BJMS
Borneo Journal of Medical Sciences

REVIEW ARTICLE

Medical Imaging in Rural Sabah: Current Barriers and Emerging Solutions

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Received: 30 September 2025

Accepted: 15 December 2025

Published: 13 July 2026

DOI: https://doi.org/10.51200/bjms.v20iSuppl.8006

Keywords: *Medical imaging, Rural healthcare, Diagnostic access;, Sabah, Teleradiology, Public–private partnership (PPP), Artificial intelligence (AI), Health workforce training*

ABSTRACT

Access to medical imaging remains limited in rural Sabah, Malaysia, due to geographical barriers, inadequate infrastructure, and a shortage of skilled radiology personnel. These constraints hinder early disease detection and timely medical intervention, perpetuating health disparities between urban and rural populations. This review examines the importance of medical imaging in rural healthcare, outlines current challenges, and explores innovative approaches to improve service accessibility. Emerging solutions include the use of mobile imaging units, task-shifting to optimize available human resources, and public–private partnerships (PPPs) to leverage shared infrastructure and expertise. Furthermore, teleradiology and artificial intelligence (AI) offer transformative potential in enhancing diagnostic accuracy, workforce training, and efficiency. Drawing lessons from successful models in Malaysia, Uganda, Saudi Arabia, and China, this paper highlights the need for a sustainable, multi-sectoral approach integrating policy support, technology adoption, and local capacity building. Such efforts are essential to ensure equitable and high-quality diagnostic services for Sabah's rural and underserved communities.

INTRODUCTION

Medical imaging is the eyes of medical and health sciences that employs ionizing or non-ionizing radiation to produce visual representations of the internal structures and functions of the human body

(Buchberger, Scholl, Krabbe, Spiller, & Lux, 2022; Hussain et al., 2022). These images are essential for diagnosing abnormalities and guiding appropriate treatment (Hussain et al., 2022). The field consists of various imaging modalities, including conventional radiography (X-ray), computed tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET), ultrasound, mammography, and dual-energy X-ray absorptiometry (DEXA), with each offering distinct diagnostic capabilities suited for specific clinical purposes (Hussain et al., 2022). However, despite the significant role of medical imaging in modern healthcare, access to these services is not universal, particularly in rural and remote regions around the world (Frija et al., 2021). In Malaysia, the issue is evident in the state of Sabah (Manual, Ibrahim, Suki, & Sciences, 2024).

Sabah is the second-largest state in the country, yet it remains one of the poorest states in Malaysia, with a high number of rural areas (Fang et al., 2022). It was documented that 45.3% of the total population is Sabah lives in rural areas, highlighting that a significant proportion of its population resides in rural and hard-to-reach areas where healthcare infrastructure is limited or underdeveloped (Brinkhoff, 2023). Factors such as mountainous geography, scattered rural populations, and economic constraints have contributed to the underdevelopment of healthcare facilities in the rural areas in Sabah, hence affecting the delivery of medical imaging services to these communities (Jeffrey, 2024). The delivery of medical imaging services in such areas is further hindered by a shortage of trained radiology personnel willing or able to serve in rural posts (Mbemba, Gagnon, & Hamelin-Brabant, 2016). The challenges then eventually limit timely diagnosis and contribute to healthcare disparities between urban and rural populations.

This review aims to study the current landscape of medical imaging in Sabah, Malaysia, with a focus on identifying its importance, existing barriers, highlighting recent innovations, and proposing future directions for improving equitable access to diagnostic imaging in rural settings.

Importance of Medical Imaging in Rural Healthcare

Medical imaging plays a pivotal role as a frontline diagnostic tool, particularly in rural healthcare settings where the burden of disease is often higher, and healthcare infrastructure is limited (Manual et al., 2024). Rural populations, particularly in regions like Sabah, Malaysia, are disproportionately affected by preventable and treatable conditions such as tuberculosis, maternal and child health complications, and trauma-related injuries (Jarman, Castillo, Carlini, Kodadek, & Haider, 2016; Manual et al., 2024). These health issues are often exacerbated by poor living conditions, limited access to care, and socioeconomic hardship, all of which contribute to elevated morbidity and mortality rates (Manual et al., 2024).

