

On Call PACS for Radiology Department

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Abstract: *The aim of this study to determine the different diagnostic image viewing used by Radio technologists while on-call, and to assess the opinions and preferences of radiology program directors regarding their use. An online survey was sent electronically to radiology technologist program directors via the Association of University technologist. Six radiology program directors and 3 chief technologist completed the survey, yielding respond, 2 different Picture Archiving Communications Systems (PACS) were identified; GE (50 %), Philips (50 %), only 5 % of all respondents use a secondary "Digital Imaging and Communications in Medicine" viewer for on-call studies. Perceptions of PACS functionality were generally neutral to weakly positive. Most respondents strongly agreed that it is important to have a single integrated PACS for viewing on-call studies and agreed that the PACS should be integrated into the Electronic Medical Records (EMR). The majority of respondents use their institution's PACS while on-call. The results show there is still a wide variety of PACS used by different institutions; however, GE, Phillips were some of the most prevalent. Most technologist surveyed have neutral to slightly positive perceptions about the functionality and ease of use of their PACS. Finally, while technologist agree that PACS should be integrated with EMR, only 50 % of respondents currently have this arrangement.*

Keywords: PACS, On-call PACS

1. Introduction

Throughout the Kingdom of Saudi Arabia, Technologists use a variety of Picture Archiving and Communication Systems (PACS) and Digital Imaging and Communications in Medicine (DICOM) viewers to Archive diagnostic images. In this study, our aim is to identify the of different diagnostic image viewing systems used by Technologists while on-call, and to investigate the opinions underpinning the use of these systems.

The PACS has revolutionized the way diagnostic digital images are obtained, stored, and interpreted. A PACS consists of three main components: the imaging modality (x-ray, CT, MRI, etc.), the Technologist's workstation, and the archiving storage hardware. These three key elements are interconnected via a secure network that transmits the universal DICOM language (which encodes the diagnostic image) from one component to another. In this way, an image can be created from a modality such as a CT, interpreted and a also report dictated by a radiologist at Other workstation, and finally the image sent alongside the final dictated report to an archiving system for future retrieval. The concept of PACS was first introduced in the early 1980s, and the first implementation of PACS took place in 1982 at the University of Kansas. However, it was not until 1993 at the Baltimore VA Medical Center that the first successful, full-scale transition to an entirely "filmless" imaging department took place in the KSA.

Several studies found implementing a uniform PACS from a film-based system improves efficiency, enhances collaboration, and decreases costs. Early financial assessments suggested that PACS might actually increase costs due to the significant investments required for both hardware and software. However, in 2006 a large-scale assessment of a hospital-wide PACS implementation revealed a net savings of \$485, 157. Perhaps most importantly, in all of these studies Technologists productivity

increased, patient waiting time decreased, and critical results were relayed more efficiently. Yet, despite these benefits, every PACS has hurdles to overcome. A recent study of Case Western's implementation of a new PACS identified unexpected network issues due to high latency of images, which required widespread upgrades in bandwidth across several hospitals within the system. While each hospital must carefully select a PACS based on criteria that suit its own needs, a few qualities have universally stood out. This includes security, prevention of lost data, and fast turnaround times. With these criteria and others in mind, there are literally hundreds of available PACS vendors to choose from, but there is currently no universally accepted "ideal" PACS. PACS administrators must work alongside Technologists and radiologists to select a PACS that makes the process of image archiving and interpretation more efficient, faster, and simpler.

This is especially important now more than ever, as Technologists and radiologists experience increasing demands from the passage of the Affordable Care Act (ACA) and from the steady rise in diagnostic imaging . On-call and after-hours radiology imaging and reports have increased throughout the KSA, and radiology programs have taken various measures to meet this increasing demand. In 2011, Deloney et al. describe the results of a national survey of program directors, which revealed that on-call studies have increased from prior years in programs across the board. Currently, 45 % of programs have staff radiologists in-house with residents covering on-call studies . In 2012, more evidence surfaced in a study surveying chief residents. Not only did after-hours imaging studies increase but demand for final reports by staff radiologists increased as well. To respond to this demand, 15 % of all programs kept a staff Technologists and radiologist in-house overnight, also an increase from previous years , we see PACS performance put to the test in a variety of ways, as radiology Technologists are required to archiving increasing volumes of studies while on-call.

