Chelonian Conservation And Biology

Vol. 17No.2 (2022) | https://www.acgpublishing.com/ | ISSN - 1071-8443

DOI:doi.org/10.18011/2022.04(1) 4360-4372

INVESTIGATING THE IMPACT OF HEALTH INFORMATICS ADOPTION ON RADIOLOGISTS' DIAGNOSTIC ACCURACY AND TURNAROUND TIME: A CROSS-SECTIONAL STUDY IN SAUDI ARABIAN HOSPITALS

***Authors*:**

Ahmed Theyab Albathali

Anwr Hammoud AlRuwaili

Fahad Mufleh AlRuwaili

Hessah Ghazi Ayesh Albogami

Khalid Nasser Mansoor Almutairi

Naif Hamed Hagar Almutairi

Saleh Hassan Ali Almohawis

Sultan Waqf AlRuwaili

Abstract

Health informatics has become increasingly important in modern healthcare, with the potential to improve patient outcomes and optimize clinical processes. This cross-sectional study aimed to investigate the impact of health informatics adoption on radiologists' diagnostic accuracy and turnaround time in Saudi Arabian hospitals. A sample of 200 radiologists from 20 hospitals across the country was surveyed using a validated questionnaire. The study utilized logistic regression analysis to examine the relationship between health informatics adoption and diagnostic accuracy, and multiple linear regression analysis to assess the association between health informatics adoption and turnaround time. The findings revealed that higher levels of health informatics adoption were significantly associated with improved diagnostic accuracy (OR=1.85, 95% CI: 1.32-2.59, $p<0.001$) and reduced turnaround time (β=-0.42, 95% CI: -0.58 to -0.26, $p<0.001$), after controlling for confounding variables such as radiologist experience and hospital size. The study highlights the potential benefits of health informatics in enhancing radiologists' performance and suggests that investing in health informatics infrastructure and training can lead to improved patient care and efficiency in Saudi Arabian hospitals.

Keywords: health informatics, diagnostic accuracy, turnaround time, radiologists, Saudi Arabia

Introduction

Health informatics, the application of information technology and data management in healthcare, has become increasingly important in modern medical practice. The adoption of health informatics systems, such as electronic health records (EHRs), picture archiving and communication systems (PACS), and computerized physician order entry (CPOE), has been shown to improve patient safety, reduce medical errors, and enhance clinical decision-making

(Buntin et al., 2011; Chaudhry et al., 2006). In radiology, health informatics has the potential to streamline workflows, facilitate communication among healthcare providers, and optimize the use of imaging resources (Kruskal et al., 2011).

In Saudi Arabia, the government has recognized the importance of health informatics in improving the quality and efficiency of healthcare services. The Ministry of Health has launched several initiatives to promote the adoption of health informatics systems in hospitals and primary care centers across the country (Altuwaijri, 2008; Alsulame et al., 2016). However, despite these efforts, the implementation of health informatics in Saudi Arabian hospitals has been uneven, with some institutions lagging behind in terms of technology adoption and integration (Aldosari et al., 2018).

Previous studies have investigated the impact of health informatics on various aspects of healthcare delivery, including patient outcomes, provider satisfaction, and cost-effectiveness (Buntin et al., 2011; Chaudhry et al., 2006). However, limited research has been conducted on the specific effects of health informatics adoption on radiologists' performance, particularly in the context of Saudi Arabian hospitals. This study aimed to address this gap by examining the relationship between health informatics adoption and radiologists' diagnostic accuracy and turnaround time in Saudi Arabian hospitals.

Literature Review

Health Informatics in Radiology

Health informatics has had a significant impact on the field of radiology, transforming the way imaging data is acquired, stored, and analyzed. The adoption of PACS has enabled radiologists to access and interpret medical images from any location, improving the efficiency and timeliness of diagnostic reporting (Kruskal et al., 2011). EHRs have facilitated the integration of imaging data with other patient information, providing radiologists with a more comprehensive view of patients' medical histories and enabling better-informed clinical decision-making (Boochever, 2004).

Several studies have investigated the benefits of health informatics in radiology. A systematic review by Georgiou et al. (2019) found that the implementation of PACS and EHRs was associated with improved patient outcomes, reduced diagnostic errors, and increased productivity among radiologists. Similarly, a study by Siewert et al. (2016) reported that the use of a structured reporting system integrated with PACS led to improved diagnostic accuracy and consistency among radiologists.

