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Opinion Piece

Digital health records in South Africa: A template on how this can be achieved in the public sector

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INTRODUCTION

Maintaining health records is essential for healthcare professionals and institutions to ensure continuity of patient care. These records also support facility-related administration purposes, hospital statistics, research, and legal processes. While electronic health records are widely adopted in high-income countries, low- and middle-income countries lag due to various challenges.(1) Paper-based systems are prone to misfiling, loss, limited accessibility, illegibility, and a lack of version control. They are difficult to back up, environmentally unsustainable, and pose barriers to operational and research use.

The World Health Organization (2) advocates for digital health, including electronic health records, as a core health system priority, promoting an ethical, secure, and sustainable implementation based on transparency, accessibility, scalability, replicability, interoperability, and data privacy.

The Imperial Lancet Commission (3) emphasises that successful digital health implementation requires not only the right technology but also innovative in process, equitable deployment, financially sustainable, and the utilisation of existing technologies such as mobile phones. Fritz et al. (4) highlight the lack of dedicated information technology personnel in resource-limited settings, emphasising the importance of adapting to available human resources.

Despite its promise, digitalisation is costly and can introduce new challenges for healthcare workers, potentially complicating workflows. While paper records are imperfect, they remain functional. Thus the benefits of digital systems depend heavily on thoughtful implementation and effective management.

As part of its strategic goal of "Ensuring better health for all," the University of the Witwatersrand (Wits) has prioritised the digitalisation of medical records at Chris Hani Baragwanath Academic Hospital (CHBAH), its largest clinical training platform. The first phase of the "Wits Bara Digitalisation Project," is presented.

BACKGROUND TO THE PROJECT

CHBAH is one of the largest public hospitals on the African continent, servicing 2,680 inpatient beds. The hospital serves close to 1. 9 million people and is a sub-speciality referral centre for patients well beyond the documented referral pathways. Furthermore, the hospital serves as one the primary clinical training and research platforms for Wits.

Resource constraints remain a key challenge in South African public hospitals.(5) At CHBAH, external funding, often from non-profit organisations , play a vital role in supporting services. One such organisation is Surgeons for Little Lives (SFLL), founded by members of the Wits Department of Paediatric Surgery in 2015, which has established strong partnerships that contribute to sustained improvements in patient care.(6)

Most clinical departments at CHBAH rely on paper-based health records. Some services, for example, laboratory,

radiology, and admissions, use siloed legacy electronic systems. Healthcare professionals also use various online applications (Apps), such as Google Forms, Wardworx and Trello, to streamline work processes, typically accessed via personal devices. These systems do not integrate and raise concerns about data fragmentation and patient confidentiality.

Given CHBAH's size and complexity, a phased approach to digitalisation was adopted. Based on the work completed by SFLL, the CHBAH Department of Paediatric Surgery was selected for development and roll-out of Phase I due to:

- Scale: The Department is suitably sized for pilot implementation – small enough (25 staff members) to allow for close collaboration, yet large enough (200 admissions and 660 outpatient visits monthly) to demonstrate impact.
- Experience: The Department has prior experience with electronic health records and have a better understanding of their functional and technical requirements.
- Buy-in: Staff are highly motivated to reduce workflow inefficiencies caused by duplicate data entry.

Key stakeholders in this initial phase include the Wits Vice-Chancellor, the then academic head of Paediatric Surgery, the chair of SFLL, a philanthropist, CHBAH CEO and the Project developer. The developer brings extensive experience in building and deploying systems across industries, both locally and internationally, with expertise in software engineering and data analytics.

THE PROJECT

The Project aimed to provide healthcare professionals with modern access to clinical data by connecting siloed legacy systems.

The overarching goal was to enhance healthcare delivery through four key outcomes:

- adoption and use of the new electronic health system,
- improved data quality,
- enabling and enhancing research, and
- establishing a scalable proof of concept for broader implementation across CHBAH and other Wits clinical platforms.

To achieve the key outcomes, the system was co-designed with clinicians to align with existing workflows, making it intuitive, efficient, and preferable (even enjoyable) to use. It was introduced as a primary source of patient information, alongside paper records, during the transition.

The data captured needed to be accurate, reliable, and comprehensive, supporting clinicians in saving time and improving decision-making. Streamlining workflows and improving data availability were expected to directly enhance patient care. From a research perspective, the system enables secure, anonymised data access for academic research.

Patient rights and data protection remain central to the Project. In consultation with the Wits Human Research Ethics Committee, compliant information letters, consent, and assent forms were developed. On admission, parents or legal guardians will be asked to provide written consent for the retrospective use of their child's data, with assent obtained from children aged seven and older. This process will be implemented consistently across all phases.

TECHNICAL SCOPE OF THE PROJECT

To be compliant with global standard for digitally structured patient health information, the data repository has to be compliant with the Fast Healthcare Interoperability Resources (FHIR®). The repository integrates data from existing systems and is supplemented by clinician-entered information.