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Recently, several studies have emerged ,imaging ,reporting new software or hardware designed to improve training, efficiency, or user experience with PACS especially when used while on-call. On-call PACS simulators were developed to help prepare new Technologists for the rigors of reading emergent imaging independently and to enhance their proficiency when using PACS in these situations. Another study describes the launch of “SimpleDICOM suite,” designed to enhance the functionality of commercially available PACS . One group analyzed six different user interface devices ranging from a five-button mouse to a gaming joystick, to see if any device provided a superior user experience or improved efficiency when using PACS. Growing demands during on-call duties make having an effective, easy-to-use PACS especially important.

To date, few studies have looked at how the great variety of different PACS and DICOM viewers affects on-call duties. This study seeks to answer that question.

2. Materials and Methods

We surveyed radiology Technologists and program directors to identify the arrangements of PACS and EMR used on-call, and to assess their views regarding the use of these systems. The survey focused on four main areas: PACS and secondary DICOM viewers, worklist and turnaround time, EMR and PACS, and opinions and preferences regarding PACS. Secondary DICOM viewers can be defined as any DICOM viewer that is used by the Technologists that is not the primary DICOM viewer that is supported by their institution’s PACS. For instance, if a Technologist’s institution uses GE but the Technologists chooses to use Other when viewing images on-call, this would be considered a secondary DICOM viewer. The respondents were asked a series of multiple choice and free text questions regarding the current arrangement of the PACS and EMR used at their institution. Respondents were also asked to rate statements on a one- to five-point Likert scale (1 = “strongly disagree” to 5 = “strongly agree”; see Appendix for complete survey). The survey was sent electronically via email to Technologists in august of 2018, and was hosted online These emails were distributed to the Association of Program Directors in Radiology and the Saudian Alliance of Radiology. The results were compiled on software and subsequently downloaded to be statistically analyzed using Microsoft Excel.

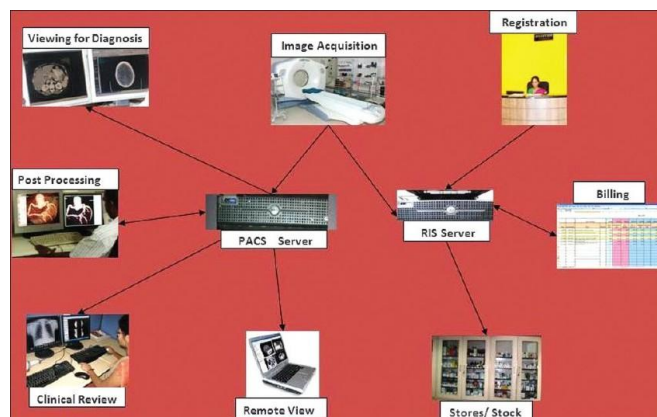
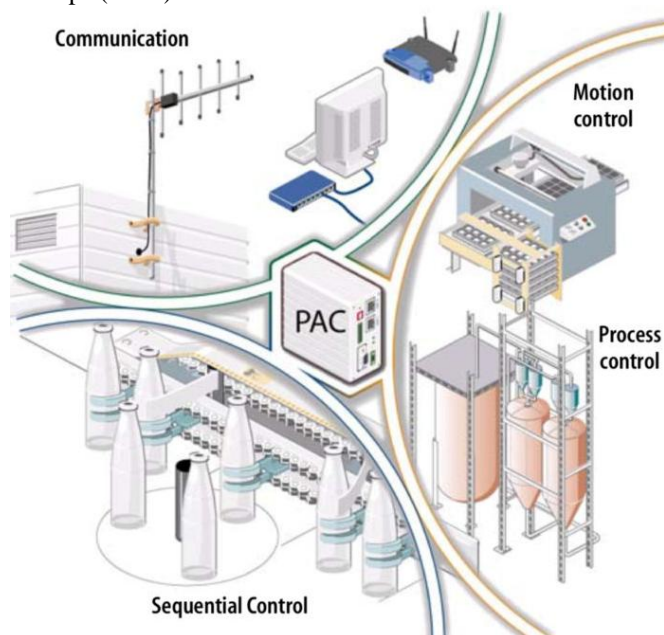
3. Results