Early and accurate diagnosis is essential for effective medical intervention, and the presence of medical imaging services in rural areas enables the timely assessment of patients' conditions. Imaging modalities such as chest X-rays for tuberculosis detection, obstetric ultrasound for maternal monitoring, and CT scans for trauma assessment significantly improve diagnostic precision (Hailemariam et al., 2023). As a result, appropriate treatment plans can be implemented sooner, ultimately enhancing patient outcomes and reducing preventable deaths (Hailemariam et al., 2023). Studies have shown that diagnostic accuracy and, hence, survival outcomes, are markedly improved when imaging is used compared to settings that rely solely on clinical assessment (Santiago, González, Cabrera, Ramos-Bossini, & Surgery, 2024). For example, a study by Ruiz Santiago et al. (2024) reported that overall diagnosis accuracy when diagnosing a hand tumor reached 81.1%, compared to only 26.3% accuracy through clinical diagnosis alone

(Santiago et al., 2024).

The majority of rural populations often belong to lower-income groups, and the absence of nearby medical facilities adds to their financial and physical burden (Hearn, Pinto, Moss, & Health, 2024; Meloni, Grazini, Marino, Rocchi, & Severini, 2024). Traveling long distances to urban centers for imaging services is not only costly but also physically demanding, especially for patients with limited mobility, the elderly, or those requiring urgent care (Hearn et al., 2024). Establishing healthcare facilities equipped with imaging modalities closer to rural communities reduces their travel time, lowers out-of-pocket costs, and improves healthcare accessibility.

Moreover, providing imaging services in rural regions is a crucial initiative aimed at reducing health disparities between urban and remote populations. With advances in digital imaging and telemedicine, diagnostic images obtained in rural facilities can now be transmitted electronically to radiology specialists in urban centers for expert consultation (Ueki et al., 2024). This connectivity not only enhances the quality of care but also integrates rural populations into the national health monitoring system. Such integration supports more equitable health policy planning, research, and resource allocation.

In the long term, accessible imaging services can empower health authorities and government stakeholders to better understand disease trends in remote regions and to implement targeted public health interventions. Ensuring that rural populations are not left behind is not merely a matter of equity, it is a national responsibility. By recognizing the role of medical imaging in rural healthcare, Malaysia can work toward a more responsive and sustainable healthcare system.

Challenges in Imaging Access in Rural Sabah

Limited access to medical imaging remains one of the major challenges in the healthcare system in rural areas of Sabah. Known for its mountainous and rugged geography, many rural regions in Sabah face serious infrastructural difficulties, including healthcare (Jeffrey, 2024). Besides, constructing proper facilities and transporting imaging equipment becomes impractical in areas lacking reliable road access and stable land for development.

Medical imaging involves the use of radiation-emitting technologies, necessitating facilities that adhere to strict design specifications to ensure radiation safety and public protection (Frija et al., 2021). The imaging areas require controlled environments, including air conditioning, stable electricity supply, and radiation-shielded walls standards (Frija et al., 2021). These structural and safety requirements increase the overall cost significantly, compared to standard clinical rooms. Moreover, imaging equipment demands continuous technical maintenance, routine quality assurance, and compliance with national radiation safety regulations, which significantly add to the overall financial and logistical burden (Healy et al., 2020). In many remote locations, poor road access limits the ability of technical personnel to conduct regular servicing and inspection, further hindering system efficiencies. Besides, while the establishment of an imaging system in rural areas may appear ideal for the community, concerns remain regarding the cost-effectiveness of implementing such a complex medical imaging ecosystem in sparsely populated regions (Frija et al., 2021). The scattered rural regions might reduce the economic feasibility of installing and maintaining the imaging systems across multiple locations.

Human resource constraint further limits the implementation of imaging in rural areas. While there may be a sufficient supply of radiographers or trained personnel, many are reluctant to serve in remote areas due to personal or family-related considerations (Okyere, Ward, Marfoh, & Mwanri, 2021). The shortage is even more pronounced for radiologists, whose numbers remain low nationwide. A study in 2023 reported that only 870 registered radiologists were available to serve a Malaysian population of 33.57 million, highlighting the urgent need for more radiologists to serve underserved areas, particularly rural regions (Ramli & Zain, 2023). Although teleradiology offers a potential solution by enabling remote radiological diagnosis and reporting by radiologists based in urban centers, its implementation is hindered by unstable internet connectivity and poor telecommunication service, both of which are persistent in the rural areas of Sabah. Given these challenges, geographical limitations, high infrastructure and maintenance costs, human resource shortages, and connectivity issues, alternative models for delivering medical imaging services in rural Sabah must be considered. These alternatives should be realistic, cost-effective, and tailored to the unique context of the region.