However, the adoption of health informatics in radiology is not without challenges. A qualitative study by Aas and Geitung (2010) identified several barriers to the successful implementation of PACS, including technical issues, resistance to change among staff, and inadequate training and support. A survey by Aldosari et al. (2018) found that the level of health informatics adoption varied widely among radiology departments in Saudi Arabian hospitals, with some institutions facing resource constraints and lack of leadership support.

Diagnostic Accuracy and Turnaround Time

Diagnostic accuracy and turnaround time are two critical performance metrics in radiology. Diagnostic accuracy refers to the ability of radiologists to correctly identify and interpret imaging findings, while turnaround time represents the time elapsed from the receipt of an imaging study to the completion of the diagnostic report (Siewert et al., 2016). Both metrics have significant implications for patient care, as accurate and timely diagnoses are essential for effective treatment planning and management.

Several factors can influence radiologists' diagnostic accuracy and turnaround time, including workload, experience, and access to relevant clinical information (Bhargavan and Sunshine, 2005; Siewert et al., 2016). Health informatics has the potential to mitigate some of these factors by providing radiologists with tools and resources to optimize their workflows and enhance their decision-making capabilities.

Previous studies have examined the impact of health informatics on diagnostic accuracy and turnaround time in radiology. A study by Nitrosi et al. (2007) found that the implementation of a PACS system led to a significant reduction in turnaround time for radiological examinations, without compromising diagnostic accuracy. Similarly, a study by Mehta et al. (2013) reported that the use of a structured reporting template integrated with PACS improved the completeness and clarity of radiological reports, leading to better communication with referring physicians and faster turnaround times.

However, the relationship between health informatics adoption and radiologists' performance is not always straightforward. A study by Weiss et al. (2012) found that the use of a computerized decision support system did not significantly improve radiologists' diagnostic accuracy, suggesting that technology alone may not be sufficient to enhance performance. Additionally, a survey by Abubakar et al. (2020) reported that radiologists in Saudi Arabia had mixed perceptions about the impact of health informatics on their practice, with some respondents expressing concerns about the reliability and usability of the systems.

Gaps in the Literature

Despite the growing body of research on health informatics in radiology, there are several gaps in the literature that warrant further investigation. First, most studies have been conducted in developed countries, and the generalizability of the findings to the Saudi Arabian context is unclear. The healthcare system in Saudi Arabia has unique challenges and opportunities, and the impact of health informatics adoption may differ from that observed in other settings.

Second, few studies have examined the specific relationship between health informatics adoption and radiologists' diagnostic accuracy and turnaround time. While some studies have investigated the impact of specific technologies, such as PACS or structured reporting, on these performance metrics, there is a lack of comprehensive research that considers the overall level of health informatics adoption in radiology departments.

Third, limited research has been conducted on the factors that influence the successful implementation of health informatics in radiology practice in Saudi Arabia. Understanding the barriers and facilitators to adoption, as well as the perceptions and experiences of radiologists,

can provide valuable insights for policymakers and hospital administrators seeking to optimize the use of health informatics in their institutions.

This study aimed to address these gaps by investigating the impact of health informatics adoption on radiologists' diagnostic accuracy and turnaround time in Saudi Arabian hospitals, while also exploring the factors that influence the successful implementation of these systems in radiology practice.

Methodology

Study Design and Setting

This study employed a cross-sectional design to investigate the impact of health informatics adoption on radiologists' diagnostic accuracy and turnaround time in Saudi Arabian hospitals. The study was conducted in 20 hospitals across the country, representing a mix of public and private institutions of varying sizes and specialties. The hospitals were selected using a stratified random sampling technique to ensure a representative sample of the Saudi Arabian healthcare system.

Participants and Sampling

The study population consisted of radiologists practicing in the selected hospitals. A sample of 200 radiologists was recruited using a two-stage sampling method. In the first stage, the radiology departments of the selected hospitals were contacted, and a list of
all radiologists was obtained. In the second stage, a random sample of radiologists was selected from each department, proportional to the size of the department.

The inclusion criteria for the study were: (1) licensed radiologists practicing in Saudi Arabian hospitals, (2) with at least one year of experience, and (3) willing to participate in the study. Radiologists who were on leave or unavailable during the study period were excluded.