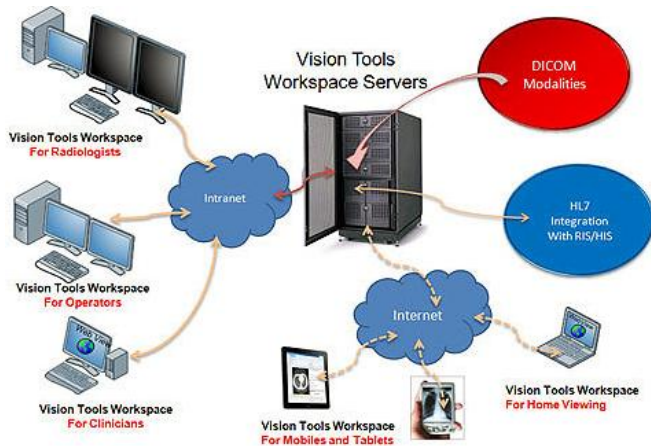
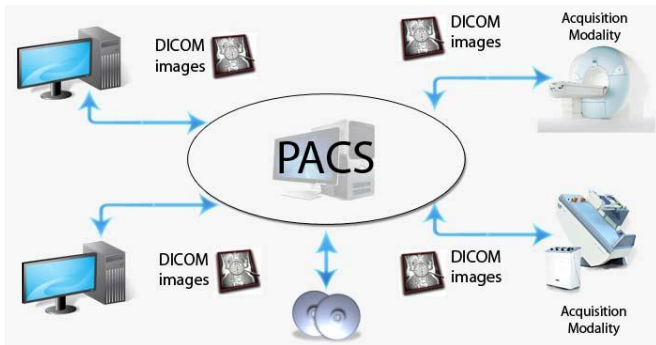
Technologists Survey

Respondents from 5 different area of radiology department participated in this study. The survey response rate was 24.9 % for program directors (PD) and 8.5 % for Technologist . Respondents were relatively equally distributed from Hail, with fewer respondents from the other cities .The majority of respondents practiced in an Hail Hospital (70 %). Other clinical settings included Community Hospitals (8 %), Imaging Centers (6 %), and Group or Clinical Practices (6 %). The size of the intuitions represented ranged from less than 10 Technologist and 15 Full Time Equivalent (FTE)

Attendings to those with more than 50 radiologist PACS and Secondary DICOM Viewers

Individuals from 5 different institutions reported the PACS they use while on-call. Out of those who responded to the survey, the most prevalent PACS is GE (55 %), followed by Phillips (45 %)





4. Discussion

The results of this study give insights into diagnostic image viewers used on-call, but also revealed more broadly applicable findings about the use of PACS across different hospital systems. The study uncovered three main findings. First, while there are many different PACS vendors implemented at Archiving system Radiology, there is insufficient evidence to suggest that specific PACS differentially impact on-call performance. Next, Technologist in hospitals universally prefer to use their home institution's PACS for on-call studies over other secondary DICOM viewers. Third, radiologists participating in this study prefer a single unified PACS in a healthcare institution and agree that EMR integration with remote access is important. However, our study revealed that only 55 % of all hospital systems represented by survey respondents currently use a PACS that is not integrated with EMR.

We identified 5 different PACS vendors used by the 5 different institutions represented in this study. These findings suggest there is clearly still great variability with regards to PACS vendor selection at hospitals, and currently there is no clear dominant player in the PACS market. However, out of our study results, GE was the most prevalent, followed by Phillips. To our knowledge, there are no similar studies looking at PACS vendors specifically at hospitals.

Alternatively, vendors with a larger market share may have established their position in the PACS market through early entry. This can allow the vendor to create long-term relationships with different hospital networks. For example, GE was one of the first companies to offer PACS to hospitals and implemented the first PACS for the Department of

Defense in the 1990s. Today, they are one of the most prevalent PACS in hospitals across the country.

