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| Harvard EXTENSION SCHOOL |
| Advanced Radiology Information Systems |
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# Introduction

Radiologists are often perceived as some of the most technologically savvy physicians, in large part due to their daily usage of software. The field was perceived as the cutting edge of futuristic technology in the 70s with adoption of advanced imaging modalities in the form of MRI and CT scans. Later in the 90s, radiologists again revolutionized the industry with the replacement of imaging film with digital. However, the industry is currently facing issues in IT architecture. Lack of interoperability is one of the key technical issues, lagging the quality in care (Garriott, K.).

For example, currently separation in radiology reporting and image database software (PACS) prevents fluidity and seamless connectivity. Radiologists must manually edit data in order to sync information. Instead of just saying “rib” and having the right images displayed to the viewer and right section queued up, radiologists must manually find the right section of the report, scroll through multiple image slices, and adjust the window levels accordingly. Also, the reporting can be faulty as well. It is one-dimensional, plain text-only document that doesn’t support markups or automatic imports of measurements from an image (*The Status of Medical Errors Among Health IT Systems*). Radiologist-recommended follow-ups happen less than 40 percent of the time, resulting in thousands of preventable deaths each year (Hansra, S.).

Digital Imaging Adoption Model (DIAM) is the collaborative effort of imaging experts around the world to create an eight-stage maturity model offering industry-standard guidance and benchmarks for IT adoption of medical imaging best practices (*Digital Imaging Adoption Model*). This group is focused on improving the future by identifying technological gaps, creating a roadmap for improvements and validating proficiencies. Their recommendation for future software design is to marry the patient’s clinical information and images with their corresponding electronic medical records. This isn’t the case, as they noted, finding patient images are still being acquired on unsecured mobile devices, ultrasounds stored on CDs or memory sticks, and patients being responsible for transporting hard copies of images between healthcare providers. I propose to solve this problem by designing an electronic image sharing software platform, called Advanced Radiology Information Systems (ARIS), that joins the patient network with their images and EHRs for enhanced interoperability for quicker and more efficient diagnoses.

# Technological Needs

## Data and Information Systems Integration

Advanced Radiology Information Systems (ARIS) will be a software platform that is integrated into patient portals and clinical settings as an installation, enhancing data flow of images with notes between an interconnected network. This would be a secure network operating on cloud storage in a Java workflow. Databases would be used in the use case diagrams on connectivity between the various actors in the system. Radiologic image compression would reduce the data volume using PACs (European Society of Radiology). This lossy compression would use JPEG algorithms for the ability of patients to choose if they are reversible or not. Further details on how to collect patient data and integrate it into the system have been documented for requirements below.

## Requirements

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|  | **Functional Requirements** | |
| R1 | Referring physician can access ARIS and place order for procedure | This requirement is met when the referring physician can add a patient and request a specific operation, using the ARIS. |
| R2 | ARIS can display worklist | This requirement is met when the technician, radiologist, and administrative assistant can all view a list that contains detailed appointment data. This data must include patient name, technician assigned, and status of the patient. |
| R3 | ARIS can acquire an image for a patient | This requirement is met when the technician can upload a picture taken from radiology modality during the imaging process. |
| R4 | Radiologist can respond to patient images | This requirement is met when the radiologist can view the image uploaded by the technician. |
| R5 | Store patient information | This requirement is met when the ARIS can intake, store, and display patient information. There must be a unique ID regarding each patient and the patient information must be able to be viewed by the technician, radiologist, and admin. |
| R6 | Require Electronic Signature | This requirement is met when the radiologist can provide his credentials during the report review process to verify identity and submit report. |
| R7 | Radiologist can review image retrieved from database | This requirement is met when a radiologist can access images associated with current and previous appointments. This must be searchable by patient in order to develop a patient history. |
| R8 | Store images | This requirement is met when the ARIS can store images taken during the imaging process. The images must be accessible and have a unique image ID. |
| R9 | CRUD Reports | This requirement is met when the radiologist can create a report based on the tech entry. The radiologist must also be able to update and delete a report. |
| R10 | Automatically retrieve demographic information and RP information | This requirement is met when the patient information displayed for each patient includes name, gender, vitals, and referring physician name. This must be readable each time the patient’s profile is accessed. |
| R11 | ARIS and PACS pull pictures, reports, and patient information properly | This requirement is met when the ARIS can access the pictures, reports, and patient information if the employee has access to the information. |
| R12 | See previous images and exams | This requirement is met when there is an archive of files including previous completed reports. The reports must include the tech entry, patient information, and radiologist report document. |

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|  | **Non-Functional Requirements** | |
| N1 | Coded in Java | This requirement is met when the main coding language used is Java. If any other languages are used, they must be compatible with Java language. |
| N2 | Database accepts SQL commands | This requirement is met when the database can be accessed and updated through SQL commands run from the Java models. |

## 2.3 Users

The current design has four actors involved in this project.

1. Referring physicians are involved with sending referrals of patients and the requested images from the radiology team. This may also include a EHR with previous images for better diagnosis.
2. Radiologists and their radiology technicians must use the platform to read, upload and provide notes each examination for their referring physician.
3. Patients can use the system to observe their notes with images and easily transfer them between providers.
4. Hospital Administrators are involved in monitoring the EHRs of patients and ensuring the records are upkept by the software.

## 2.4 Security and Privacy

It is important to identify weaknesses and risks when designing the platform. The traditional method of sending medical images is by burning them onto a CD and delivering them in person or through the mail. However, this method has several drawbacks risking HIPAA violation. Unless they are protected by a password or encrypted, the images aren’t secure. Another risk is the cost of training staff to ensure security and privacy. Electronic signatures would be required when signing in and out of system. The program would run on multiple programming languages including Java which has various security providers such as JMS, a native Oracle Cloud Infrastructure services that monitors customer data centers. HIPAA compliance would be essential when designing the system and encryption of data would be implemented.

# Summary

The risk of inaction is too high when looking at reform to Radiology IT. Improving the software tools for radiologists and technicians can greatly improve the interoperability and efficiency of reporting. It is my intention to propose new IT innovation that is integrated throughout the entire medical industry for the benefit of patients, providers and insurers. As the world is moving towards more advanced technology, there is a need for hospitals and imaging centers to improve their workflow to facilitate patients for better diagnosis.

## References

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