

Streamlining the Processes of Radiology Workflow: Nurses' Roles and Difficulties in Coordinating Diagnostic Imaging

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Abstract

Background: Nurses are a central part of radiology workflow improvement as they help in communication, patient preparation, and compliance with imaging protocols. Unfortunately, ineffective staffing, inadequate training, and slow adaptation to new technologies limit their effectiveness.

Objective: The purpose of this research was to assess the role and issues confronted by nurses in terms of optimizing the radiology department's work processes in a tertiary level health institution in Riyadh Saudi Arabia.

Methods: A qualitative phenomenological approach was used, involving semi-structured interviews, focus group discussions, and participant observations with 15 nurses in the radiology department. Thematic analysis was conducted to identify key themes and sub-themes.

Results: Findings revealed that nurses contribute significantly to workflow optimization through patient education, coordination, and process improvement strategies. However, challenges such as heavy workload, lack of specialized training, and communication barriers were identified. Technological advancements, including electronic health records and artificial intelligence, were perceived as both opportunities and challenges in optimizing workflow efficiency.

Conclusion: Although nurses are pivotal in radiology's workflow efficiency, challenges with staffing, training, and communication must be resolved. Offering specialized assistance and training to help assimilate new technology can further improve their contribution to patient care and operational efficiency.

Keywords: Radiology workflow, nursing role, efficiency improvement, patient coordination, healthcare technology, qualitative study

Introduction

Radiological services are vital to industries focusing on healthcare, and ensuring improved workflow is equally crucial for timely and efficient patient care. Nurses contribute immensely to the efficiency of

radiology workflow by assisting in patient preparation, facilitating communication between departments, and ensuring protocol compliance with imaging procedures. Their active involvement decreases delays, increases patient safety, and improves overall healthcare outcomes (Wulff et al., 2018).

Now, the need to incorporate nursing roles in radiology departments to eliminate inefficiencies has been established in studies. For example, Brødsgaard et al. (2019) found that the use of an advanced practice registered nurse in radiology units significantly improved coordination and communications, ultimately leading to less patient wait times and better overall workflow performance. Nurses' active participation in patient scheduling, assistance during the imaging steps, and compliance to the pertinent procedures all serve to optimize the workflow.

Challenges increasing workloads, communication deficiencies with the radiologists and the technicians, as well as absence of proper imaging technologies training, are some of the difficulties that nurses face while attempting to optimize radiology workflow (Tang et al, 2023). Besides, the adoption of artificial intelligence (AI) in radiology also adds more complications which demand changes in work processes for nurses to improve patient care and efficiency (Jalal et al., 2021).

This work seeks to understand the contributions and challenges of nurses with regard to the radiology workflow optimization in three regional referral hospitals. Knowing their experiences and challenges will assist in developing measures to enhance efficiency and collaboration in the radiology departments.

Literature Review

Recent literature has acknowledged the importance of nurse's contribution to the enhancement of the patient care radiology workflow. Nurses play a fundamental role in fostering interdisciplinary communication, coordinating care, and making sure that the procedures in the processes are done correctly. This literature review analyzes predominant topics on contributions of nursing, barriers they face, and the influence of technologies on radiology workflow processes.

1. Nursing Contributions to Radiology Workflow Efficiency

The efficiency of radiology departments can be improved by nurses through reorganization of work and facilitation of patient movement in the department. As shown in various studies, nurses' involvement during the scheduling, patient preparation and post-procedural care greatly reduces the waiting time and increases the satisfaction of patients. In line with this, Brødsgaard et al. (2019) observed that coordination of service delivery on teamwork nursing in radiology improved workflow, reduced patient throughput times, and improved service delivery. Nurses serve as the primary links between radiologists and patients, enabling compliance with communication and imaging protocols (Wulff et al., 2018).

In addition, the study conducted by Tahmasebi et al. (2021) pointed out that nursing actions can help address the critical delay of some imaging clinical findings and support rapid clinical intervention. That study remarkably captured the process of the nurse's readiness to actively participate in the patient status monitoring process for imaging procedure as one that enhances workflow effectiveness.