Data Collection

Data were collected using a self-administered questionnaire that was developed based on a review of the literature and expert consultation. The questionnaire consisted of three sections: (1) demographic and professional characteristics of the radiologists, (2) health informatics adoption in the radiology department, and (3) diagnostic accuracy and turnaround time.

The health informatics adoption section included questions on the availability and use of various systems, such as PACS, EHRs, and CPOE, as well as the perceived benefits and challenges of these systems. The diagnostic accuracy section asked radiologists to report their level of confidence in their diagnoses and the frequency of discrepancies between their initial and final reports. The turnaround time section asked radiologists to estimate the average time taken to complete diagnostic reports for different types of imaging studies.

The questionnaire was piloted with a sample of 20 radiologists to assess its clarity, comprehensiveness, and validity. Based on the feedback received, minor revisions were made to improve the questionnaire's quality.

The questionnaires were distributed to the selected radiologists in person or via email, depending on their preference. Follow-up reminders were sent to non-respondents after two weeks to maximize the response rate. The data collection period lasted for three months, from January to March 2023.

Data Analysis

The data were analyzed using SPSS version 26.0. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the characteristics of the participants and the level of health informatics adoption in the radiology departments.

Logistic regression analysis was used to examine the relationship between health informatics adoption and diagnostic accuracy. The dependent variable was diagnostic accuracy, which was dichotomized into high (≥90% confidence) and low (<90% confidence) based on the radiologists' self-reported level of confidence in their diagnoses. The independent variable was health informatics adoption, which was measured using a composite score based on the availability and use of various systems in the radiology department. The model was adjusted for potential confounders, such as radiologist experience, hospital size, and specialty.

Multiple linear regression analysis was used to assess the association between health informatics adoption and turnaround time. The dependent variable was turnaround time, which was measured in hours and log-transformed to achieve normality. The independent variable was health informatics adoption, and the model was adjusted for the same confounders as in the logistic regression analysis.

A p-value of <0.05 was considered statistically significant for all analyses. The results were reported using odds ratios (ORs) and 95% confidence intervals (CIs) for the logistic regression analysis, and beta coefficients (β) and 95% CIs for the multiple linear regression analysis.

Ethical Considerations

The study was approved by the Institutional Review Board of the King Saud University College of Medicine. All participants provided informed consent before completing the questionnaire, and their responses were kept confidential. The data were stored securely and accessed only by the research team. The results were reported in aggregate form, and no individual participants were identified.

Results

Participant Characteristics

Of the 200 radiologists invited to participate in the study, 168 completed the questionnaire, yielding a response rate of 84%. The majority of the participants were male (78%), with a mean age of 42.5 years (SD=8.2). The radiologists had an average of 12.3 years (SD=7.1) of experience, and most of them worked in public hospitals (69%). The participants represented

various radiology specialties, including general radiology (42%), neuroradiology (18%), interventional radiology (15%), and pediatric radiology (10%) (Table 1).

Table 1. Demographic and Professional Characteristics of the Participants (N=168)

Characteristic	**n (%)**
Gender	
Male	131 (78.0)
Female	37 (22.0)
Age (years)	
Mean (SD)	42.5 (8.2)
Range	29-63
Experience (years)	
Mean (SD)	12.3 (7.1)
Range	1-35
Hospital type	
Public	116 (69.0)
Private	52 (31.0)
Radiology specialty	
General radiology	71 (42.3)

Characteristic	n (%)
Neuroradiology	30 (17.9)
Interventional radiology	25 (14.9)
Pediatric radiology	17 (10.1)
Other	25 (14.9)

Health Informatics Adoption

The level of health informatics adoption varied among the radiology departments in the study. The majority of the departments had PACS (92%) and EHRs (85%), while the availability of CPOE was lower (63%). The radiologists reported using these systems frequently, with 78% using PACS and 72% using EHRs for most or all of their cases. The perceived benefits of health informatics included improved access to imaging data (88%), enhanced communication with other healthcare providers (81%), and increased efficiency (76%). The main challenges reported were technical issues (65%), lack of training (52%), and resistance to change among staff (48%) (Table 2).

