Enhancing Radiology Workflows: Semi-automated Cervical Cancer Reporting at the Cancer Diseases Hospital

ZSC 2025
Zambia Science Conference
Nov 26-28, 2025
Lusaka, Zambia

Kangwa E. Mukuka[1,2], Festus Mwape[1,2], Lena Lambart[3], Mayumbo Nyirenda[1], Lighton Phiri[2] and Zola Mahlaza[4]

[1]Dept. of Computing and Informatics, University of Zambia · [2]DataLab Research Group, University of Zambia
[3]Dept. of Oncology, Cancer Diseases Hospital, University Teaching Hospitals · [4]Dept. of Computer Science, University of Cape Town

Abstract

Cervical cancer remains the most prevalent form of cancer among women in Zambia, contributing significantly to delayed treatment and high mortality rates. At the Cancer Diseases Hospital (CDH-UTH), radiologists face substantial workflow challenges, including prolonged turnaround times for report generation. This project proposes a semi-automated software solution to streamline radiology workflows and reduce reporting delays. The system integrates a structured checklist interface, FIGO staging support, and an editable AI-assisted report generator, all deployed via a web-based platform built with ReactJS and Express.js. A pilot evaluation involving radiologists at CDH demonstrated strong usability and workflow alignment, with positive feedback on interface clarity and reduced manual effort. The solution also incorporates metadata extraction, standardized reporting formats, and plans for integrating a fine-tuned machine learning model. By enhancing reporting efficiency and supporting clinical decision-making, the system aims to improve patient outcomes and contribute to scalable cancer care innovation in low-resource settings.

Keywords: Artificial Intelligence (AI), Cancer Diseases Hospital - University Teaching Hospitals (CDH-UTH), Cervical Cancer, Computed Tomography (CT), Digital Imaging and Communications in Medicine (DICOM), International Federation of Gynecology and Obstetrics (FIGO), Natural Language Generation (NLG), Natural Language Processing (NLP).

Introduction

Background: In Zambia, the scarcity of radiologists has resulted in significant delays in cancer treatment, with patients waiting up to three months for their first treatment after diagnosis. Specifically, there are less than 15 radiologists in the public sector [1]. One of the primary contributing factors to this delay is the turnaround time, which refers to the period between a radiologist receiving images and sending back a report [2]. Research shows that cancer continues to be one of the leading causes of death worldwide [3]. Cervical cancer in Zambia is the most popular form of cancer, accounting for 41.1% in females and 23.8% in overall cases nationwide. Additionally, among the various forms of cancer, cervical cancer is ranked first as causing the most deaths in Zambia at 23.4% [4].

Statement of Problem: Delayed initiation of cancer treatment due to prolonged medical image interpretation and report generation significantly worsens patient outcomes, often leading to preventable deaths. Currently, at observed hospitals, the process takes approximately two hours, with 30 minutes dedicated to report generation alone. This project aims to develop a software-based solution to streamline and expedite the interpretation and reporting process, ultimately reducing delays and improving patient outcomes.

Aim: The aim of this study is to design and implement a software based solution that reduces the turnaround time, thereby improving the efficiency of radiology workflow.

Objectives:

i. To demonstrate the understanding of the cervical cancer staging workflow.
ii. To design and implement a software that assists radiologists as they interpret images and generate reports.
iii. To evaluate the effectiveness and usefulness of the implementation.

Research Questions:

i. How can we develop a model to semi-automate cervical cancer report generation using machine learning?
ii. How can we develop a prototype based on the model in (i), to semi-automate cervical cancer report generation using machine learning?
iii. How does the model generalize on Zambian patients?

Significance of the Study: The findings of this study will be of great benefit to medical practitioners in the country in assisting the process of report generation.

Literature Review

The first large-scale contrastive vision-language Framework or 3D chest CT was introduced by CT-CLIP, trained on a dataset o 25, 692 paired CT volumes and reports. The volumetric slices are encoded into spatial-causal tokens by a 3D transformer. These tokens are contrastively aligned with embeddings from the including and impression section of radiology reports. This allows zero-shot multi-abnormality detection and supports case retrieval and vision-language chat [5]. Unlike 2D VLMs, Merlin processes the entire 3D voxel volume at once enabling a better understanding of abdominal organs. Merlin is a CT foundational model trained on 6 million image slices, HER codes and reports [6]. M3D-LaMed expands 3D VLM capabilities by combining a pretrained 3D ViT encoder with a large language model using a 3D spatial pooling perceiver. It is built on 120K 3D image-text pairs and 622K instructions, it supports a wide range of tasks including image–text retrieval, VQA, report generation, and 3D referring segmentation [7].