Current strategies to improve imaging access in rural Sabah

Despite these persistent challenges, several strategic approaches have been implemented or proposed to enhance medical imaging accessibility in rural Sabah. Among them, mobile imaging units, public-private partnerships, and training initiatives have emerged as promising solutions tailored to the region's geographic and socio-economic context.

In rural areas, conditions that could be detected early and effectively managed in urban settings often remain undiagnosed or are identified too late, leading to preventable complications and increased morbidity and mortality. Mobile imaging solutions, by providing timely diagnostic services, have the potential to bridge this gap, helping to reduce health disparities and ensuring that rural populations benefit from advancements in medical care (Datta et al., 2019).

Mobile X-ray involves performing imaging procedures outside the radiology department using a mobile X-ray machine. In clinical settings, it is sometimes referred to as "portable X-rays," a term originating from the early small X-ray units that could be dismantled and reassembled at the patient's bedside or location. However, these early portable systems are no longer in use due to radiation protection concerns. Modern mobile X-ray machines are mounted on wheeled platforms, enabling them to be easily relocated between various locations within a healthcare facility (Bwanga et al., 2023).

Mobile X-ray units have traditionally been utilised within hospital settings, particularly for imaging patients in intensive care units who cannot be easily transported. Beyond hospital walls, these mobile radiography services are increasingly employed in community settings in countries like Denmark, where they serve vulnerable populations such as the homeless and residents of nursing homes. A study by Andersen (2023), highlighted the effectiveness of mobile radiography units in delivering improved diagnostic services to this underserved group. The study also emphasised the importance of continuously adapting the service based on both its successes and challenges, demonstrating the potential for mobile nits to bridge healthcare access gaps among vulnerable communities (Andersen, Precht, McEntee, & Pedersen, 2023). Mobile imaging continues to be utilised when patients are too fragile to be transported to the radiology department. Furthermore, mobile examinations have proven to be cost-effective for hard-to-reach populations, particularly for tuberculosis screening and in low- and middle-income countries (Toppenberg, Christiansen, Rasmussen, Nielsen, & Damsgaard, 2020). In addition to managing acute medical cases, mobile imaging units play a vital role in disease screening initiatives. In areas with high tuberculosis (TB) prevalence and limited healthcare infrastructure, these units contribute significantly to public health by offering on-site chest X-ray services. This immediate diagnostic capability enables earlier detection of TB, which is critical for controlling transmission and reducing the burden of this infectious disease (Al-Naser, Alshadeedi, & Sciences, 2024). Mobile X-ray units (MXUs) have been shown to be an effective tool for active case finding, particularly in hard-to-reach populations with a high burden of disease. Their ability to detect cases at an early stage, when individuals are less infectious, plays a crucial role in reducing transmission and improving health outcomes. This strategy of enhancing access to X-ray services through mobile units has also been demonstrated to be cost-effective, as supported by previous studies, making it a practical and sustainable approach for underserved populations (Datta et al., 2019). A scoping review by Toppenberg et al. (2020), which included 12 studies, identified four main themes on mobile X-ray services: target population, population health, experience of care, and cost-effectiveness. The review found that mobile X-rays could potentially benefit wider groups such as hospice, psychiatric, and intellectually disabled patients. Evidence showed good image quality, improved patient and staff satisfaction, and possible cost-effectiveness, particularly outside hospital settings. However, the overall literature lacked sufficient evidence to draw firm conclusions on which populations would benefit most, underscoring the need for further research to optimize the role of mobile X-ray (Toppenberg et al., 2020).

Task-shifting has emerged as a pragmatic approach to address workforce shortages in healthcare systems, making use of already available human resources by delegating specific tasks traditionally performed by highly trained professionals to health workers with lower formal qualifications. In Ghana, for example, medical assistants have long been involved in diagnosing and treating a wide spectrum of illnesses from terminal diseases to the common cold (McPake & Mensah, 2008). A qualitative study involving sixty-eight (68) in-depth interviews with primary health care workers and four interviews with key staff managers highlighted how task-shifting is organized, including its strengths and challenges. The interview guide explored the official duties of health workers, additional tasks assigned, their perceptions of these responsibilities, and the difficulties encountered. Findings revealed that task-shifting is widely practiced across health centres, though the degree of implementation varies. Importantly, the strategy fosters teamwork and creates a shared sense of urgency among health workers, thereby improving access to care (Okyere, Mwanri, & Ward, 2017) .