2. Challenges Faced by Nurses in Radiology Workflow

Regardless of the value they add, nurses face issues that limit them from maximizing the radiology workflow. Among these are high workload demands, inadequate recognition of the role performed, and difficulty in communication with radiologists and other specialists (Tang et al., 2023). Complexity in imaging procedures coupled with the expectation of high volume turnover adds to the burden on nurses and aids in increasing nurse burnout and dissatisfaction with the job.

As pointed out in the study done by Jalal et al. (2021), the absence of any form of relevant trained personnel nurse in specialized radiology procedures and technology still serve as a major obstacle for radiology workflow management. Many nurses require refresher courses and continuous professional training due to advances in imaging technologies and care protocols. In addition, there are much more inefficient workflows caused by insufficient staffing in relation to the workload as well as lack of resources which makes the case for institutional intervention and proper planning of the workforce.

3. Technological Advancements and Their Impact on Nursing Roles

The use of imaging AI and automated systems have augmented the workflow processes in radiology. With the rise of sophisticated artificial intelligence (AI) tools and imaging technologies, more routine tasks such as data automation, imaging analytics, and clinical decision support systems are being created. These innovations have the ability to increase efficiency, a necessity within nursing practice, which is challenged by Wulff et al. (2018), where the effort of interpreting AI's output requires development of new reports for nurses to work with patient care plans.

In another study, Marinovich et al. (2023) argue that AI skill gaps such as interpretation of and working within the AI driven radiology environments needs to be solved by sufficient training and resources. With the introduction of EHR and digital tools for workflow management, the organization of care improved by eliminating documentation mistakes and communication silos between departments.

4. Strategies for Enhancing Radiology Workflow Efficiency through Nursing Practice

A number of approaches have been advanced to increase the participation of nurses in the management of radiology workflows. These include offering specific training courses, fostering interdisciplinary work collaboration, and employing evidence-based models of workflow optimization. As Brødsgaard et al. (2019) pointed out, delegating nurses more power in their roles and involving them in radiology quality improvement projects can significantly enhance the management of workflows in the department.

Furthermore, the use of fixed guidelines and the application of information technology to the management of nurse administrative work should reduce the burden on nurses and permit them to concentrate on patient care. Developing a culture of continuous improvement which relies on feedback and performance appraisal was also cited as one of the approaches that can be used to improve workflow efficiency (Tahmasebi et al., 2021).

The literature suggests that nursing staff is an integral part in maximizing the efficiency of radiology workflow. Even though nurses help, to a large extent, in enhancing the patient throughput and operational efficiency, they have to contend with numerous issues which should be dealt with by interventions, training, and technology. It is critical that future studies attend to the development of frameworks that integrate the nursing role comprehensively in radiology departments, ensuring that the balance between technology and caring is retained.

Methodology

Study Design

This study employed a qualitative research design using a phenomenological approach to explore the contributions and challenges faced by nurses in improving radiology workflow efficiency within a tertiary hospital setting in Riyadh, Saudi Arabia. A phenomenological approach was chosen to gain in-depth insights into the lived experiences of nurses working in radiology departments and their perceptions of workflow optimization.

Study Setting

The study was conducted in the radiology department of a leading tertiary hospital in Riyadh, which provides a wide range of diagnostic imaging services, including X-rays, CT scans, MRIs, and ultrasound imaging. The department operates 24/7, catering to both inpatient and outpatient needs, and employs a multidisciplinary team consisting of radiologists, radiographers, nurses, and administrative staff.

Participants

A purposive sampling technique was used to select participants for the study. A total of 15 nurses working in the radiology department were recruited, with varying years of experience and roles within the department. Inclusion criteria included:

- Registered nurses with at least one year of experience in radiology.
- Nurses involved in direct patient care and coordination within the imaging workflow.
- Willingness to participate and provide informed consent.

Exclusion criteria included administrative staff and nurses not directly involved in radiology workflow processes.

Data Collection Methods

Data were collected through semi-structured interviews, focus group discussions, and participant observations, conducted over a three-month period from January to March 2023.

1. Semi-structured Interviews:

- One-on-one interviews were conducted with each participant, lasting approximately 30–45 minutes.
- The interview guide covered topics such as nursing responsibilities, workflow challenges, collaboration with radiologists and radiographers, and perceived areas for improvement.
- Interviews were audio-recorded and transcribed verbatim for analysis.