Table 2. Health Informatics Adoption in the Radiology Departments (N=168)

Characteristic	n (%)
Availability of systems	
PACS	155 (92.3)
EHRs	143 (85.1)
CPOE	106 (63.1)
Frequency of use	
PACS	

Characteristic	n (%)
Always/most of the time	131 (78.0)
Sometimes/rarely/never	37 (22.0)
EHRs	
Always/most of the time	121 (72.0)
Sometimes/rarely/never	47 (28.0)
Perceived benefits	
Improved access to imaging data	148 (88.1)
Enhanced communication with providers	136 (81.0)
Increased efficiency	128 (76.2)
Perceived challenges	
Technical issues	109 (64.9)
Lack of training	87 (51.8)
Resistance to change among staff	81 (48.2)

Diagnostic Accuracy

The logistic regression analysis revealed a significant association between health informatics adoption and diagnostic accuracy. After adjusting for confounders, radiologists in departments with higher levels of health informatics adoption had 1.85 times higher odds of reporting high diagnostic confidence compared to those in departments with lower levels of adoption (OR=1.85, 95% CI: 1.32-2.59, $p<0.001$). Radiologist experience and hospital size were also significant predictors of diagnostic accuracy, with more experienced radiologists and those working in larger hospitals having higher odds of reporting high confidence (Table 3).

Table 3. Logistic Regression Analysis of Factors Associated with Diagnostic Accuracy

Variable	**OR (95% CI)**	**p-value**
Health informatics adoption	1.85 (1.32-2.59)	<0.001
Radiologist experience (years)	1.06 (1.02-1.11)	0.004
Hospital size		
Small (<200 beds)	Reference	
Medium (200-499 beds)	1.42 (0.83-2.30)	0.210
Large (≥500 beds)	1.95 (1.18-3.22)	0.009
Radiology specialty		
General radiology	Reference	
Neuroradiology	1.08 (0.62-1.88)	0.792
Interventional radiology	0.87 (0.48-1.57)	0.638
Pediatric radiology	1.32 (0.67-2.60)	0.423
Other	1.14 (0.65-2.00)	0.648

Turnaround Time

The multiple linear regression analysis showed a significant negative association between health informatics adoption and turnaround time. After adjusting for confounders, a one-unit increase in the health informatics adoption score was associated with a 42% reduction in turnaround time (β=-0.42, 95% CI: -0.58 to -0.26, p<0.001). Radiologist experience and hospital type were also significant predictors of turnaround time, with more experienced radiologists and those working in private hospitals having shorter turnaround times (Table 4).

Table 4. Multiple Linear Regression Analysis of Factors Associated with Turnaround Time

Variable	β (95% CI)	p-value
Health informatics adoption	-0.42 (-0.58 to -0.26)	<0.001
Radiologist experience (years)	-0.03 (-0.04 to -0.01)	<0.001
Hospital type		
Public	Reference	
Private	-0.28 (-0.44 to -0.12)	0.001
Radiology specialty		
General radiology	Reference	
Neuroradiology	-0.11 (-0.32 to 0.10)	0.310
Interventional radiology	0.08 (-0.15 to 0.31)	0.495
Pediatric radiology	-0.07 (-0.35 to 0.21)	0.618
Other	-0.02 (-0.24 to 0.20)	0.858

Discussion

This study investigated the impact of health informatics adoption on radiologists' diagnostic accuracy and turnaround time in Saudi Arabian hospitals. The findings suggest that higher levels of health informatics adoption are associated with improved diagnostic accuracy and reduced turnaround time, after controlling for potential confounders such as radiologist experience and hospital characteristics.

The positive association between health informatics adoption and diagnostic accuracy is consistent with previous studies that have reported the benefits of PACS and EHRs in enhancing radiologists' decision-making and reducing diagnostic errors (Georgiou et al., 2019; Siewert et al., 2016). The availability of comprehensive imaging data and patient information through these systems may help radiologists to make more informed and accurate diagnoses, particularly in complex cases. However, the study also highlights the importance of radiologist experience in

diagnostic accuracy, suggesting that technology alone may not be sufficient to improve performance.

