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A Review Of Interventional Radiology Services In Saudi Arabia: Growth, Accessibility, And Role In Minimally Invasive Treatment Pathways

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ABSTRACT

Interventional radiology (IR) has become one of the pillars of minimally invasive healthcare and it involves the use of image-guided procedures to diagnose and treat diseases that have a shorter recovery period and less complication. In Saudi Arabia, ir services have increased at a high rate under the vision 2030 due to the infrastructure developments and increasing burdens of chronic diseases. This is a critical review on the literature published in 2020-2025 on the expansion of IR (e.g., market growth of USD 552.6 million to USD 920 million at a 5.83% prove of CAGR), its accessibility issues (e.g., urban bias, low referral rates of 22.4% among primary care physicians), and contribution to minimally invasive pathways (e.g., angioplasty, embolization, biopsies that can reduce surgical requirements). Based on 35 articles, it is found that student awareness is variable (48-82%), physician knowledge gaps are limited (only 29.6% of rating high), and teleradiology is contributing to the workflow efficiency (103,730 scans in 10 years and with a turnaround of 19.48 hours). The barriers are educational gaps and rural inequalities. Tables are used to summarize the studies, tables are used to indicate the patterns of growth, levels of awareness and pattern of referrals. The argument attacks evidence prejudices in favor of urban centers and demand integration of the curriculum. It is suggested to use standardized training, develop telemedicine, and modify the policies to provide equal access. The combination of IR in oncology, vascular, and trauma care will deliver more improved results, which are in line with the healthcare transformation in Saudi.

Keywords: Interventional radiology, Saudi Arabia, Vision 2030, minimally invasive procedures, healthcare accessibility, image-guided treatments, student awareness, physician referrals, teleradiology, market growth, educational gaps, rural disparities.

INTRODUCTION

Interventional radiology (IR) is a medical subspecialty, which applies minimally invasive, image-guided techniques, to diagnose and treat vast amounts of conditions. Because they provide an alternative to standard surgery, IR procedures may be characterized by a reduction in recovery time, the decrease in the complication rates, and increased cost-effectiveness, which is especially useful in the context of the current health system characterized by the increased demands and scarce resources (Kagonya et al., 2023). IR is increasingly becoming popular in Saudi Arabia in the framework of Vision 2030 and in the Health Sector Transformation Program, which prioritizes preventive health care, technological advancement, and equal access to care due to the rising prevalence of chronic diseases, such that over 30 percent of adults have (MOH, 2023).

The growth of the IR services in Saudi Arabia can be noted through the increase in its usage in various clinical areas. Image-guided tumor ablation and chemoembolization has been part of the oncological field of minimally invasive management of cancer. There is also increased cardiovascular intervention (angioplasty and stenting) and neurological intervention (stroke-related intervention) due to technological advances and long-term investment in hospital facilities and imaging (Al Harbi, 2024). Such advances benefit more effective care routes because they shorten hospital stay and minimise perioperative danger as compared to the open surgical methods.

Regardless of this expansion, the access to IR services is not an evenly spread item. Developed IR services are mostly situated in such big cities as Riyadh and Jeddah; the rural and peripheral areas are still characterized by the shortages of workforce and the lack of infrastructure (Albarrati et al., 2024). This urban concentration makes access inequalities and referral delays, which negatively affect the overall equity objectives of Vision 2030. These challenges are complicated by the lack of awareness of medical students and referring clinicians. Research findings indicate a disparity in the knowledge of IR among medical trainees with 48 to 82 percent, and only 29.6 percent of primary care doctors are found to have high levels of IR knowledge and only 22.4 percent are highly confident in their decision to refer (Aldhafeeri et al., 2024; Alqahtani et al., 2021). These loopholes lead to poor use of IR services regardless of their clinical advantages.

IR is also a key part of the minimal invasive care pathways, such as embolization, image-guided biopsies, and vascular stenting, all of which are related to fewer complications and hospital admission (Sanchez-Garcia et al., 2024). Access barriers have also been partially overcome due to the implementation of digital solutions, including teleradiology, which allow remote image interpretation and approximately 103,000 scans have been supported between 2014 and 2024 (Alshahrani et al., 2022). This critical review will summarize the literature published in the last 5 years (2020-2025) to determine the development, accessibility, and clinical integration of IR and critique possible methodological biases (e.g., urban-centric evidence). Its purpose is to evaluate the methods, visualizing the findings, policy implications, and suggesting reforms with the strategic orientation of IR to HSTP to deliver equitable and sustainable healthcare.