A mobile health App was designed with a robust and scalable architecture. Built using the Flutter framework, the App enables the creation of natively compiled applications for both iOS and Android from a single code base. This results in high performance, energy efficiency, and access to hardware features such as biometric authentication and near-field communication (NFC).

Data transmission between the App and the server is handled via gRPC (Google Remote Procedure Call), a modern, high-performance, open-source protocol that supports efficient, low-latency communication across platforms. This is particularly beneficial in environments with limited bandwidth or where data costs are a concern.

The App also utilises Microsoft's ASP.NET server as a middleware server, which provides tools and technologies for building secure web APIs (programmatic interfaces that enable applications to interact). ASP.NET allows easy and efficient communication between the mobile App and the server, enabling the App to access and manipulate data stored on the server. In addition, the App is aligned with the FHIR® standard, ensuring structured, standardised healthcare data exchange and interoperability with other systems in a standardised format.

This architecture supports the development of a scalable, efficient, and interoperable mobile health solution for healthcare professionals. The high-level system architecture diagram is provided in Figure 1.

The decision was made not to adopt EPIC or other established electronic health record systems due to several critical factors primarily related to their cost, lack of necessary infrastructure, reliable connectivity, and dedicated personnel. Established electronic health record platforms are also typically proprietary and rigid in nature.

Thus the Project prioritised integration with existing systems and avoiding creating isolated data silos. Engagement with high-level stakeholders from current service providers was initiated to explore integration pathways for patient

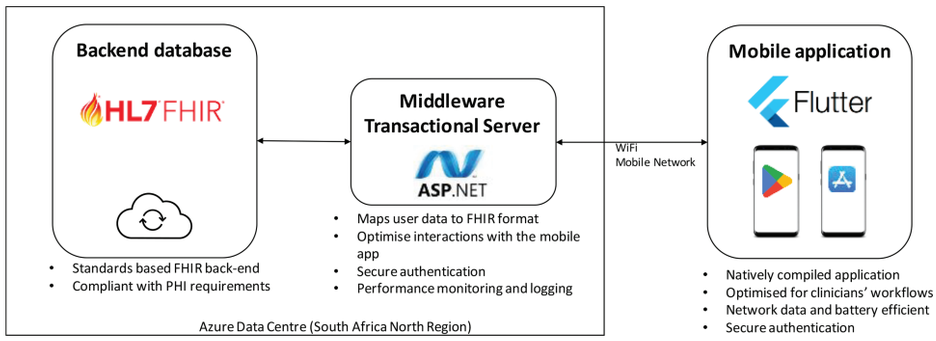

Figure 1: The visualisation of the high-level system architecture

Table 1: Planned development for Phase 1

Milestone	App functionality description	System replaced
Tasks	• User registration and biometric authentication • Create and search for patient files • View and edit basic patient details • Admit and discharge patients • Create and complete tasks for admitted patients	WardWorx
Doctors' notes	• Log procedures and operation notes • Log discharge summaries • Log general and uncategorised notes and images • Search and access previous notes • Generate summary statistics for admissions, discharges and procedures	HealthSpace Google doc: operations
Theatre lists	• Scheduled procedures • Edit, cancel or complete scheduled surgeries • View and export daily theatre lists	Google calendar Typed theatre lists
Morbidity and mortality notes	• Create notes in patient files to record morbidities, mortalities and central lines • Generating corresponding summary statistics	Google doc: morbidities, mortalities and central lines
Patient lists	• View and manage patient lists for daily handovers (for example recently admitted, pending emergency cases, pending external cases)	Google doc call sheets Weekly doc
Tests	• Log laboratory and radiology requests • Import laboratory results from the National Health Laboratory Service (using robotic process automation	National Health Laboratory Service website

records across platforms. Some of the systems in use at CHBAH include the National Health Laboratory Service system NHLS-TRAK, the hospital admission system SAP HIS, and the radiology system IMPAX. While full integration through application programming interfaces (APIs) is planned, it requires more time and resources. In the meantime, robotic process automation will be utilised to bridge the gaps until seamless interoperability is achieved. The use of open standards further enables future data portability and interoperability.

Legal compliance has been a priority from the outset. Legal experts were consulted to guide decisions, ensure regulatory compliance, and facilitate smoother implementation. The core back-end infrastructure, developed by Microsoft, meets the highest standards for healthcare data security and compliance. It also includes built-in functionality to automatically anonymise patient records upon export, facilitating secure and compliant research activities.

PROJECT DEVELOPMENT

The Project was conceptualised in April 2022 and leadership from the Department of Paediatric Surgery and SFLL met with the developers to define operational requirements. Engagement with junior doctors ensured buy-in and informed the development process. A strong, trust-based relationship was built between the doctors and the developer. The Project was developed and rolled out in incremental phases.

Phase 1 development commenced in November 2022. (Table 1).