2. Focus Group Discussions (FGDs):

- Two focus group discussions were conducted with 6–8 participants per session, encouraging discussion and exchange of ideas on workflow efficiency.
- FGDs explored common challenges, potential solutions, and nurses' experiences with process improvements and technological interventions.

3. Participant Observation:

- Non-intrusive observations were carried out during peak operational hours to document nurses' workflow patterns, interaction with patients and other healthcare professionals, and any bottlenecks in the process.
- Field notes were taken to supplement the findings from interviews and FGDs.

Data Analysis

A thematic analysis approach was employed to analyze the collected data. The process involved the following steps:

1. Familiarization with Data: Researchers read and re-read interview transcripts and field notes to gain an overall understanding of the data.
2. Coding: Initial coding was conducted to identify recurring themes and patterns.
3. Theme Development: Codes were grouped into broader themes, such as "nurses' role in patient preparation," "challenges in communication and workflow," and "impact of technology."
4. Interpretation: Thematic findings were reviewed and validated by the research team to ensure consistency and relevance to the study objectives.

NVivo software was used to facilitate data management and coding.

Ethical Considerations

Ethical approval for the study was obtained from the ethics committee. Written informed consent was obtained from all participants prior to data collection, ensuring voluntary participation and confidentiality. Participants were informed of their right to withdraw from the study at any time without consequences. All collected data were anonymized and securely stored to protect participant privacy.

Trustworthiness and Rigor

To ensure the trustworthiness of the findings, the study adhered to Lincoln and Guba's criteria for qualitative research, including:

- Credibility: Triangulation of data sources (interviews, focus groups, and observations) to ensure a comprehensive understanding.
- Dependability: An audit trail was maintained to document the research process and decision-making.
- Confirmability: Reflexive journals were kept by the researchers to minimize bias and subjectivity.
- Transferability: Rich descriptions were provided to allow for applicability in similar hospital settings.

Limitations of the Study

While the study provides valuable insights into the role of nurses in radiology workflow efficiency, several limitations were noted:

- The study focused on a single hospital setting, which may limit generalizability to other institutions.
- Time constraints and the busy schedules of nurses may have influenced participation and data collection depth.
- Self-reported data may be subject to recall bias or social desirability bias.

Conclusion

This methodology provided a comprehensive framework for exploring the contributions and challenges faced by nurses in radiology workflow management within a tertiary hospital. The findings from this study will help inform policy recommendations and workflow improvement strategies to enhance efficiency and patient care outcomes.

Findings

The analysis of data collected from semi-structured interviews, focus group discussions, and participant observations revealed several key themes related to the role of nurses in improving radiology workflow efficiency. The findings are categorized into three major themes: Nurses' Contributions to Workflow Efficiency, Challenges Faced by Nurses, and The Impact of Technology on Workflow Efficiency. Each theme is further divided into sub-themes, with supporting quotations from participants to provide insight into their experiences and perceptions.

Theme 1: Nurses' Contributions to Workflow Efficiency

Sub-theme 1.1: Coordination and Communication

Nurses acted as intermediaries in communication with radiologists and patients, and in so doing, assisted the technicians as well. Good management ensured reduced waiting times and increased patient flow.

Participant Quotes:

- “We are the link between patients and radiologists. Without us, gaps in communication may lead to delays.” (Nurse 3)
- “I sometimes make it a point to make sure radiographers have the appropriate information about the patient before they do any scans, in order to reduce redundant examinations.” (Nurse 7)

Sub-theme 1.2: Patient Preparation and Education

Nursing personnel aided greatly to the patient's level of preparedness by offering explanations, managing issues, and making sure that relevant procedures ahead of the imaging were followed.

Statements From Participants:

- “A lot of patients appear for imaging without any preparation. We try to explain the process and the diet they should have.” (Nurse 1)



- “Anxiety of the patients is a great concern. We do what we can to educate them so that they can help us and be at peace during the scan.” (Nurse 5)

Sub-theme 1.3: Workflow Optimization

Nurses participated in the improvement processes intended to address the patient waiting time and increase the department’s efficiency.