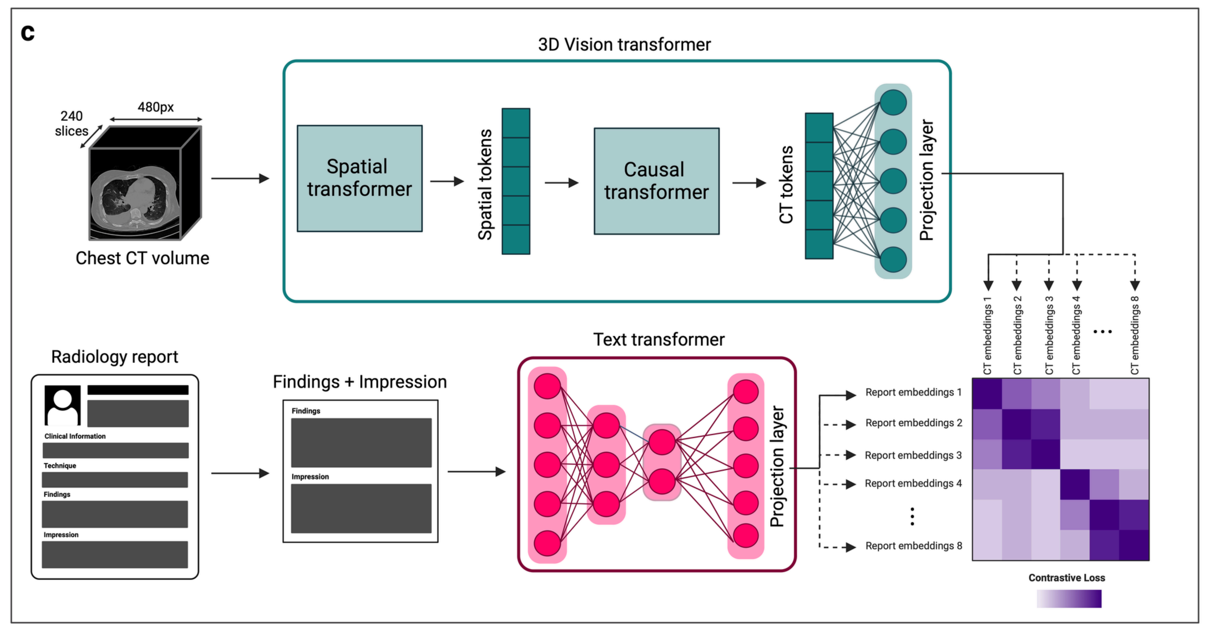

Figure 1. CT-CLIP workflow illustrating spatial–causal 3D vision transformers aligned with radiology report embeddings via contrastive learning. Diagram adapted from Hamamci et al., 2024 (CT-CLIP).

Materials and Methods

This study adopted a mixed methods research design to explore radiologists' workflow challenges and evaluate the potential of an AI-assisted reporting system at the Cancer Diseases Hospital (CDH-UTH). The approach combined qualitative and quantitative techniques to capture both contextual insights and structured user feedback. The spiral model was use d as the software process model of choice.
Due to the AI model not being trained, performance metrics such as accuracy and efficiency were not assessed in this phase. The focus remained on user-centered evaluation, laying the foundation for future technical validation once the model is fully trained.

- Dataset: Medical reports from CDH-UTH pending ethical approval.
- Machine Learning Model
  - Llama-3 8B model from Meta AI
- WebAPI
  - Data from the Machine Learning model is exposed through an API using Express.js.
  - The API is responsible for selecting, analyzing, and producing predicted results based on the features.
- WebApplication
  - Software development tools: React, Node.js and Express.js
  - Visual Studio Code as an IDE
  - Git and GitHub was used for version control.
- Database: MongoDB was used for data storage.

