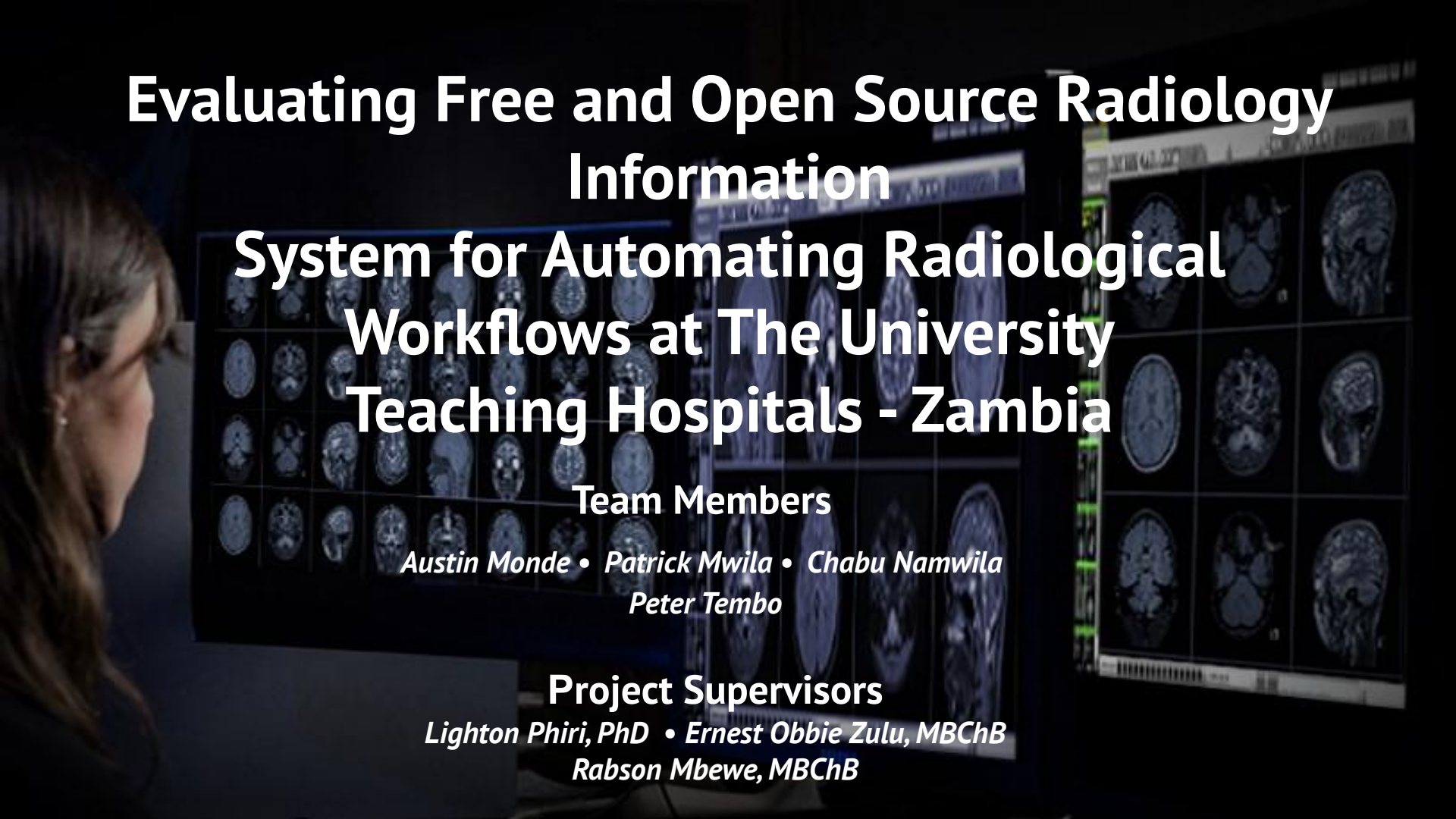

Evaluating Free and Open Source Radiology Information System for Automating Radiological Workflows at The University Teaching Hospitals - Zambia

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Presentation Outline

- Research Background
- Objectives
- Related Work
- Ethical Considerations
- Methodology
- Results
- Conclusion
- Demonstrations / Questions