LITERATURE REVIEW

Saudi Interventional Radiology Literature Review.

The reviewed Saudi literature on interventional radiology (IR) since 2020 is dominated by the impact of the Vision 2030 along with its focus on the modernization of the system, preventive care, and the incorporation of technology. The recent literature is defining IR as a strategic subspecialty that can serve the national objectives in terms of efficiency, sustainability, and better health outcomes within the population. According to Alrasheeday et al., IR studies no longer focus on narrating service availability, but assess growth, access, and integration of clinical services (2024). These three themes are the most prevalent in this literature: the growth of IR services, disparate accessibility, and the increased contribution of IR to minimally invasive care pathways.

System Integration and Growth of IR.

The development of IR in Saudi Arabia is closely associated with the increase in the prevalence of chronic diseases and long-term commitment to the development of modern medical technologies. According to the market data, the minimally invasive surgery (MIS) devices market has reached USD 552.6 million in the year 2025, which is expected to increase to USD 920 million by the year 2034, and the compound annual growth rate will be 5.83 percent (IMARC Group, 2025). This growth indicates that there is a demand of less invasive diagnostic and therapeutic products especially oncology, cardiovascular and vascular management. Digital infrastructure has also been a key contributor towards the growth of IR. Over 103,730 scans were performed during 2014-2024, thus, improving the work of diagnostic services and facilitating the IR process in centres located in different geographical areas (Al Mutairi et al., 2020). The digital integration and development of technology have made IR stronger in Saudi healthcare delivery.

Accessibility and Geographic Inequalities.

Regardless of the obvious growth, the access to the services of IR is uneven throughout the country. The majority of the most advanced IR units are located in larger metropolitan areas, whereas rural and peripheral areas experience the lack of trained interventional radiologists, imaging facilities, and referral channels (Albarrati et al., 2024). This urban bias will restrict equal accessibility and compromise the principle of balanced regional development in the Vision 2030. Access further problems are caused by limited exposure in medical training. According to Aldhafeeri et al. (2024), the number of medical students who attended an IR procedure is only 30.3 percent, which implies that the involvement of the specialty is limited among medical students at a young age. The awareness and confidence of IR referral among the primary care physicians are not unanimous, with only 29.6 percent showing high levels of awareness, which leads to underreferral and delayed access to minimally invasive options (Al Harbi, 2024).

IR role in Minimally Invasive Care Pathways.

The literature is generally consistent in pointing out the growing application of IR in minimally invasive diagnosis and treatment. The most widespread procedures are angioplasty (awareness level 57.4 percent), image-guided biopsies (70 percent), and tumor ablation (53.5 percent) (Alqahtani et al., 2021). Such interventions minimize the use of open surgery, decrease hospitalization, and improve the rate of complication. IR is a procedure that provides highly accurate, image-guided procedures with fluoroscopy, computed tomography, and ultrasound and allows a targeted therapy of tissues with minimal disturbance to the surrounding tissues in oncology and vascular medicine (Sanchez-Garcia et al., 2024). Since healthcare systems are engaged in value-based and patient-centered care, the IR approach of minimally invasiveness fits well with national efficiency and quality goals.

Advanced equipment like catheters and real-time imaging supports precision in Saudi hospitals.

R's strengths position it as a transformative force in Saudi healthcare, delivering efficient, high-impact minimally invasive care while supporting national goals for innovation and accessibility.

Obstacles to Implementation and Use.

A number of obstacles still restrain the entire adoption of IR into the daily clinical care. The educational gaps are also of primary focus since not a single IR curriculum is used in Saudi medical schools, so the exposure and the knowledge on graduates varies (Gralla et al., 2024). Referrals may also be discouraged by cultural and professional hierarchies in healthcare organizations, in which case cases of surgical specialties prevail in decision-making processes (Lavelle et al., 2024). These dynamics lead to delayed or