In the context of medical imaging, the radiography profession faces similar challenges of expanding responsibilities amidst a global shortage of qualified radiographers. Task-shifting has been adopted as a strategy to mitigate this shortfall. For instance, in Sweden, the shortage of radiographers has necessitated that assistant nurses take on selected imaging-related tasks. These include assisting with calculations of glomerular filtration rate (GFR), providing patient care during contrast administration, and managing schedules for computed tomography (CT) and magnetic resonance imaging (MRI) procedures. (Christensen, Pettersson, & Bjällmark, 2021).

In sub-Saharan Africa (SSA), health priorities in rural areas often emphasize the prevention of infectious diseases, which means medical imaging tends to be under-prioritized. Consequently, many rural imaging facilities operate with older, less sophisticated, and poorly maintained equipment. The shortage of radiographers and sonographers exacerbates the situation. In some settings, imaging units are managed by radiographers, but in the most remote areas, only auxiliary staff with informal, on-the-job training are available to provide imaging services (Kawooya, 2012). Table 1 shows the summary for current strategies to improve imaging access in rural sabah.

Table 1: Current strategies to improve imaging access in rural Sabah

Strategy	Description	Global or Regional Example	Potential Benefits for Rural Sabah	References
Mobile Imaging Units	Deployment of mobile X-ray or imaging vehicles equipped with diagnostic systems to reach underserved areas.	Mobile X-ray units in Denmark and India for TB screening and community health services.	Brings imaging closer to patients, reduces travel burden, enables early diagnosis, and supports disease screening programs (e.g., TB).	Datta et al., 2019.Bwanga et al., 2023. Andersen., et al., 2023 Toppenberg et al., 2020 Al-Naser et al., 2024
Task-Shifting and Targeted Training	Delegation of selected imaging tasks to trained allied health workers or assistants under supervision.	Tanzania's two-year Assistant Medical Officer (AMO) training program and Ghana's medical assistant model.	Addresses shortage of radiographers and radiologists; builds local capacity; sustains imaging services in rural areas.	McPake & Mensah., 2008 Okyere et al., 2017 Christensen et al., 2021 Kawooya 2012 Ferraioli & Meloni .,2007
Public–Private Partnerships (PPPs)	Collaboration between public institutions and private entities to share infrastructure, expertise, and technology.	Malaysia (UMMC-UMSC-CIGMIT) dual model; Saudi Arabia PPP in teleradiology.	Expands access to advanced imaging, enhances cost-efficiency, and fosters technology transfer to rural hospitals.	Adegboyega et al., 2024 Waran et al., 2022 Alshamrani & Alkenawi., 2021

A notable example of addressing this gap is seen in Tanzania, where targeted training initiatives have expanded access to imaging services in rural areas. The success of this strategy is largely credited to Professor Helmut Diefenthal, a missionary doctor at the Kilimanjaro Christian Medical Centre (KCMC) in rural Moshi. He pioneered a two-year program to train Assistant Medical Officers (AMOs) in imaging, specifically to serve underserved rural populations. To date, 68 AMOs have graduated, with 67 still working in rural Tanzania. By contrast, a radiology residency program launched at KCMC in 1998 has trained 12 specialists, but only eight remain in Tanzania, and just one is practicing in a rural setting. This comparison highlights the relative sustainability and effectiveness of task-shifting strategies such as AMO training in strengthening rural imaging capacity.(Ferraioli & Meloni, 2007).

Similarly, rural areas in Sabah face comparable challenges, with limited radiographers, outdated equipment, and high patient demand. Task-shifting, as demonstrated in Tanzania, should be prioritized as a viable strategy to optimize existing human resources. By empowering allied health workers or trained assistants to support imaging services under supervision, Sabah can address the shortage of radiography professionals and expand access to medical imaging in its remote communities. Such an approach holds promise for improving equity in healthcare delivery and reducing disparities between urban and rural populations.