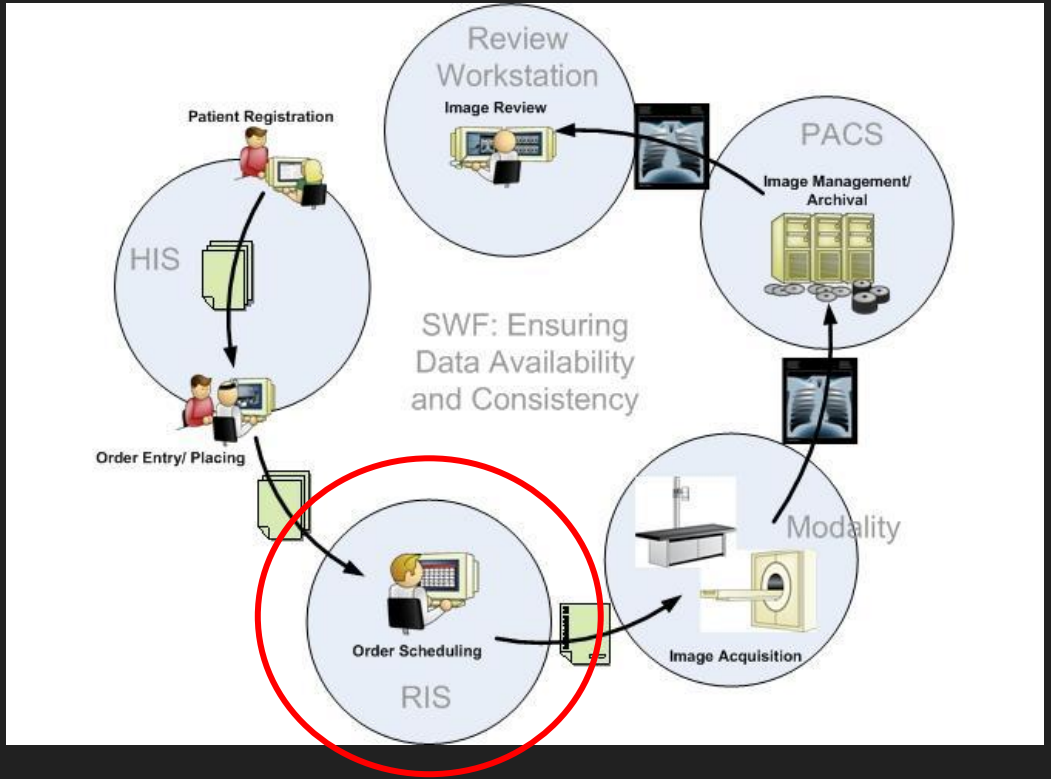
Research Background

- The current radiology workflows in public health facilities in Zambia are manual, paper-based and prone to errors.
  - Requesting for examinations
  - Communication between medical staff
  - Sharing of reports on interpreted medical images
  - Linking medical images to requests, etc

- The intent of our study was to evaluate the feasibility of adopting FOSS RIS at UTHs towards automating radiological workflows.

Research Background

- Our research is part of a much larger project being undertaken at the University Teaching Hospitals



Objectives (1/2)

- **Broad Objective**
  - To investigate the feasibility of leveraging an interoperable RIS platform for efficient and effective management of radiological tasks.
- **Specific Objectives**
  - To understand the workflows and challenges of the radiology department.
  - To identify a FOSS Radiology Information System.
  - To evaluate the usability of a FOSS Radiology Information System.

Objectives (2/2)

- Research Questions
  - What are the primary workflows and challenges of a radiology department?
  - What FOSS Radiology Information System can be used in the health sector?
  - How usable is a FOSS Radiology Information System?

Related Work (1/3)

- Related work crucial to the research we undertook include:
  - Challenges with Radiological Workflows in Zambia – mentioned in a paper titled "An audit of licensed Zambian diagnostic imaging equipment and personnel" and also in paper titled "Radiology nursing: a little-known speciality in Zambia".
    - Here we found gaps related to challenges with:
      - Manual entry of data
      - Turnaround time due to workload
      - Effective communication between referring physicians and radiologists, etc.

