UNIVERSITY OF THE WESTERN CAPE

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# Annual Progress Report - 2025

Department of Computer Science

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| **Student Name:** | Naledi Khumalo |
| **Student Number:** | 3892456 |
| **Supervisor:** | Dr. James Nkosi |
| **Department:** | Computer Science |
| **Reporting Period:** | 1 January 2025 - 31 December 2025 |
| **Date Submitted:** | 15 September 2025 |

## 1. EXECUTIVE SUMMARY

This report summarises research progress for the 2025 academic year. Significant milestones have been achieved including completion of data collection (Phase 2), successful development of baseline machine learning models achieving 91.8% accuracy, and a peer-reviewed conference publication at SAICSIT 2025. The project timeline remains on track with minor delays in ethics clearance renewals.

## 2. RESEARCH PROGRESS

### 2.1 Completed Activities

- [x] Collected and preprocessed 2,400 chest X-ray images from Tygerberg Hospital
- [x] Developed 3 baseline CNN models (ResNet-50, EfficientNet-B3, DenseNet-121)
- [x] Achieved best accuracy of 94.2% sensitivity on the validation set
- [x] Published paper at SAICSIT 2025 conference proceedings
- [x] Completed Python for Data Science workshop (CSIR, 3 days)
- [x] Led department journal club discussion on transformer architectures

### 2.2 Challenges Encountered

The primary challenge has been delays in obtaining additional imaging data from Groote Schuur Hospital due to institutional review board (IRB) backlog from COVID-era processes. This has been partially mitigated by augmenting the training dataset with publicly available NIH ChestX-ray14 images. Ethics clearance renewal is expected by Q1 2026.

## 3. PUBLICATIONS & PRESENTATIONS

- Molefe, T., & van der Berg, S. (2025). "ML-Driven Diagnostics in Low-Resource Settings." Proc. SAICSIT 2025.
- Molefe, T. (2025). "Attention Is All You Need for Medical Imaging." Department Journal Club, UWC. (Presented)

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# Progress Report (cont.)

Plan & Supervisor Assessment

## 4. PLAN FOR NEXT PERIOD

> Complete model optimization with attention mechanisms (Q1 2026)

> Begin clinical validation at Tygerberg Hospital (Q2 2026)

> Deploy prototype on edge device for point-of-care testing (Q2 2026)

> Submit journal paper to The Lancet Digital Health (Q3 2026)

> Begin thesis writing - Chapters 1-3 draft (Q3 2026)

## 5. SUPERVISOR ASSESSMENT

Naledi Khumalo has demonstrated excellent progress this reporting period. The research output is of high quality and the conference paper was well received. I am satisfied that the project is on track for completion within the registered period. The data collection delays are acknowledged and the mitigation strategy is appropriate.

**- Dr. James Nkosi**

Date: 20 September 2025

## 6. OVERALL RATING

[ ] Unsatisfactory

[ ] Below Expectations

[ ] Satisfactory

[ ] Good

**[X] Excellent**