medicine, image-guided biopsies are playing a larger role in the characterization of molecular alterations and subsequently guiding oncologists' treatment choice for individual patients. Presence of predictive biomarkers for certain malignancies can be utilized for treatment selection between conventional anticancer treatment, targeted therapies, and immunotherapies (15).

Conclusion

Amidst a complex political and economic situation, the first state-of-the-art diagnostic and medical imaging center in Afghanistan was established successfully after overcoming a multitude of obstacles. Lack of funding from the government and a lack in trained healthcare workers, difficulties in procurement and maintenance of imaging modalities, as well as a lack of awareness of the value of radiology services posed colossal challenges against the backdrop of political turbulence and the Covid-19 pandemic. Apart from providing evidence-based high-value imaging care and acting as a leading platform for continuous research and education, it is our aspiration to be able to play a role in complementing the development of other non-radiology medical fields with the imaging services provided. Strong collaboration with local and international organizations and sufficient funding are the keys to a long-term sustainable radiology service.

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of Afghanistan ENT Surgeons Society West; (7) Dr. Zamari Noori, MD, Consultant Urologist, Head of Surgery Department of Aria Apollo Hospital; (8) Dr Nazifullah Poyandah, MD, Neuropsychiatrist, Director of Hemayat Neuropsychiatry Hospital; (9) Dr Khaled Iman, MD, Neurospine Surgeon, Head of Neurospine Surgery Department of Loqman Hakim Hospital, Chairman of Neurosurgery and Spine Association-Herat.

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Conflicts of Interest

The authors report no conflicts of interest.

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