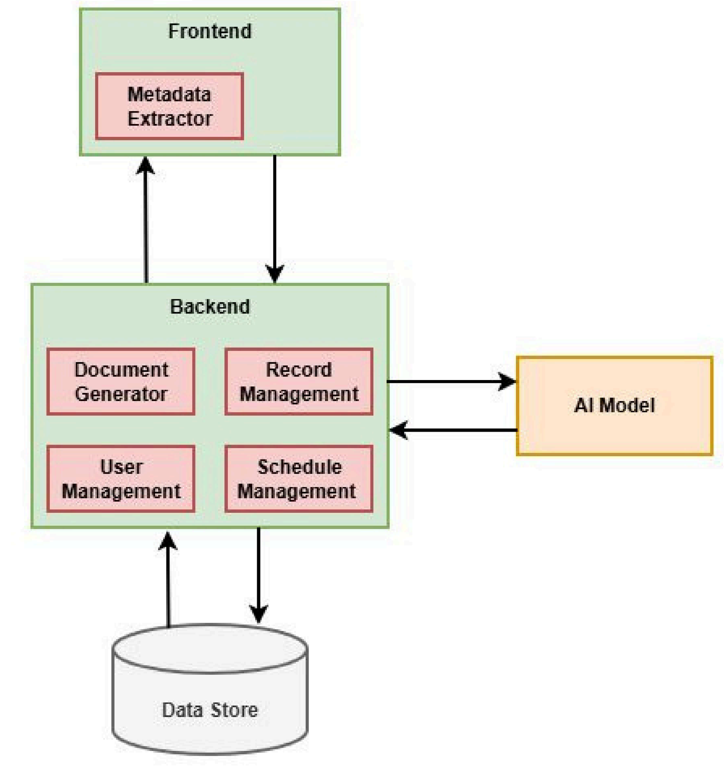

Figure 2. System architecture

Results and Discussion

Based on the identified challenges, a semi-automated reporting system was designed and implemented using a web-based architecture with React and Express. Although the AI model was not yet trained during this phase, the functional prototype demonstrated that, by automating metadata extraction and standardizing report generation, the system reduces manual documentation time, a key contributor to reporting delays.

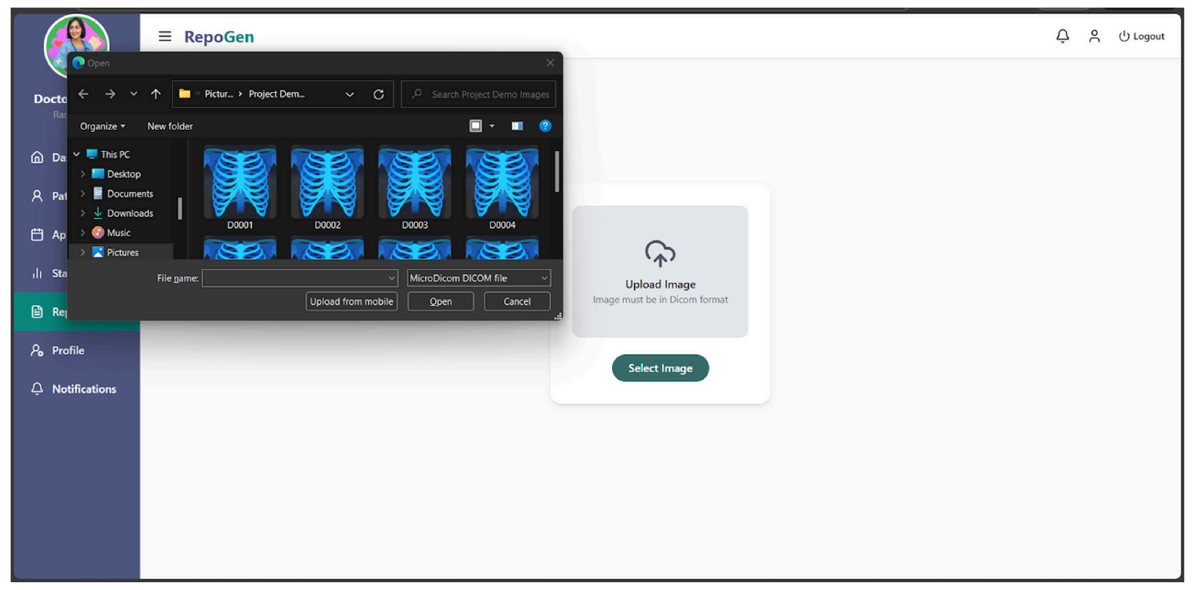

Figure 3. DICOM Formatted Image Upload Interface.

Evaluation

Usability was measured using controlled observation and the Technology Acceptance Model (TAM) among three radiologists at CDH-UTH.

TABLE I. Evaluation results.

Evaluation Statement	Mean Score	Interpretation
The system interface is intuitive and easy to navigate	4.7	Strongly Agree
The checklist and FIGO stage selection process is clear and well-structured	4.7	Strongly Agree
The app responds quickly and reliably	4.3	Agree
I feel confident using the app without additional help	4	Agree
The app integrates well with my workflow	5	Strongly Agree
The system reduces manual data entry effort	5	Strongly Agree
I would consider using this system regularly if fully implemented	4.7	Strongly Agree

Conclusion and Recommendations

In this study we proposed a method to reduce the turnaround time for cervical cancer reporting, we measure the usability of the software among the radiologists at CDH-UTH. Their positive attitude towards the piece of software proved to be useful, though the delayed ethical approval hindered a more in-depth quantitative analysis of the software. Planned future-work includes fine tuning the M3D-LaMed for image-text retrieval, report generation, and segmentation once ethical approval has been granted.