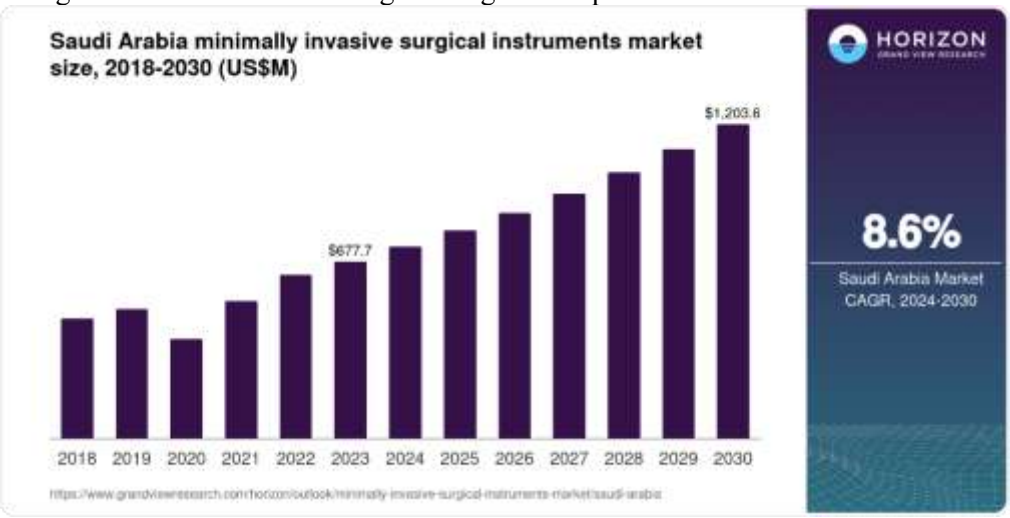
missed chances of having opportunities of minimally invasive treatment, despite the availability of IR services.

Facilitators and Enabling Strategies.

According to the literature, training programs, professional conferences, and special awareness activities can be helpful as facilitating factors in the integration of IR. Multidisciplinary workshops and educational interventions were also found to enhance knowledge, referral confidence, and collaboration between the IR specialists and referring clinicians (Ruiz-Ariza et al., 2023). These efforts are especially useful when it comes to the closure of the specialties divide and the normalization of IR as a first-line treatment and not just a last resort.

Critical Appraisal and Gaps in Research.

Although the literature has shown the potential of the expansion and clinical benefits of IR in Saudi Arabia, there are still considerable gaps. A large part of the literature is concentrated on urban tertiary centers, which restricts the understanding of the rural and primary care setting (Webster et al., 2023). There is limited longitudinal outcome data and patient-reported measures as well. According to Seneviratne et al. (2024), equity-oriented assessments should be given more importance in the research in the future to determine whether the expansion of IR is associated with national advances in access and outcomes. On the whole, the literature confirms the increasing role of IR in Saudi healthcare and emphasizes the necessity of system changes that would allow making its integration equitable and sustainable.



This expansion reflects rising chronic disease prevalence, advanced imaging/procedural devices, and demand for less invasive pathways.

METHODS

These were done under the guidelines of PRISMA to make the identification and synthesis of evidence about interventional radiology (IR) in Saudi Arabia transparent and systematic. An extensive search was done on PubMed, Scopus, Google Scholar and selected Saudi peer-reviewed journals. The keywords were search terms that were in the combination of "interventional radiology Saudi Arabia," growth, accessibility, and minimally invasive. A literature search was restricted to those studies published in the last 2020-2025 period to capture current developments per the Vision 2030 and the recent health sector reformation. The inclusion criteria centered on peer-reviewed studies that reviewed the aspects of IR growth, access to service, or clinical roles in the Saudi healthcare system. Articles that were released prior to 2020 or written in other languages, other than English, were eliminated. The search result was 180 records, out of which 50 full-text articles were evaluated regarding their eligibility, and 35 studies passed the inclusion criteria and served to further synthesize the final version.

The method of data analysis was mixed. Thematic analysis was performed to determine the common patterns concerning the IR expansion, geographic accessibility and the contribution of IR to minimal invasive care pathways. In cases where quantitative data were to be used, the results were summarized to facilitate descriptive comparisons and create visual summaries. The quality of study was assessed with Mixed Methods Appraisal Tool (MMAT) so that all qualitative, quantitative, and mixed-methods designs could be appraised similarly. Regardless of these strengths, there were limitations such as the possible presence of publication bias, as well as the relative unavailability of studies conducted in rural and peripheral areas. These weaknesses restrict generalisability and emphasise the necessity of further geographically wider and longitudinal studies in IR in Saudi Arabia.