Related Work (2/3)

- Related work crucial to the research we undertook include:
  - Enterprise Medical Imaging (EMI) – mentioned in a number of papers, one of which include “Enterprise Medical Imaging for Improved Radiological Workflows: Towards an Interoperable and Standards-Based Medical Imaging Platform in Public Health Facilities in Zambia”.
    - Here we found gaps related to:
      - Emphasis on adoption of FOSS RIS as a potential solution towards automating radiological workflows

Related Work (3/3)

- Related work crucial to the research we undertook include:
  - Understanding of Free and Open Source Software - which led to the discovery of RIS.
    - Here we found gaps related to:
      - Maintenance and Flexibility of FOSS

Ethical Considerations

- To effectively conduct our research, measures were undertaken to ensure compliance with ethical issues sort from the following:
  - The University of Zambia Biomedical Research Ethics Committee (UNZA BREC), in a letter dated 5th May, 2022 with reference No.2731-2022 granted clearance to conduct the research.
  - The National Health Research Authority (NHRA), in a letter with reference No. NHRA000024 10/05/2022 granted clearance to conduct the research.
  - The Ministry of Health (MoH), in a letter dated 16th May, 2022 granted clearance to conduct the research.
  - The University Teaching Hospitals (UTHs), in a letter dated 5th September, 2022 granted clearance to conduct the research at the UTHs.

Methodology (1/4)

- **Understanding Radiological Workflows and Challenges at UTHs**
  - **To understand the radiological workflows and challenges at the UTHs, we undertook a series of activities from observations, interviews to archival record analysis.**
  - **Here we gathered comprehensive data regarding challenges and requirements used to discover a suitable FOSS Radiology Information System.**

Methodology (2/4)

- **FOSS Radiology Information System Discovery**
  - **A comparative analysis of different freely available FOSS RIS was done based on different metrics meeting the requirements.**
  - **Two main radiology information systems were analyzed in depth, OpenMRS Radiology Module and LibreHealth RIS.**
  - **We decided to settle for OpenMRS Radiology Module.**

Methodology (3/4)

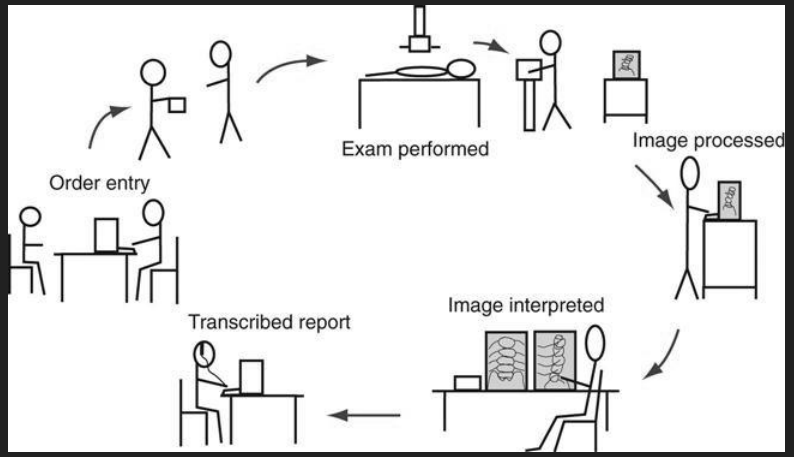
- **Usability Testing of FOSS Radiology Information System**
  - **Usability testing was a crucial step for the comprehensive evaluation of the OpenMRS Radiology Information System (RIS) module.**
  - **Focused on the features of Patient Registration and Modality Request Scan as these features came built in the default installation of the system.**

Methodology (4/4)

- Data Analysis
  - To measure “usability” or “ease of use” of the OpenMRS RIS, we used the System Usability Scale (SUS).
  - It is a 10-item questionnaire with 5 response options for each item, ranging from Strongly agree to Strongly disagree.