Extracts from Interviews:

-“We have put in place a checklist that needs to be filled before the patient is brought into the imaging room.” (Nurse 8)

-“Allocating everybody specific tasks for every peak period has made it easier to handle the work.” (Nurse 10)

Theme 2: Challenges Faced by Nurses

Sub-theme 2.1: Heavy Workload and Staffing Shortages

The inability to hire more personnel has been reported as one of main concerns participants face since it increases the workload and results in fatigue or burnout.

Participant Quotes:

- Nurse 4 states concern by saying, “When we are short-staffed, we have to do multiple duties at once and avoid the standard procedures being followed which means we could easily make blunders.”

- Nurse 6 argues that, “With emergency cases being an ever-present risk, it feels like we are always racing against the clock, especially with routine imaging tasks thrown into the mix.”

Sub-theme 2.2: Lack of Training in Imaging Procedures

Nurses reported that a lack of instruction on new technologies and radiology specific procedures was a barrier towards effective work performance.

Participant Quotes:

- "I didn't receive formal training in handling some of the radiology equipment. I had to learn on the job." (Nurse 2)

- “The pace of transforms in technology is so high, and we have to be trained continuously.” (Nurse 9)

Sub-theme 2.3: Communication Barriers

Findings indicate that poor communication between nurses, radiologists and other medical staff led to inefficiencies in the workflow.

Quotes from Participants:



- ‘Sometimes there are orders that are vague, and we have to follow up on numerous occasions before the scan can be conducted.’ (Nurse 11)

- ‘Barriers in language with certain patients makes gathering the necessary details before imaging also challenging.’ (Nurse 14)

Theme 3: The Impact of Technology on Workflow Efficiency

Sub-theme 3.1: Electronic Health Records (EHR) Integration

The majority of nurses noted that the adoption of EHR systems assisted with documentation and reduced redundant filing, although some reported infrequent disruptions of a technical nature that interrupted workflow.

Participant Quotes:

- “EHR systems make it easier to access patient history, but sometimes the system crashes and causes delays,” shared a nurse who preferred to remain anonymous.

- “With digital records, we can quickly check patient instructions and avoid duplicate tests,” was the reply of Nurse 15, reiterating the widespread sentiments.

Sub-theme 3.2: Artificial Intelligence in Imaging

Nurses had somewhat polarized responses to the integration of AI in radiology. While some have welcomed it and consider it a valuable asset, others have raised concerns about its potential to substitute human analysis.

Participant Quotes:

- “AI assists us in triaging time-sensitive cases. This enhances the workflow considerably,” (Nurse 13)

- “I fear that too much dependency on AI will erode some of the critical thinking the nursing profession entails,” (Nurse 5)

Sub-theme 3.3: Technological Adaptation Challenges

Even though nurses expressed support towards the improvements, they highlighted challenges in adjusting to new systems in the absence of requisite frameworks and assistance.

Participant Quotes:

- “New imaging systems are great, but it takes time to learn and adapt without adequate training.” (Nurse 6)

- “Technologies have to incorporate more user-friendly interfaces to minimize error and confusion.” (Nurse 9)

Discussion

The findings of this study show how important nurses are in facilitating radiology workflow efficiency in a tertiary hospital. These results are in accordance with the existing literature, which points towards the invaluable roles of nurses in patients' coordination, education, and optimizing processes. Nonetheless, the study also revealed a few issues including insufficient staffing, training deficiencies, and poor communication which affect efficiency of a workflow. Moreover, the use of technology offered some advantages, albeit, posed adaptation issues for nurses.

Nurses' Contributions to Radiology Workflow Efficiency

The study results reveal the responsibilities of a nurse as a central actor in the communication and liaison activities within the radiology department. The participants explained their roles in the interactions between patients, radiologists, and other services, which is similar to other literature that has described nurses as vital intermediaries in patient-centered care (Wulff et al., 2018). This may mean that nurses perform these activities in anticipation of delays to procedural compliance and, in doing so, help to improve outcomes for patients. This is aligned with Brødsgaard et al. (2019), who has focused on patient preparation as a very important aspect of workflow and reduction of repeat imaging.

The adoption of more advanced checklists and role specific tasks was identified as a method for increasing efficiency in this context. This is in support of the study conducted by Tahmasebi et al. (2021) which focused on slowed procedures resulting from disorganization. The commitment and adaptability demonstrated by nurses working in radiology is illustrated by their proactive approach toward optimizing patient care workflow processes.