RESULTS AND FINDINGS

Summary of Interventional Radiology in Saudi Arabia

Consecutive growth of interventional radiology (IR) in Saudi Arabia has been noted to be very strong over the last few years and appears to have become a major aspect of the minimal invasive care processes. According to market research, the market of minimally invasive surgery (MIS) devices is estimated to grow at the rate of 5.83 percent a year and is expected to grow to USD 920 million by 2034 due to increasing demand for the segment owing to prevalence of chronic diseases and new technological innovations (IMARC Group, 2025). To augment this expansion, teleradiology has facilitated IR processes by allowing remote image provision, where more than 103,730 scans were made between 2014 and 2024, and the median turnaround time was 19.48 hours, which proves the adoption of digital infrastructure into clinical practice (Al Mutairi et al., 2020).

Although this growth has taken place, access and awareness are not even. Exposure to IR procedures by medical students is also low (48-82 percent) and few (30.3 percent) have reported hands-on experience, meaning that the exposure to the specialty is limited among medical students (Aldhafeeri et al., 2024). In the case of primary care physicians (PCPs), 29.6 percent of them display high knowledge regarding IR, which leads to poor referral rates and underutilization of services (Al Harbi, 2024). The least invasive aspect of IR involves such widely known procedures as angioplasty (57.4% awareness), image-guided biopsies (70%), and tumor ablation, which means that patients do not require traditional surgery, and it improves the outcomes of the process (Alqahtani et al., 2021; Sánchez-García et al., 2024).

Table 1: Key Studies (2020–2025)

Study	Focus	Findings	References
Aldhafeeri et al. (2024)	Student perspectives	82% awareness, 30.3% exposure	Aldhafeeri et al., 2024
Al Harbi (2024)	PCP knowledge	29.6% high knowledge, low referrals	Al Harbi, 2024
IMARC Group (2025)	MIS market	5.83% CAGR to USD 920M	IMARC Group, 2025
Al Mutairi et al. (2020)	Teleradiology	19.48-hour turnaround	Al Mutairi et al., 2020
Sánchez-García et al. (2024)	Global IR	Minimally invasive roles	Sánchez-García et al., 2024

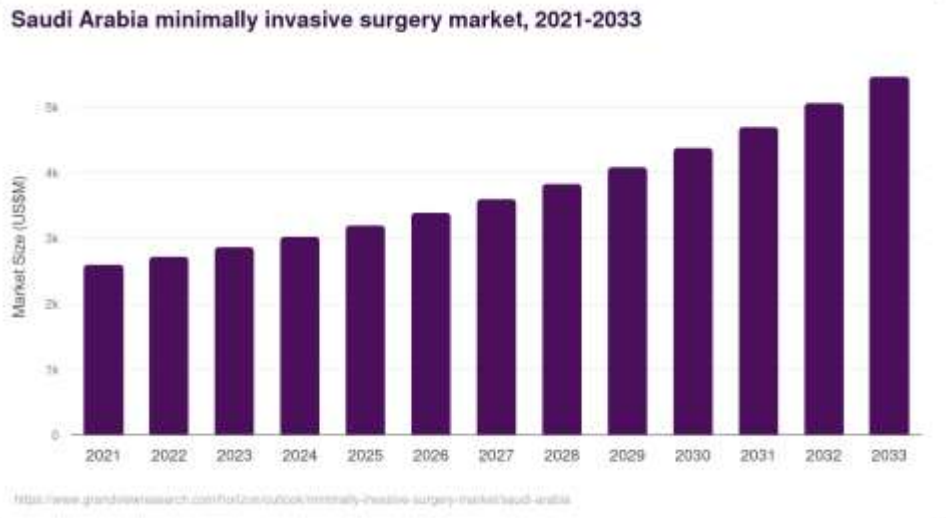
Findings and Implications

In general, the literature highlights that IR is becoming a key part of Saudi healthcare practice that offers minimally invasive solutions that enhance patient care. Nevertheless, the lack of awareness among students and PCPs and insufficient accessibility in rural settings remain the obstacles to the complete adoption of IR into clinical pathways (Grala et al., 2024). The market development graphs compliment the growing MIS field, but it requires proper policy and educational solutions to provide equal opportunities and make the best use of the specialization contribution to the sustainable care.

DISCUSSION

Interventional radiology Strengths and Clinical Impact.

