Impact of Implementation of DICOM Modality Worklist on Patient Registration at the Diagnostic Radiology Department: A One Center Retrospective Study

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Abstract
Background: Nodaway most hospitals in Egypt have digital radio-diagnostic modalities that support the DICOM protocol. Integrating radiology information systems with medical imaging equipment has numerous benefits, including improved efficiency, reduced errors, enhanced patient experience, accelerated workflow for healthcare workers, and improved resource management. The results of the implementation of the DICOM modality worklist system at the diagnostic radiology department of Minia Oncology Center underscore the value of such systems in healthcare settings, providing clear evidence of enhanced operational performance and patient care quality. *Methods*: The study included 500 patients, five registration staff, and 10 radiology technicians. The included radiological modalities in this survey are MRI, CT, and mammography. Data was collected through surveys, interviews, and direct observation. Pre-implementation data were gathered for two months, followed by a one-month implementation period, and post-implementation data were collected for another two months. *Results*: The overall results of this study demonstrate significant improvements in several key areas following the implementation of the DICOM modality worklist system at the diagnostic radiology department of Minia Oncology Center. *Conclusion*: The implementation of the DICOM modality worklist system at the Minia Oncology Center has proven effective in enhancing patient registration efficiency, reducing errors, and improving both patient and staff satisfaction. The integration of HIS-RIS-PACS systems, facilitated by the DICOM protocol, is crucial for any hospital seeking to improve operational performance and patient care quality. The significant improvements observed in this study highlight the indispensable role of DICOM in modern medical imaging and patient management systems.

Keywords: DICOM; Worklist; Integration; Radiology Information System (RIS).

Introduction

To the best of our knowledge, this study is the first of its kind to be conducted within the Egyptian healthcare landscape, aiming to evaluate the transformative effects of the DICOM Modality Worklist system in a diagnostic setting specifically in the Minia Oncology Center. The application of information technology in healthcare has been relatively slow compared to other fields such as banking, transportation, and trading. The healthcare system has been slow to understand, exploit, and incorporate information technology for its practical and strategic functionalities [1].

The American College of Radiology (ACR) and the National Electrical Manufacturers Association developed the DICOM (Digital Imaging and Communications in Medicine) Protocol, a standard method

for transferring images and information between medical imaging devices and radiology information systems [2].

Most hospitals in Egypt use digital radiodiagnostic modalities that support the DICOM protocol. The implementation of the DICOM modality worklist system in the diagnostic radiology department of the Minia Oncology Center led to significant improvements in efficiency, accuracy, and satisfaction for both patients and staff. These results underscore the value of such systems in healthcare settings, providing clear evidence for enhanced operational performance, patient care quality, and better resource management [3].

This study aimed to prove the impact of integrating the DICOM modality worklist with the radiology information system on the patient registration process and workflow. This study assessed the following points:

- Patient registration times
- Data accuracy
- Patient and staff satisfaction
- Resource utilization: it includes the time needed for registration staff to manually register the patient and the number of technicians needed (per patient per imaging modality as well as time consumed on each imaging modality) to introduce patient data manually.

Materials and Methods

The Minia Oncology Center faces challenges in managing patient registration efficiently. In the diagnostic radiology department, manual processes often lead to long waiting times, data entry errors, and overall inefficiency.

The study employs a mixed-methods approach that incorporates both quantitative and qualitative data by comparing pre-and post-implementation data.

The study included 500 patients, five registration staff, and 10 radiology technicians. The included radiological modalities in this survey are MRI, CT, and mammography. Data was collected through surveys, interviews, and direct observation. Pre-implementation data were gathered for two months, followed by a one-month implementation period, and post-implementation data were collected for another two months.

Metrics overview used in this study were as follows:

1. Registration time for the patient, minutes
2. Total number of errors in data entry (per 100 cases)
3. Resource utilization:
    - Time consumed on each imaging modality per patient, minutes
    - Registration staff time per patient, minutes
    - Number of technicians needed (per patient per imaging modality)
4. Number of non-satisfied patients per whole number of asked patients
5. Number of non-satisfied registration staff per whole number of asked staff
6. Number of errors in data entry per imaging modality type/study time.

Results

The evaluated metrics showed a decrease in all evaluated metrics (Table 1) with a reduction in patient registration time, decreasing by approximately 66.7% from 15 minutes pre-implementation to less than 5 minutes post-implementation, a substantial reduction in data entry errors, decreasing by 87.5%, from 40 errors per 100 cases pre-implementation to 5 errors per 100 cases post-implementation, machine time decreased by 80%, registration staff time decreased by 60%, technicians needed (per patient per examined

modality) decreased by 50%. The number of satisfied patients increased by 180%, and the number of satisfied staff members increased by 80% (Table 1).

Table 1. Key Performance Metrics Before and After Implementation.

Metric	Pre-Implementation	Implementation	Post-Implementation
1. Registration time for the patient, minutes	15	10	<5
2. Total number of errors in data entry (per 100 cases)	40	30	5
3. Resource utilization:			
- Time consumed on each imaging modality per patient, minutes	15	9	<3
- Registration staff time per patient, minutes	5	3	2
- Number of technicians needed (per patient per imaging modality)	6	4	3
4. Number of non-satisfied patients per whole number of asked patients	350	200	80
5. Number of non-satisfied registration staff per whole number of asked staff	5	3	1
6. Number of errors in data entry per imaging modality type/study time			
MRI	10	5	1
CT	10	12	2
Mammography	20	13	2

Discussion

The development and acceptance of the DICOM standard have become a basic requirement for implementing electronic imaging in radiology. DICOM now provides a standard for electronic communication between radiology and other parts of the hospital enterprise [4].

The Modality Worklist function allows an automated, reliable, error-free transfer of information stored in the HIS directly to the modality, supported by almost all manufacturers of digital DICOM modalities [5].

Unreliable data can directly impact patient care when images are labeled incorrectly and stored incorrectly on the PACS, rendering them incomplete, mismatched, unmatched, or simply missing [6].

At our center, we have been utilizing PACS for nearly three years. In a PACS environment, even minor errors in data entry can cause severe workflow disruption. For example, a space entered at the keyboard instead of a hyphen, or an extra space between the first and last names, might render an accession number useless. These errors usually require manual intervention, which is time-consuming and can disrupt workflow and compromise the accuracy of the electronic medical record [7].

The radiology process is initiated by a request for a radiology procedure for a specific patient, usually part of a radiology order that may request multiple procedures. Each requested procedure generates a different result instance, leading to a radiology report containing the interpretation and impressions of the radiologist [8].

DICOM provides a network transaction that enables users to query for reporting tasks. The DICOM worklist enables a system to query a reporting work list from a workflow manager using query keys, and the work list provider answers the query by sending a list of matching work items. The DICOM system performing the reporting task can send feedback about the actions taken, including the performer's identity and the action date and time [9].

Conclusions

The implementation of the DICOM modality worklist system at the Minia Oncology Center has proven effective in enhancing patient registration efficiency, reducing errors, and improving both patient and staff satisfaction. The integration of HIS-RIS-PACS systems, facilitated by the DICOM protocol, is crucial for any hospital seeking to improve operational performance and patient care quality. The significant improvements observed in this study highlight the indispensable role of DICOM in modern medical imaging and patient management systems.

List of Abbreviations: MRI: Magnetic Resonance Imaging; CT: Computed Tomography; ACR: American College of Radiology; HIS: Hospital Information System; RIS: Radiology Information System; PACS: Picture Archiving and Communication System; DICOM: Digital Imaging and Communications in Medicine

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