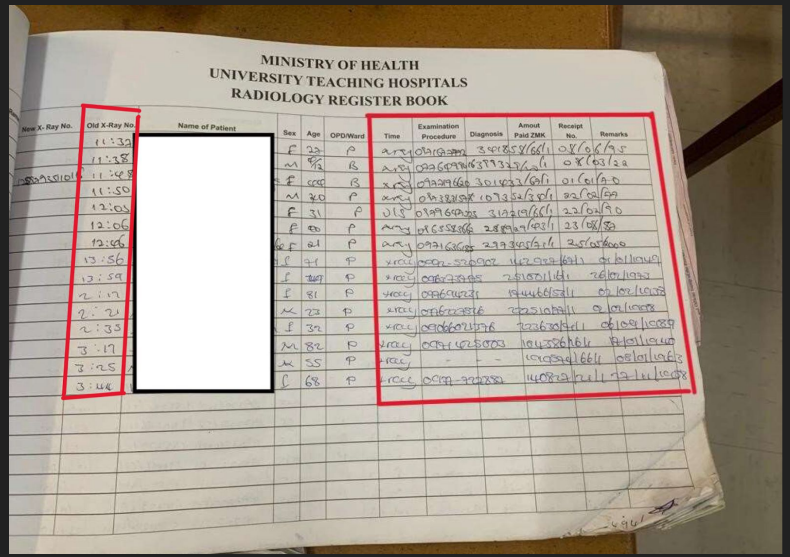
Results (1/6)

- Workflows in the Radiology Department – Key players
  - Referring physicians are the primary care doctors
  - Cashier or NHIMA – where payments are made / verified
  - Clerks – check in the patients and collect demographic information
  - Radiographers – performs imaging examination
  - Radiologists — interpret medical images and produce reports



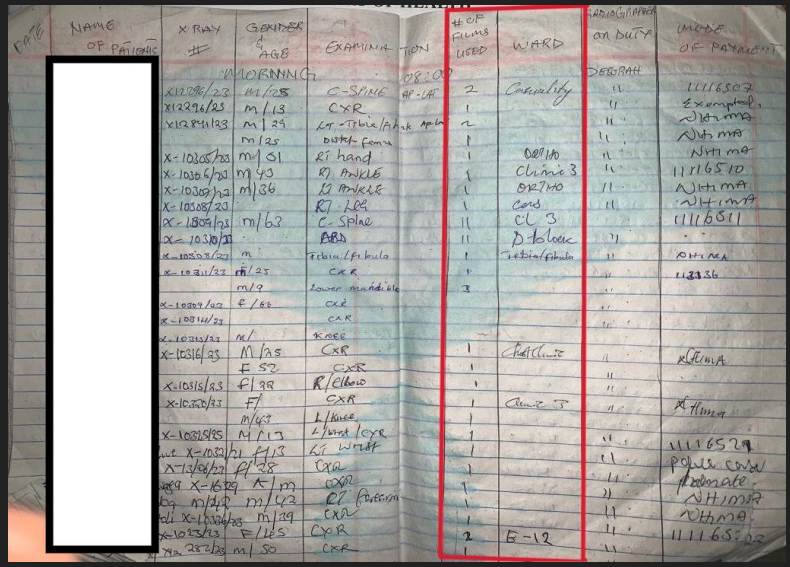
Results (2/6)

- Challenges with Radiological Workflows (1/3)
  - Clerk's registry – inconsistent entry of data in the various columns, information entered in the wrong columns, incomplete information leaving some data fields empty.



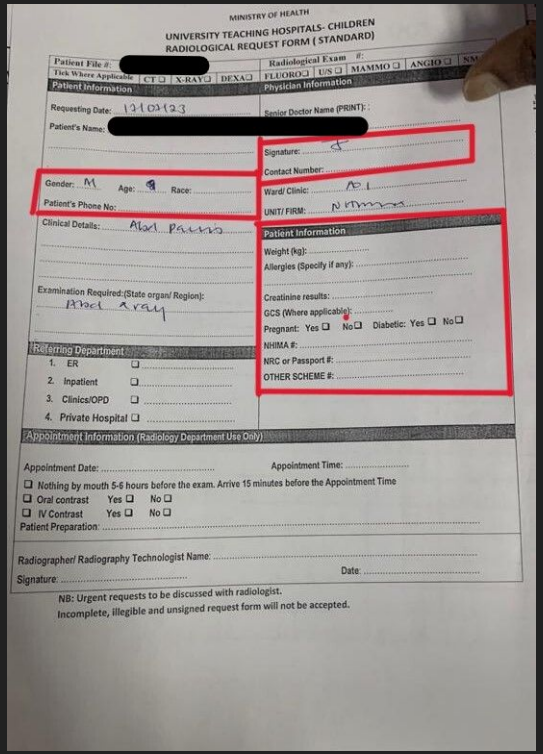
Results (3/6)

- Challenges with Radiological Workflows (2/3)
  - Radiographer's registry – incomplete information with empty data fields.