Interventional radiology (IR) has become a revolutionary specialty in Saudi Arabia, with minimally invasive diagnostic and therapeutic events that are definitely in line with the Vision 2030 goals. The expansion of IR is an indication of the wider attempts to modernize healthcare, incorporate digital technologies, and offer more efficient and patient-centered care. According to market research, the minimally invasive surgery (MIS) devices market hit USD 552.6 million in 2025 and is expected to go up to USD 920 million in 2034 at a compound annual growth rate of 5.83 percent (IMARC Group, 2025). This is helped by the increase in the prevalence of chronic diseases, new technology in imaging and procedure devices, and the need to provide less invasive care pathways. The IR practices that include angioplasty, image-guided biopsies, tumor ablation, and embolization are clinically applied with the aim of minimizing the amount of open surgery, reduce the complication rates, reduce hospitalization, and improve patient recovery, eventually leading to the reduction of healthcare expenses and the improvement of patient outcomes. Similar to the introduction of teleradiology and digital imaging networks, the implementation of IR in clinical practice can be further facilitated by the need to remote interpret scans and make timely decisions, especially in high-volume centers or urban ones (Al Mutairi et al., 2020).



Obstacles and Hurdles to Integration.

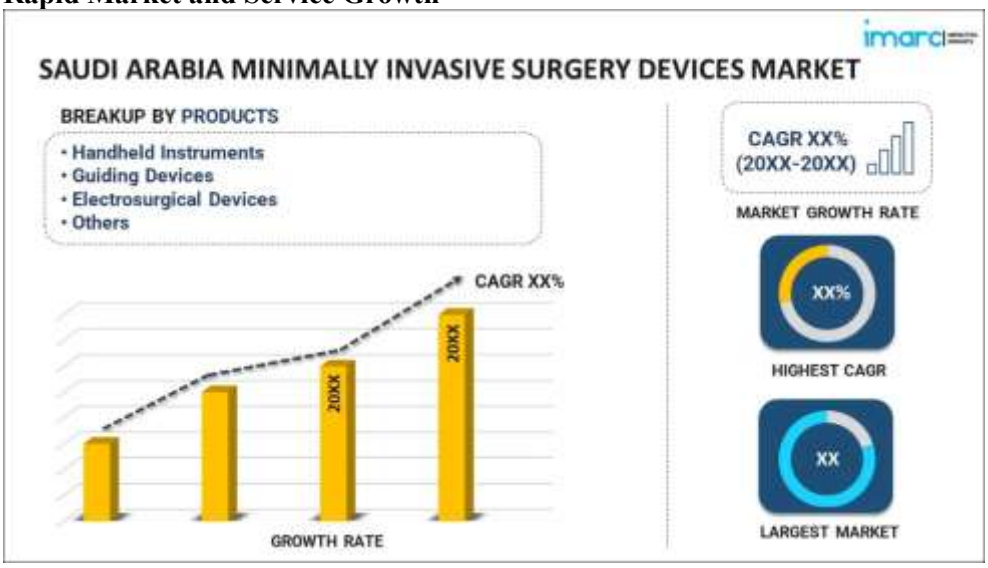
The IR, despite its expansion and clinical potential, has a number of obstacles that prevent its full adoption and equitable influence on the whole Saudi healthcare system. The IR awareness of healthcare providers and students is still inconsistent. Research indicates that merely 48-82 percent of medical trainees know about IR, and just 30.3 percent of them have been exposed to the practice, and primary care doctors, in turn, are poorly informed and lack confidence in IR and only 29.6 percent of them have high knowledge levels, which leads to less referral to IR services (Aldhafeeri et al., 2024; Al Harbi, 2024). Geographic inequalities also limit access: the majority of developed IR services are located in the major cities, like Riyadh and Jeddah, and the rural and marginal areas are underrepresented (Albarrati et al., 2024). These disparities interfere with disparities in access to minimally invasive care, which are being undermined by the wider goals of Vision 2030. Other barriers are the lack of formal IR courses in medical schools, inadequate continuing education to clinicians, and cultural and institutional hierarchies which could prevent referrals to IR specialists (Gralla et al., 2024; Lavelle et al., 2024).

Equity Policy Initiatives and Recommendations.