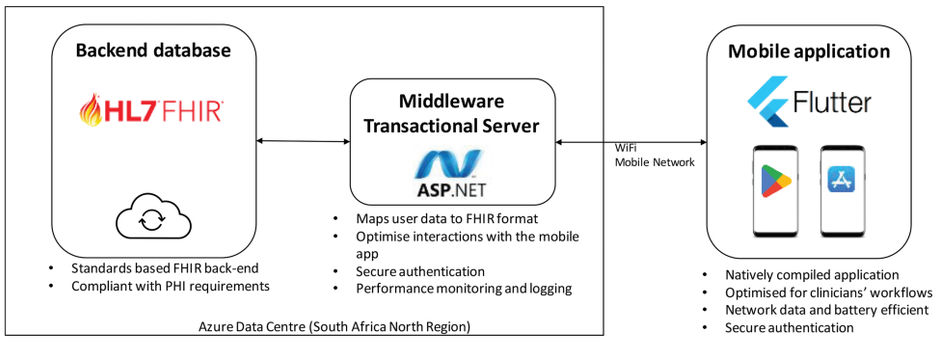

Figure 2: The visualisation of the high-level system architecture

TABLE 2:

Ethical	• Data is secure, and patient privacy is ensured • Project governance by a university management committee to ensure the sustainability of the Project
Financial	• No additional staff is required; healthcare professionals enter the data as they engage with patients • Improve the efficiency of healthcare professionals • Cost-effective as no additional devices or infrastructure are required, staff use their mobile phones, which are familiar and always accessible
Functionality	• Developed with the end users, addressing end users' needs. • Developed for local context • Usability – App using health care professional's smartphone • User interface experience • The App can aggregate and report data • Customised, structured forms help to standardise data capture; built-in validation flags highlights missing or erroneous data
Organisation	• Extensive stakeholder involvement during inception, development, validation, testing and implementation. • Project governance • Commitment to the Project – at grassroots level and from all levels of management
Political	• Support from the hospital management • Collaboration with authorities in developing a national coding system
Technical	• Technical challenges, such as internet connectivity, were addressed swiftly • Reputable system architects • Using international standards and state-of-the-art interfaces
Training	• The doctors were all computer literate and had existing knowledge of electronic databases. • The Project developer provided extensive training on the App's use. • Built-in feedback functionality in the App allows users to send feedback (with annotated screenshots) to developers from within the App; high-priority issues and suggestions are addressed promptly.

Phase 2 expanded Phase 1 to the Departments of Paediatric Surgery at Charlotte Maxeke Johannesburg Academic Hospital and Nelson Mandela Children's Hospital. Phase 3 has included the Department of Paediatrics at CHBAH.

TECHNICAL SCOPE OF THE PROJECT

The developed mobile health App was designed with a robust and scalable architecture. Built using the Flutter framework, the App enables the creation of natively compiled applications for both iOS and Android from a single code base. This results in high performance, energy efficiency, and access to hardware features such as biometric authentication and near-field communication (NFC).

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SUSTAINABILITY OF THE PROJECT

Sustainability measures were embedded at multiple levels of the Project from the outset.

A core university management committee was established to oversee long-term sustainability and governance. This committee includes key stakeholders and overlaps with the Project's steering committee to ensure continuity and alignment.

One of the committee's primary responsibilities is financial oversight. Surgeons for Little Lives and a private philanthropist funded phases 1 and 2, while Phase 3 received funding from the Wits Faculty of Health Sciences and the same donor. Ongoing costs for these phases are minimal and have already been secured.

Recognising the challenges of financial sustainability in digital health initiatives, future phases will only proceed once the university management committee, with support from Wits University, secures the necessary funding to ensure responsible and sustainable implementation.

FACTORS THAT CONTRIBUTED TO THE SUCCESSFUL IMPLEMENTATION OF THE PROJECT

Fritz et al (4) suggest seven categories of factors that contribute to successful health IT implementation and Table 2 highlights these catgories specic to this project.

IMPACT OF THE PROJECT

Following an appropriate post-implementation period, each department will formally evaluate the impact of the Project. Informal observations indicate that healthcare professionals spend less time on data entry and retrieval, allowing more time for patient care. The Project has improved access to clinical data, enabling more informed decision-making.

CONCLUSION

Based on the recommendations of the Imperial Lancet Commission on implementing and expanding technology, a project was developed and executed to provide healthcare professionals in the Department of Paediatric Surgery at CHBAH with modern, integrated access to previously isolated legacy information systems, alongside easy and efficient access to clinical patient data. This initiative paved the way for broader implementation across other clinical departments at CHBAH and can serve as a guide for hospitals with limited resources aiming to digitise their health records.

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Author contributions

All authors contributed to the conception and implementation of the project.
JS wrote the draft manuscript.
All authors critically reviewed the manuscript, approved the final version, and agreed to be accountable for the manuscript content.

Declaration of interest

JS is employed by Surgeons for Little Lives.
JL is the chairman of Surgeons for Little Lives.
RP represents Max Brozin Investments.
EG is employed by Business Science Corporation.
AG is a director of Business Science Corporation.

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