Results (4/6)

- Challenges with Radiological Workflows (3/3)
  - Radiological request form – **incomplete information about the patient's diagnosis.**



MINISTRY OF HEALTH

UNIVERSITY TEACHING HOSPITALS- CHILDREN

RADIOLOGICAL REQUEST FORM (STANDARD)

Patient File #: [redacted] Radiological Exam #:

Tick Where Applicable | CT ☐ | X-RAY ☐ | DEXA ☐ | FLUORO ☐ | US ☐ | MAMMO ☐ | ANGIO ☐

Patient Information

Requesting Date: 12/09/23

Patient's Name: [redacted]

Gender: M Age: 4 Race:

Patient's Phone No:

Clinical Details: Abd Pains

Examination Required:(State organ/ Region): Abd xray

Referring Department:

1. ER ☐
2. Inpatient ☐
3. Clinics/OPD ☐
4. Private Hospital ☐

Physician Information

Senior Doctor Name (PRINT):

Signature:

Contact Number:

Ward/ Clinic: AD 1

UNIT/ FIRM: Nimma

Patient Information

Weight (kg):

Allergies (Specify if any):

Creatinine results:

GCS (Where applicable):

Pregnant: Yes ☐ No ☐ Diabetic: Yes ☐ No ☐

NHIMA #:

NRC or Passport #:

OTHER SCHEME #:

Appointment Information (Radiology Department Use Only)

Appointment Date: Appointment Time:

☐ Nothing by mouth 5-6 hours before the exam. Arrive 15 minutes before the Appointment Time

☐ Oral contrast Yes ☐ No ☐

☐ IV Contrast Yes ☐ No ☐

Patient Preparation:

Radiographer/ Radiography Technologist Name:

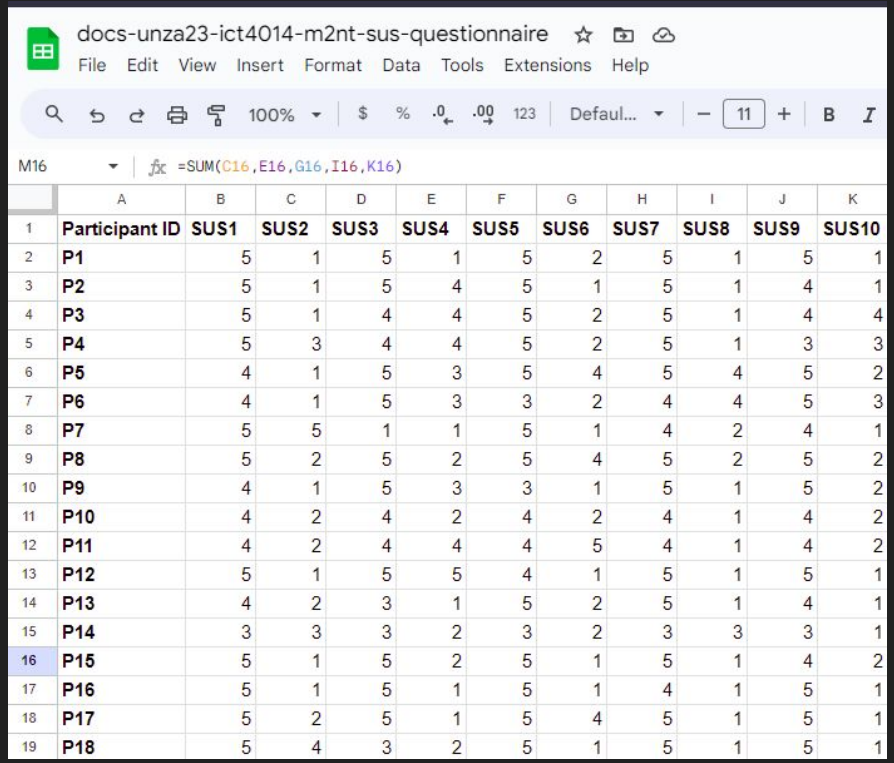
Signature: Date:

NB: Urgent requests to be discussed with radiologist.