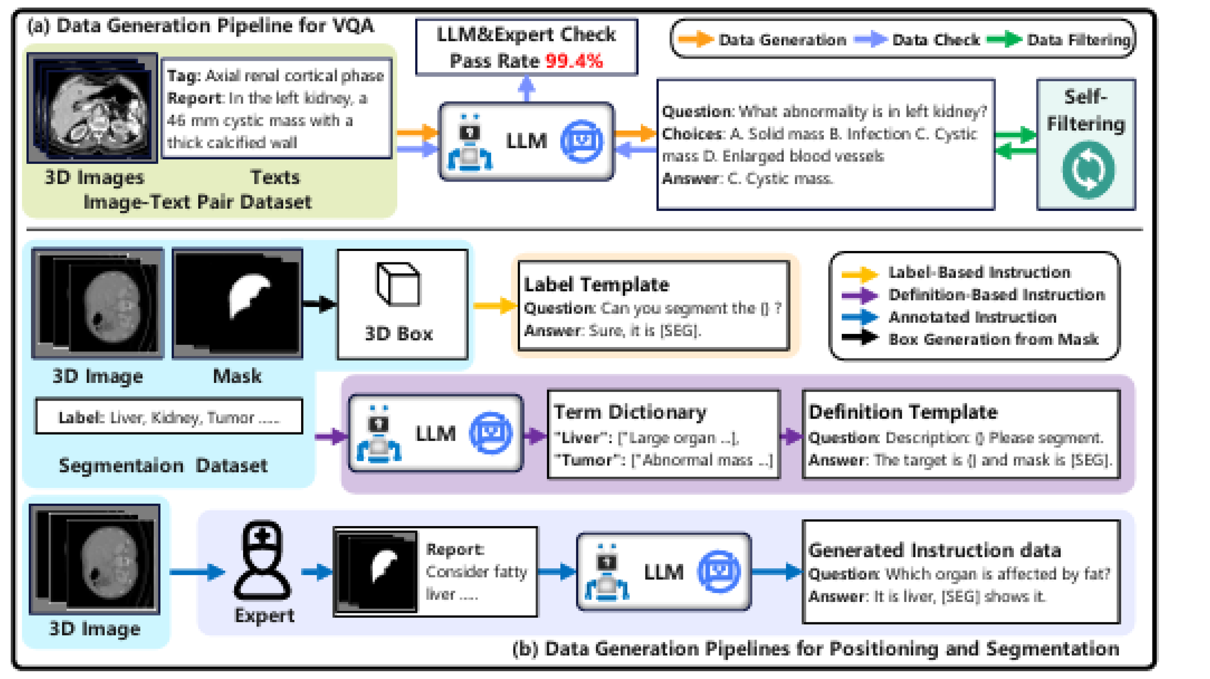

Figure 4. Proposed future model architecture based on M3D-LaMed.

Acknowledgements

We would like to thank the radiologists and staff at the Cancer Diseases Hospital for their support and insightful contributions. We also thank the Department of Computing and Informatics at the University of Zambia for academic support, UNZA BREC, Google Research, Data Science Africa, and the EMI-Z Project for their guidance and collaboration throughout this work.

References

[1] O. Bwanga, et al, "Image Interpretation and Reporting by Radiographers in Africa: Findings from the Literature Review and their Application to Zambia," Medical Journal of Zambia, vol. 48, no. 2, pp. 125–135, 2021.
[2] J. M. Mumba, et al, "Cervical cancer diagnosis and treatment delays in the developing world: Evidence from a hospital-based study in Zambia," Gynecologic Oncology Reports, vol. 37, p. 100784, 2021.
[3] M. Kalubula, et al, "Epidemiology of Cancers in Zambia: A significant variation in Cancer incidence and prevalence across the nation," Malawi Medical Journal, vol. 33, no. 3, pp. 186-195, Sep. 2021.
[4] J. Ferlay, et al, "Global Cancer Observatory: Cancer Today," International Agency for Research on Cancer, Lyon, France, 2024.
[5] I. E. Hamamci et al., "Developing Generalist Foundation Models from a Multimodal Dataset for 3D Computed Tomography," arXiv, arXiv:2403.17834, Sep. 2025.
[6] L. Blankemeier et al., "Merlin: A Vision Language Foundation Model for 3D Computed Tomography," arXiv, arXiv:2406.06512, Jun. 2024.
[7] F. Bai et al., "M3D: Advancing 3D Medical Image Analysis with Multi-Modal Large Language Models," arXiv, arXiv:2404.00578, Mar. 2024.

Contanct Information

DataLab Research Group
University of Zambia
Private Bag 32379
Lusaka, Zambia 10101

Web: datalab.unza.zm
Email: datalab@unza.zm
EMI x Z: emi.org.zm

Kangwa E. Mukuka <kangwa1mukuka@cs.unza.zm>
Festus Mwape <festus.mwape@cs.unza.zm>
Lighton Phiri <lighton.phiri@unza.zm>