Numerous challenges in its healthcare system, including inadequate infrastructure, limited resources, and disparities in access to quality care. The satisfaction of physicians with diagnostic support services is a critical determinant of healthcare quality and patient outcomes. Public-Private Partnerships (PPPs) have emerged as a potential solution to address this issue by leveraging the resources and expertise of both private and public sectors. It has been shown to positively impact health care service delivery in areas where it is practiced, and they are preferred due to responsiveness to consumer preferences and accessibility (Adegboyega et al., 2024). One of the examples of a dual public–private healthcare model in Malaysia is the University of Malaya, which operates both the University of Malaya Medical Centre (UMMC), a major public teaching hospital with over 1,000 beds and the University of Malaya Specialist Centre (UMSC), a smaller 100-bed private hospital established in 1999. The establishment of UMSC enabled senior specialists to engage in limited private practice while continuing their academic and clinical duties within the university system. Although UMSC has its own dedicated wards, it shares key facilities such as operating theatres and imaging systems with UMMC on a sessional basis, typically during off-hours or weekends. The Centre for Image-Guided and Minimally Invasive Therapy (CIGMIT) was designed to cater to both public and private patients, where private patients are charged standard private fees, while public patients receive care at government-subsidized rates (Waran, Thillainathan, Karuppiah, & Pickard, 2022). Another illustrative example can be seen in the Kingdom of Saudi Arabia (KSA), where the Ministry of Health (MOH) has undertaken major reforms to address the growing demand for healthcare services resulting from rapid population growth. To enhance both the quality and efficiency of care, particularly in the field of medical imaging, the MOH launched its first public–private partnership (PPP) initiative dedicated to teleradiology. This approach allows hospitals within the network to be digitally interconnected, enabling remote image sharing and expert consultation. The integration of PPPs not only promotes operational efficiency and cost-effectiveness compared with traditional public service delivery but also significantly expands access to imaging services for remote and underserved regions across the country (Alshamrani & Alkenawi, 2021).

Similarly, in the context of Sabah, particularly in its rural and remote regions, adopting comparable PPP frameworks could play a transformative role in bridging the gap in medical imaging accessibility. By integrating public healthcare infrastructure with private sector expertise and technology, Sabah could enhance diagnostic capacity, reduce referral delays, and ensure equitable access to essential imaging services for its rural population.

Future directions

To address this shortcoming, Sabah needs to increase the number of trained radiologists. A previous study showed that, seven teaching hospitals across Malaysia participate in joint board examinations for radiology specialists. In August 2021, the National Postgraduate Medical Curriculum was introduced to unify and standardize specialist training nationwide, producing approximately 70-80 radiologists annually. Radiology training is highly competitive, requiring candidates to pass the Medical Specialist Pre-Entrance Examination (MedEx), a radiological knowledge test, and interviews. To further overcome the shortage, the Ministry of Health (MOH) has introduced a parallel pathway program, allowing trainees to pursue external fellowship examinations such as those from the Royal College of Radiologists (RCR, UK) and the Royal Australian and New Zealand College of Radiologists (RANZCR) while being trained in MOH hospitals. Graduates from these pathways are required to serve in MOH facilities, aligning with Malaysia's plan to meet specialist needs by 2035 (Ramli & Zain, 2023).

Similarly, in rural Uganda, radiology training has primarily focused on ultrasound and plain X-ray interpretation. Before targeted interventions, fewer than 5% of trained sonographers were from rural areas. Through collaborative efforts between the Ernest Cook Ultrasound Research and Education Institute (ECUREI) in Kampala, Mengo Hospital, Jefferson Ultrasound Research and Education Institute (JUREI, USA), Fontys/Meduprof-S (Netherlands), and the Ugandan government, over 350 health workers including nurses, midwives, radiographers, assistant physicians, and doctors have completed diploma-level ultrasound training, with half of them from rural regions. A follow-up survey found that 76% of graduates remained in their hospitals and continued practising ultrasound two years after training. ECUREI has also introduced a one-year course in X-ray film interpretation and a free e-learning program to expand access for those unable to attend in person. Additionally, ECUREI has begun training biomedical technologists to maintain imaging equipment in rural areas (Kawooya, 2012). Similarly, in Sabah, future initiatives could focus on providing training and education for rural healthcare providers to strengthen diagnostic capacity. Teleradiology can serve as an effective educational platform by connecting rural practitioners with radiology specialists, offering real-time consultations and continuous learning opportunities. These remote interactions enable local providers to enhance their diagnostic skills, gain insights into complex case management, and stay updated on advancements in radiology and medical imaging technologies. Furthermore, teleradiology networks can facilitate continuing professional development (CPD) and disseminate up-to-date training materials, ensuring that rural healthcare staff remain competent and confident in delivering imaging-based care.