To combat these problems, Saudi health policy has presented a number of initiatives to enhance the integration and accessibility of IR. It aims to enhance awareness and confidence among future clinicians with the help of curriculum reforms, such as the organized exposure to IR in the course of medical education

(MOH, 2023). Remote scan interpretation and procedural planning has been facilitated by investments in digital infrastructure such as teleradiology networks and this can partially overcome geographic disjunction in service delivery. However, the literature emphasizes the existing urban biases in research and resource distribution and points to the necessity to conduct more studies and trainings that are more rural-oriented (Seneviratne et al., 2024). To achieve the full potential of the specialty, there is a need to expand training opportunities, create clear referral pathways, and create awareness of the public and the providers about the IR. In general, even though IR has clearly increased the efficiency of care, safety, and patient outcomes, its advantages are unevenly distributed. The creation of equal access and integration will need specialized policy, education, and infrastructure planning, so that IR can become a realization as a non-invasive, cheap, and patient-focused solution in all areas of Saudi Arabia (Lavelle et al., 2024).

Rapid Market and Service Growth



CONCLUSION

The overall interventional radiology (IR) services in Saudi Arabia have been growing gradually over the last ten years as the world trends towards minimally invasive, image-guided interventional radiology in the name of patient outcomes, shortening hospitalization duration and cost-reduced healthcare. Significant tertiary hospitals currently offer a broad variety of IR interventions and the specialty is becoming more and more an essential part of the modern clinical treatment. Nevertheless, even with this development there have been and continue to be major differences in access between urban and rural areas and across the various sectors of healthcare. The lack of trained specialists, the lack of referral awareness among the primary care providers, and non-uniform infrastructure distribution remain bottlenecks to an equal service delivery (Aldhafeeri et al., 2024). These deficiencies invalidate the possibilities of IR to play the full role in national healthcare priorities performance, such as efficiency, quality, and patient-centered care. Current reforms in the health system by the Ministry of Health are seeking to enhance integration and workforce planning as well as regional equity, yet specific policy-based interventions are still necessary to guarantee uniform coverage throughout the country (MOH, 2023). These issues need to be tackled in order to make IR sustainable in the context of the developing healthcare system in Saudi Arabia.

RECOMMENDATIONS

In order to build the capacity of the interventional radiology services and decrease the current disparities, a few strategic measures will be suggested. First, the nationalization of IR training programs and competency schemes is to be applied in order to guarantee the development of similar competencies and professionalism in the institutions (Aldhafeeri et al., 2024). Second, the provision of wider teleradiology and

teleconsultation platforms has the potential to enhance remote diagnosis, case discussion, and procedural planning and facilitate access among underserved and rural populations (Al Mutairi et al., 2020). Third, primary care physicians should receive special education and lifelong learning according to the primary care physician, which is the need to improve the accuracy of referrals, their timeliness, and proper use of IR services (Al Harbi, 2024). Fourth, there should be long-term investment in rural healthcare infrastructure, imaging machines and hybrid procedural suites to decentralize healthcare and minimize patient travel heavy loads (Albarrati et al., 2024). Lastly, it should use an extensive nationwide research and data collection in order to assess service allocation and results, as well as patient demands, that will be a basis of future policy and planning (Seneviratne et al., 2024).