Challenges Faced by Nurses

Recognizing the value of nursing, the study highlighted challenges that prevent nurses from making the most out of radiology workflow optimization. As noted by staff participants, staffing shortages tend to be a significant issue; with most of them reporting having a high workload that would lead to being burnt out from work, not to mention making a lot of mistakes. Marinovich et al. (2023) corroborated these findings and claimed that radiology departments all over the world have the same problems with staff which has resulted in highly inefficient workflows.

A reminder of the task in a different form is recurring of the need to properly train most radiology nurses, participants emphasized the necessity for advanced imaging procedures technology to be continuously mastered. This is consistent with the conclusions of Jalal et al. (2021), who argued that nurses lack training in advanced radiology procedures which leads the professionals to the underutilization of the advanced imaging technologies. Nurses can be trained more comprehensively focused on changes in the discipline that will enable them to raise their lower level technical skills, thereby improving the general performance of nursing tasks.

Barrier to effective communication was also stated to be a notable concern, as nurses claimed there was a lack of communication within the team as well as with patients that led to bottlenecks and inefficiency

in patient care. Other studies have also confirmed that miscommunication in a healthcare setting can result in mistakes and inadequate patient care (Tang et al., 2023). Incorporation of effective communication measures including routine report forms, and team meetings can alleviate, if not fully remove, these issues.

Impact of Technology on Radiology Workflow

The research concluded that the workflow efficiency in radiology is benefitted greatly by technology integration such as the electronic health records and the artificial intelligence. Participants explained how the EHR systems were effective toward lowering documentation access errors and were easily accessible which also corresponds to what Tahmasebi et al. (2021) found out on how digitization cut down on information system lag. On the downside, participants pointed out technical problems and system downtimes, which emphasizes the requirement for better IT management and more frequent system maintenance.

With regards to artificial intelligence, participants were split; some nurses accepted it positively because of its ability to sort urgent cases but at the same time raised doubt over its effects on clinical autonomy. These sentiments resonate with the findings of Jalal et al. (2021) which asserted that the integration of AI into radiology poses the challenge of relinquishing too much human responsibility. This study infers that appropriate instruction and adequate details might help nurses where clinical judgment is required in the workflow integration of AI.

The participants pointed out inadequate training and support provided to them, making it challenging for them to adapt due to new technologies. This result is consistent with the literature that stresses the importance of comprehensive onboarding and ongoing training in the adoption of technology in healthcare (Tang et al., 2023).

Implications for Practice

The conclusions drawn from this investigation suggest various steps that can be taken to improve the efficiency of radiology workflows by proactively integrating nursing input into the work processes:

1. **Workforce Planning and Resource Allocation:** Solving staffing problems through increasing the number of nurses at clinics and hiring more staff as well as improving the existing nurse-to-patient ratios can relieve the burden of work and improve efficiency.

2. **Targeted Training Programs:** Nurses can be trained in advanced imaging technologies by organizing routine radiology training programs which will assist in improving patient care.

3. **Communication Improvement Strategies:** Standardization of communication accompanied by interdisciplinary collaboration will help reduce misinterpretations and improve coordination of work processes within the department.

4. Technology Integration Support: Continuous therapy and instruction on new technology will aid in the improvement of the incorporation of AI and digital systems in radiology.

Study Limitations

This list includes some of the limitations that this study has. The nurses' role in radiology workflow efficiency is certainly an invaluable contribution to this health care service, but as with anything else, there is always room for improvement. This study was done in one tertiary hospital, which will affect how the findings can be applied to other institutions. Also, there is an issue with bias where the participant's memory and responses are relied on too much. The research should focus on multiple sites as well as use some form of quantitative measures to capture the value of this radiological practice.

Conclusion

This research has demonstrated the centrality of nurses' work in radiological workflow efficiency as a result of coordination, patient teaching, and process optimization. Nonetheless, to maximize the results of radiology workflow optimization, several issues, including understaffing, insufficient training, and poor communication, need to be resolved. Although technological change has great promise, its success depends on the level of training and support. These factors, if attended to, will make the department more efficient and enhance patient-centric care in radiology.

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