Another future direction for rural areas in Sabah is the integration of Artificial Intelligence (AI) in healthcare services. AI has the potential to transform access to primary healthcare, significantly enhancing the efficiency and quality of services in rural and underserved regions. By training healthcare workers to utilize AI-based systems, the shortage of qualified professionals can be alleviated while improving diagnostic accuracy and decision-making. AI tools have been increasingly applied in the early detection, diagnosis, and management of diseases, with neural network models such as convolutional and abductive networks demonstrating high accuracy across various applications. However, studies emphasize the need for robust, real-world research to fully validate the clinical value and public health benefits of AI integration (Lamem, Sahid, Ahmed, & Health, 2025). In China, healthcare services in rural areas have increasingly benefited from the adoption of medical AI technologies. According to a report by the South China Morning Post, a portable all-in-one diagnostic station weighing only 11 pounds has been introduced in village healthcare settings. This device is capable of performing 11 types of tests, including blood pressure measurement, electrocardiography, and routine urine and blood analyses. Developed by an internet-based healthcare company under the national rural healthcare program, the system automatically uploads results and patient records to an online platform for data analysis, generating preliminary diagnoses for review by village health workers. In addition, several major technology companies in China are investing in AI-driven smart clinics, featuring AI-powered chatbots that can interact with patients, provide medical advice, and deliver online training programs for rural healthcare personnel (Guo & Li, 2018).

If implemented in rural Sabah, Artificial Intelligence (AI) could also enhance diagnostic accuracy and efficiency in medical imaging. Modern AI systems are capable of rapidly reading and interpreting images to detect and predict conditions such as pulmonary lesions and prostate cancer. For instance, while radiologists achieve an average accuracy of 66% in predicting brain tumour neuropathology, AI algorithms have reached 85% accuracy. In aortic analysis, AI can complete evaluations within two minutes, compared with 30 minutes using conventional methods, thereby reducing reporting time by approximately 63%. Such advancements greatly shorten the time needed to perform tests, generate results, and provide clinically useful interpretations. Moreover, AI helps to minimise human cognitive bias, further improving diagnostic consistency and

Table 2: Future directions to improve access in Rural Sabah

Strategy	Description	Global or Regional Example	Potential Benefits for Rural Sabah	References
Expansion of Radiology Training Programs	Increase the number of trained radiologists through the National Postgraduate Medical Curriculum and MOH parallel pathway programs (RCR UK, RANZCR).	Malaysia -seven teaching hospitals offering joint board exams;~70–80 radiologists produced annually.	Builds sustainable local expertise, reduces dependence on urban centers, and strengthens diagnostic capacity statewide.	Ramli & Mohd Zain., 2023
Targeted Rural Training Initiatives	Offer specialized diploma and e-learning courses in ultrasound and X-ray interpretation for rural health workers.	Uganda and ECUREI collaboration trained 350 rural health workers in imaging, with 76% retention in rural posts.	Improves human resource distribution, enhances skills of rural staff, and maintains service continuity.	Kawooya., 2012
Integration of Artificial Intelligence (AI)	Apply AI tools for automated image interpretation, disease detection, and diagnostic support.	China ,portable AI diagnostic stations and AI-powered smart clinics in rural areas.	Increases diagnostic speed and accuracy, reduces workload, and minimizes human error and cognitive bias.	Lamem et al., 2025 Guo & Li., 2018 Achour, N., et al 2025
AI-Based Workforce Empowerment	Train rural healthcare providers to utilize AI systems for basic diagnostic tasks and tele-consultations.	Global Examples .AI use in early cancer and cardiovascular disease detection.	Addresses workforce shortages, improves service efficiency, and promotes technology adoption in rural healthcare.	Lamem et al., 2025 Guo & Li., 2018 Achour, N., et al 2025

reliability among radiologists (Achour et al., 2025). Table 2 shows the summary for future directions access in Rural Sabah.

CONCLUSION

In conclusion, improving access to medical imaging in rural Sabah requires addressing persistent challenges such as limited infrastructure, workforce shortages, and geographical barriers. While mobile imaging units, task-shifting, and public–private partnerships offer promising solutions, sustainable progress depends on strengthening local training programs and integrating digital innovations such as teleradiology and artificial intelligence (AI). These technologies can enhance diagnostic accuracy, reduce reporting time, and provide continuous education for rural healthcare providers. By adopting a coordinated, multi-sectoral approach that combines human capacity development and technological advancement, Sabah can move toward achieving equitable and efficient healthcare services for its rural and underserved communities.

CONFLICT OF INTEREST

The author declares no conflict of interest related to this manuscript.

ACKNOWLEDGEMENT

The author expresses sincere gratitude to the Faculty of Medicine and Health Sciences, Universiti Malaysia Sabah (UMS) for the continuous academic support and encouragement throughout the preparation of this manuscript. Appreciation is also extended to colleagues from the Department of Biomedical Science for their constructive feedback and discussions that contributed to the improvement of this work.

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