Incomplete, illegible and unsigned request form will not be accepted.

Results (5/6)

- OpenMRS Radiology Module Usability Evaluation
  - Upon understanding the challenges and workflows which gave input to the discovery of FOSS RIS, we discovered, deployed and tested the usability of the system using a SUS questionnaire

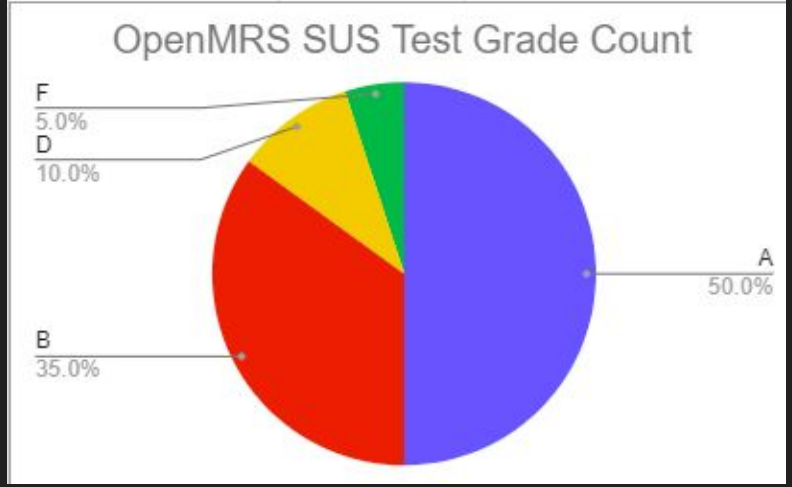


	A	B	C	D	E	F	G	H	I	J	K
1	Participant ID	SUS1	SUS2	SUS3	SUS4	SUS5	SUS6	SUS7	SUS8	SUS9	SUS10
2	P1	5	1	5	1	5	2	5	1	5	1
3	P2	5	1	5	4	5	1	5	1	4	1
4	P3	5	1	4	4	5	2	5	1	4	4
5	P4	5	3	4	4	5	2	5	1	3	3
6	P5	4	1	5	3	5	4	5	4	5	2
7	P6	4	1	5	3	3	2	4	4	5	3
8	P7	5	5	1	1	5	1	4	2	4	1
9	P8	5	2	5	2	5	4	5	2	5	2
10	P9	4	1	5	3	3	1	5	1	5	2
11	P10	4	2	4	2	4	2	4	1	4	2
12	P11	4	2	4	4	4	5	4	1	4	2
13	P12	5	1	5	5	4	1	5	1	5	1
14	P13	4	2	3	1	5	2	5	1	4	1
15	P14	3	3	3	2	3	2	3	3	3	1
16	P15	5	1	5	2	5	1	5	1	4	2
17	P16	5	1	5	1	5	1	4	1	5	1
18	P17	5	2	5	1	5	4	5	1	5	1
19	P18	5	4	3	2	5	1	5	1	5	1

Results (6/6)

- Data Analysis
  - Showcases descriptive statistics of the processed data.
  - The SUS score grade for the overall usability of the system came out at 79% which is between 68% - 80.3% giving an adjectival rating of Good thereby recommending the adoption of the system.

Descriptive Stats	SUS Scores	SUS Mean Score Grade
Mean	79	B
Standard Deviation	13.06360956	
Min	45	
Max	97.5	