In order to get a complete picture of the software-based practice environment that impacts Technologist on-call, our study ascertained the different EMR that are used in concert with their institution's PACS. From the responses to this survey, our study identified 5 different EMR systems representing a total of 5 hospitals PACS vendors represented in this study, there is still a great variety of different systems in use. For comparison, in 2009 one study surveyed 63 % of all hospitals in the United States found that only 9 % had some form of EMR in place. The results from our study suggest EMR adoption is on the rise and is nearly ubiquitous in the hospitals represented in this study. Since this study focuses on Hail hospitals, many of which are part of a multi-hospital network, this may provide some explanation as to why the rates of EMR use are so high. A previous study by Li et al. showed that hospitals that were part of a multi-hospital network were more likely than independent hospitals to have EMR. Furthermore, the passage of the Health Information Technology for Economic and Clinical Health Act (HITECH Act) in 2009 has substantially increased adoption of EMR with its requirements to demonstrating meaningful use.

The second primary finding of this study revealed that the overwhelming majority of respondents prefer to use their institution's PACS for on-call studies versus using an alternative DICOM viewer. Ninety percent of all survey participants indicated they used their institution's PACS for on-call studies. The Technologist who did use a secondary DICOM viewer stated they did so out of necessity. Specifically, their institutions' PACS were not available for outside studies while on-call. These findings suggest the need for a uniform PACS platform across different hospitals within a multi-hospital network. This is especially relevant today as more individual hospitals are joining larger networks of hospitals, thus requiring on-call radiology coverage to take place at different geographical locations. By making all images in a hospital network available on a single "home institution's" PACS, the process of interpreting diagnostic images is simplified for the Technologist and all staff involved, enhancing efficiency. This was demonstrated early

The results show a very low rate of secondary DICOM viewer use for on-call duties, which makes sense given the call structure of Hail hospitals. Most programs tend to have in-house call, so it seems logical that the Technologist on-call will use the supported in-house PACS. Additionally, as mentioned previously, increasing demands brought on by more after-hours imaging has led to more attending Technologist staying in-house for on-call duties. Therefore, both program directors and chief residents have become more likely to take in-house call. Secondary DICOM viewers are evolving, and now highly functional DICOM viewing software is available for mobile devices such as the iPhone and iPad, creating a very portable option that could be of use in multi-hospital networks. Still, even with technological advances improving secondary DICOM viewers' functionality and flexibility, Technologist in Hail hospitals rely on the institution's PACS for on-call studies. This can be

due to increased familiarity with the home system and greater functionality over external secondary viewers. These findings support the concept of a single, unified PACS across a hospital system.

Although the results of this study represent 50 % of accredited radiology Hail hospitals, some of the results rely on a relatively smaller sample of the Technologist and program director population (survey response rate of 10 and 30 %, respectively). Therefore, the attitudes of respondents may not necessarily reflect the views of all Technologist. who are unhappy with their PACS were less likely to spend the time to complete this survey. Furthermore, due to the small sample size, it was not possible to draw conclusions regarding which specific PACS was easiest to use or decreased turnaround time the most. Future surveys could be directed towards obtaining a larger sample of both program directors and Technologist, it would also be beneficial to get more details of specifically how many hospitals fall under the network of a respondent's institution and which hospital networks have different PACS at different hospitals.

5. Conclusions

Technologist in radiology Dept were surveyed regarding their current use of PACS and DICOM viewers while on-call, and their opinions regarding their institution's PACS. The results show there are a great variety of different PACS used by hail hospitals represented in this study, but GE, Phillips, were some of the most prevalent. There is insufficient evidence to suggest that any specific PACS impacts the performance of Technologist on-call versus other PACS. The majority of respondents prefer to use their institution's PACS instead of an alternative DICOM viewer. Finally, Technologist believe there should be a single, unified PACS at an institution for viewing on-call studies, and that the PACS should be integrated with their institution's EMR; however, only 55 % of those surveyed report having a PACS that is integrated with EMR.

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