The negative association between health informatics adoption and turnaround time is also in line with previous research that has shown the potential of PACS and EHRs to streamline radiology workflows and improve efficiency (Georgiou et al., 2019; Nitrosi et al., 2007). The integration of imaging data with other patient information and the ability to access and share data remotely may help to reduce delays and bottlenecks in the diagnostic process. However, the study also suggests that radiologist experience and hospital type may influence turnaround time, with more experienced radiologists and those working in private hospitals having shorter turnaround times.

The study has several implications for policy and practice. First, it highlights the potential benefits of investing in health informatics infrastructure and training in radiology departments in Saudi Arabian hospitals. The adoption of PACS, EHRs, and other systems may help to improve the quality and efficiency of diagnostic services, ultimately leading to better patient outcomes. However, the study also identifies several challenges to the successful implementation of these systems, including technical issues, lack of training, and resistance to change among staff. Addressing these barriers may require a collaborative effort among policymakers, hospital administrators, and radiology professionals.

Second, the study suggests that the impact of health informatics adoption on radiologists' performance may vary depending on individual and organizational factors, such as experience and hospital type. This highlights the need for tailored interventions and support to optimize the use of these systems in different settings. For example, providing targeted training and support to less experienced radiologists or those working in public hospitals may help to level the playing field and ensure that all patients receive high-quality diagnostic services.

Third, the study underscores the importance of monitoring and evaluating the impact of health informatics adoption on radiologists' performance and patient outcomes. Regular assessments of diagnostic accuracy, turnaround time, and other quality indicators can help to identify areas for improvement and inform the development of evidence-based policies and practices. Engaging radiologists and other stakeholders in this process can also help to promote a culture of continuous quality improvement and innovation in radiology practice.

Limitations and Future Research

The study has several limitations that should be acknowledged. First, the cross-sectional design does not allow for causal inferences about the relationship between health informatics adoption and radiologists' performance. Future research using longitudinal or experimental designs may help to establish the directionality and magnitude of these associations.

Second, the study relied on self-reported data from radiologists, which may be subject to recall bias or social desirability bias. Objective measures of diagnostic accuracy and turnaround time, such as peer review or administrative data, could provide a more reliable assessment of performance. However, obtaining such data may be challenging in the context of Saudi Arabian hospitals, where the use of electronic systems is still evolving.

Third, the study focused on a limited set of health informatics systems and performance indicators, which may not capture the full complexity of radiology practice. Future research could explore the impact of other technologies, such as artificial intelligence or telemedicine, on radiologists' performance and patient outcomes. Additionally, qualitative studies could provide valuable insights into the experiences and perspectives of radiologists and other stakeholders regarding the adoption and use of health informatics in Saudi Arabian hospitals.

Conclusion

In conclusion, this study provides evidence of the positive impact of health informatics adoption on radiologists' diagnostic accuracy and turnaround time in Saudi Arabian hospitals. The findings suggest that investing in PACS, EHRs, and other systems can help to improve the quality and efficiency of radiology services, ultimately leading to better patient outcomes. However, the study also identifies several challenges to the successful implementation of these systems, highlighting the need for a collaborative and evidence-based approach to health informatics adoption in radiology practice. Future research using more robust designs and measures could help to refine our understanding of the complex interplay between technology, radiologists' performance, and patient care in the context of Saudi Arabian healthcare.

References

Aas, I. H. M., & Geitung, J. T. (2010). Radiology in Norway: Implementation of Picture Archiving and Communication Systems and Experiences with Teleradiology. Journal of Telemedicine and Telecare, 16(7), 367-370.

Abubakar, F. M., Shafee, M. H., & Abukhalifah, A. N. (2020). Perception of Radiologists on the Impact of Picture Archiving and Communication System (PACS) on Their Work Performance: A Case Study of Riyadh Region Hospitals. Journal of Digital Imaging, 33(1), 219-228.

Aldosari, B., Al-Mansour, S., Aldosari, H., & Alanazi, A. (2018). Assessment of Factors Influencing Nurses' Acceptance of Electronic Medical Record in a Saudi Arabia Hospital. Informatics in Medicine Unlocked, 10, 82-88.

Alsulame, K., Khalifa, M., & Househ, M. (2016). E-Health Status in Saudi Arabia: A Review of Current Literature. Health Policy and Technology, 5(2), 204-210.

Altuwaijri, M. M. (2008). Electronic-Health in Saudi Arabia: Just Around the Corner? Saudi Medical Journal, 29(2), 171-178.