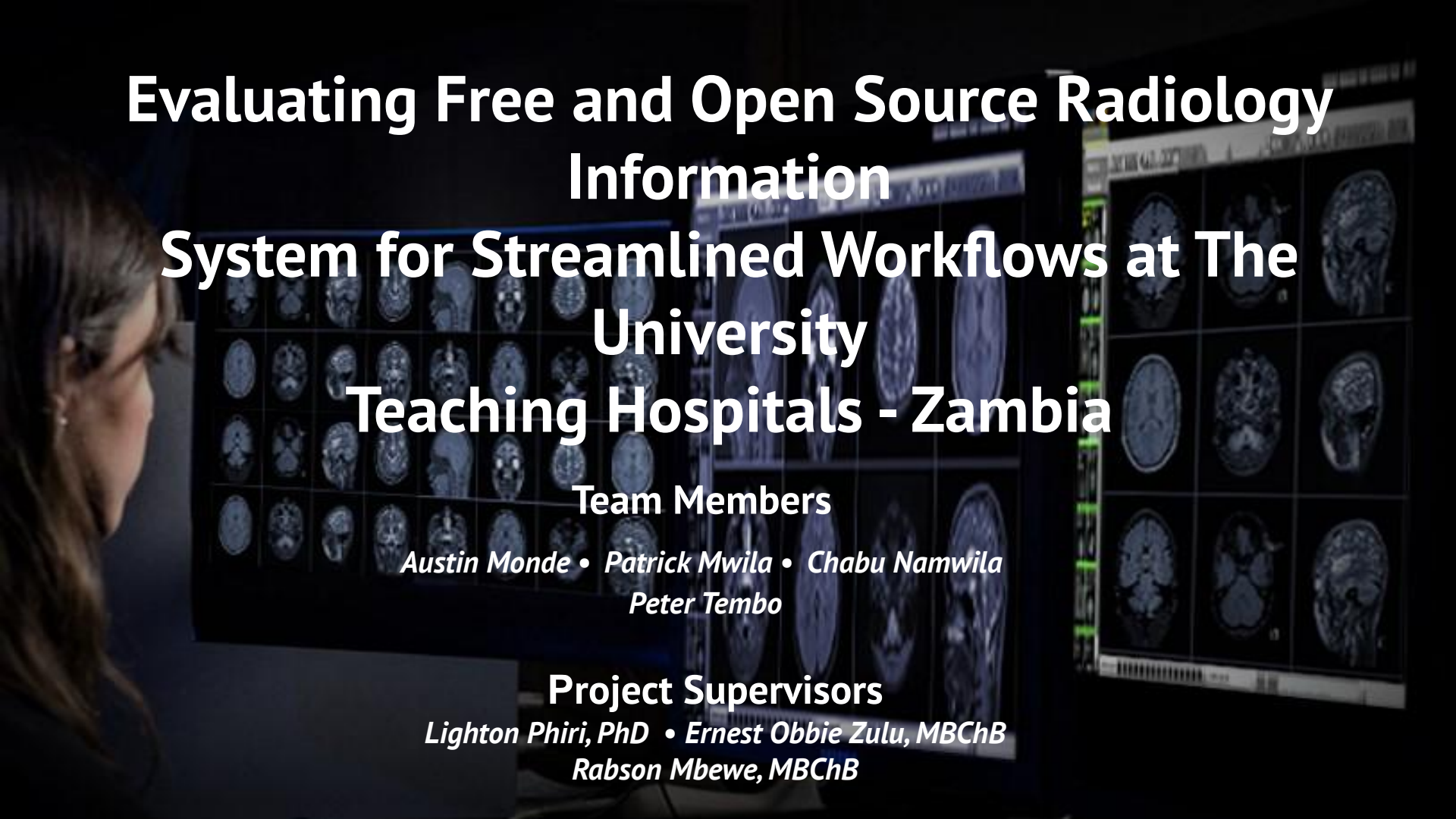


Conclusion

- This research has shown that adopting a FOSS Radiology Information System is a viable solution from manual based workflows to digitalised workflows.
- Ultimately, by adopting a RIS, the following benefits are made manifest:
  - **Improved Patient Outcomes:** Improves the accuracy and efficiency of radiology workflows, leading to more accurate diagnoses, timely treatment.
  - **Efficient Workflow:** Reduces the time taken to interpret and report on medical images, and improving overall workflow efficiency, which leads to improved productivity and reduced healthcare costs.

Demonstrations / Questions

- The OpenMRS RIS URL:
  - http://139.162.219.40:8080/openmrs
    - Username: admin
    - Password: Admin123



Evaluating Free and Open Source Radiology Information System for Streamlined Workflows at The University Teaching Hospitals - Zambia

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