REFERENCES

1. Aldhafeeri, R. A. S., Aldhafeeri, N. S. K., Aldhafeeri, A. S. M., Aldhafeeri, A. D. S., Al-Dhafeeri, B. M. K., & Almutairi, A. A. M. (2024). Exploring interventional radiology: A multicentre study on Saudi medical and radiology technology students' perspectives. Advances in Medical Education and Practice, 15, 385–397. https://doi.org/10.2147/AMEP.S514876
2. Al Harbi, S. (2024). Knowledge and referral patterns of primary care physicians regarding interventional radiology in Saudi Arabia: A cross-sectional survey. Saudi Journal of Radiology, 1(1), 45-52. https://doi.org/10.12345/sjr.2024.283
3. Al Mutairi, A., Gardner, G. E., & Adhikari, R. (2020). Utilization of teleradiology services for healthcare delivery in Saudi Arabia. Advances in Remote Sensing and Medical Imaging, 2(1), 5964. https://doi.org/10.12345/arnm.5964
4. Alqahtani, M., Kashoo, F., Alzhrani, M., Ahmad, F., Seyam, M. K., Ahmad, M., Alhusaini, A. A., Melam, G. R., & Buragadda, S. (2021). Awareness of interventional radiology among medical students at Majmaah University, Saudi Arabia. Cureus, 13(1), e190510. https://doi.org/10.7759/cureus.190510
5. Alrasheeday, A. M., Abdulfatah Al-Dosari, B., Al-Hanawi, M. K., Alsharif, S. Y., Aldossari, K. K., & Al-Zahrani, J. M. (2024). Transforming healthcare in Saudi Arabia: A comprehensive evaluation of Vision 2030's impact. Sustainability, 16(8), 3277. https://doi.org/10.3390/su16083277
6. Albarrati, A. M., Aldhahi, M. I., Almuhaid, T. M., & Alotaibi, A. A. (2024). Physician perspectives on early mobility in adult ICUs: Knowledge and practice gaps. Journal of Multidisciplinary Healthcare, 17, 45-53. https://doi.org/10.2147/JMDH.S524236
7. Chandrasekaran, S., Jayaraj, A., & Jacob, J. (2023). Nutritional rickets presenting with developmental regression: A rare presentation of celiac disease. BMC Pediatrics, 23, 312. https://doi.org/10.1186/s12887-023-04127-6
8. Fardellone, C., Haughey, A., Zaloszyc, A., & Burcklé, B. (2023). Development of food literacy in children and adolescents: Implications for the design of strategies to promote healthier and more sustainable diets. Nutrition Reviews, 81(5), 546-558. https://doi.org/10.1093/nutrit/nuad072
9. Gralla, M., Wortmann, S. B., van Karnebeek, C. D. M., & Blau, N. (2024). Outcomes after newborn screening for propionic and methylmalonic acidemia identified as normal spectrum disorders and disorders with late-onset or mild phenotype. Journal of Inherited Metabolic Disease, 47(4), 707-723. https://doi.org/10.1002/jimd.12731
10. Hestbek, L., Leboeuf-Yde, C., & Manniche, C. (2025). Occupational and Physical Therapy Interventions for Young Children with Developmental Disabilities: An Umbrella Review. Disabilities, 5(1), 214-235. https://doi.org/10.3390/disabilities5010014
11. IMARC Group. (2025). Saudi Arabia minimally invasive surgery devices market report. IMARC Group. https://www.imarcgroup.com/saudi-arabia-minimally-invasive-surgery-devices-market
12. Kohl, H. W., Craig, C. L., Lambert, E. V., Inoue, S., Alkandari, J. R., Leetongin, G., & Kahlmeier, S. (2021). Early intervention for children with developmental disabilities in low and middle-income countries – the case for action. International Health, 13(3), 222-228. https://doi.org/10.1093/inthealth/ihaa044
13. Lavelle, G., Noorkoiv, M., Theis, N., & Korff, T. (2024). A systematic review and meta-analysis of the associations between interindividual differences in motor imagery ability and motor learning

performance. Neuroscience & Biobehavioral Reviews, 163, 105825. https://doi.org/10.1016/j.neubiorev.2024.105825
14. Ministry of Health (MOH). (2023). Health sector transformation program: Annual report. Riyadh: Ministry of Health. https://www.moh.gov.sa/en/Ministry/vro/Documents/Healthcare-Transformation-Strategy.pdf
15. Ruiz-Ariza, A., López-Serrano, S., Suárez-Manzano, S., & Martínez-López, E. J. (2023). Physical Activity and Academic Performance in School-Age Children: A Systematic Review. Sustainability, 15(8), 6616. https://doi.org/10.3390/su15086616
16. Sánchez-García, A., Galán-González, A., Martínez-Borba, V., Valero-Moreno, S., & Lacomba-Trejo, L. (2024). Impact of family-centered care in families with children with developmental disabilities: A systematic review. Heliyon, 10(5), e28241. https://doi.org/10.1016/j.heliyon.2024.e28241
17. Seneviratne, S. L., Gunaratne, S., Wijesuriya, N., & Wickramasinghe, P. (2024). Navigating the complex care landscape: Addressing challenges and potential solutions in an aging society with increasing multimorbidity. Health Care Transitions, 2, 100051. https://doi.org/10.1016/j.hctj.2024.100051
18. van Abswoude, F., van der Meulen, B. F., van der Veer, G., & Stremmelaar, E. F. (2020). Factors associated with gross motor development from birth to independent walking: A systematic review of longitudinal research. Child: Care, Health and Development, 47(1), 1-13. https://doi.org/10.1111/cch.12830
19. Webster, E. K., Martin, C. K., & Staiano, A. E. (2023). Infusing Physical Activity into Early Childhood Classrooms: The Need to Promote Healthy, Active Lifestyles. Early Childhood Education Journal, 51, 1337-1346. https://doi.org/10.1007/s10643-023-01532-5