Abstract

Tuberculosis (TB) continues to be a global cause of millions of deaths yearly. The World Health Organization (WHO) believes that TB can completely be eliminated with proper treatment and monitoring tools and systems in place. It has therefore developed a strategy to end TB worldwide, the Stop TB Strategy focusing on eliminating TB by 2035. The general objective of this study was to develop a web-based module for improved healthcare delivery, monitoring and reporting for TB patients in Care2x HMIS. The specific objectives of this study were:

- Identify, gather and analyse the requirements for TB module for healthcare delivery, monitoring and reporting in Care2x HMIS
- Develop and integrate with Care2x HMIS, a TB module for healthcare delivery, monitoring and reporting
- Validate the developed module for TB in Care2x HMIS

This study selected Kibong'oto Infectious Diseases Hospital 'KIDH' located at 3°11'46.3"S 37°06'21.0"E coordinates in Siha district of Kilimanjaro Region, Tanzania as a case study area. The targeted group was health services providers for TB patients. The motive for selecting KIDH was to answer the first research question "How is the existing TB care and treatment practiced and what are the requirements for developing a TB module in Care2x HMIS?" as KIDH is the National designated facility for providing care and treatment of TB patients.

Purposive sampling was used to select KIDH since it is the specialised in TB care and designated to treat TB in the country. The facility has a total 250 employees, clinical and non-clinical. Stratified sampling was employed to get participants from different strata based on profession. On each stratum, representatives were selected randomly of which each had an equal chance. The selected representatives comprised of 12 doctors, 26 nurses, 3 laboratory personnel, 1 radiologist, 2 pharmacists and 2 IT personnel.

The tools and techniques which were employed in the collection of data were questionnaires, interviews as well as documents and Care2x HMIS review.

Qualitative and quantitative methods were both employed in this study to get what was required of the TB care digitisation at KIDH. In analysing quantitative results, the Statistical Package for the Social Sciences (SPSS) was used. The process started by carefully analysing the Patients flow chart

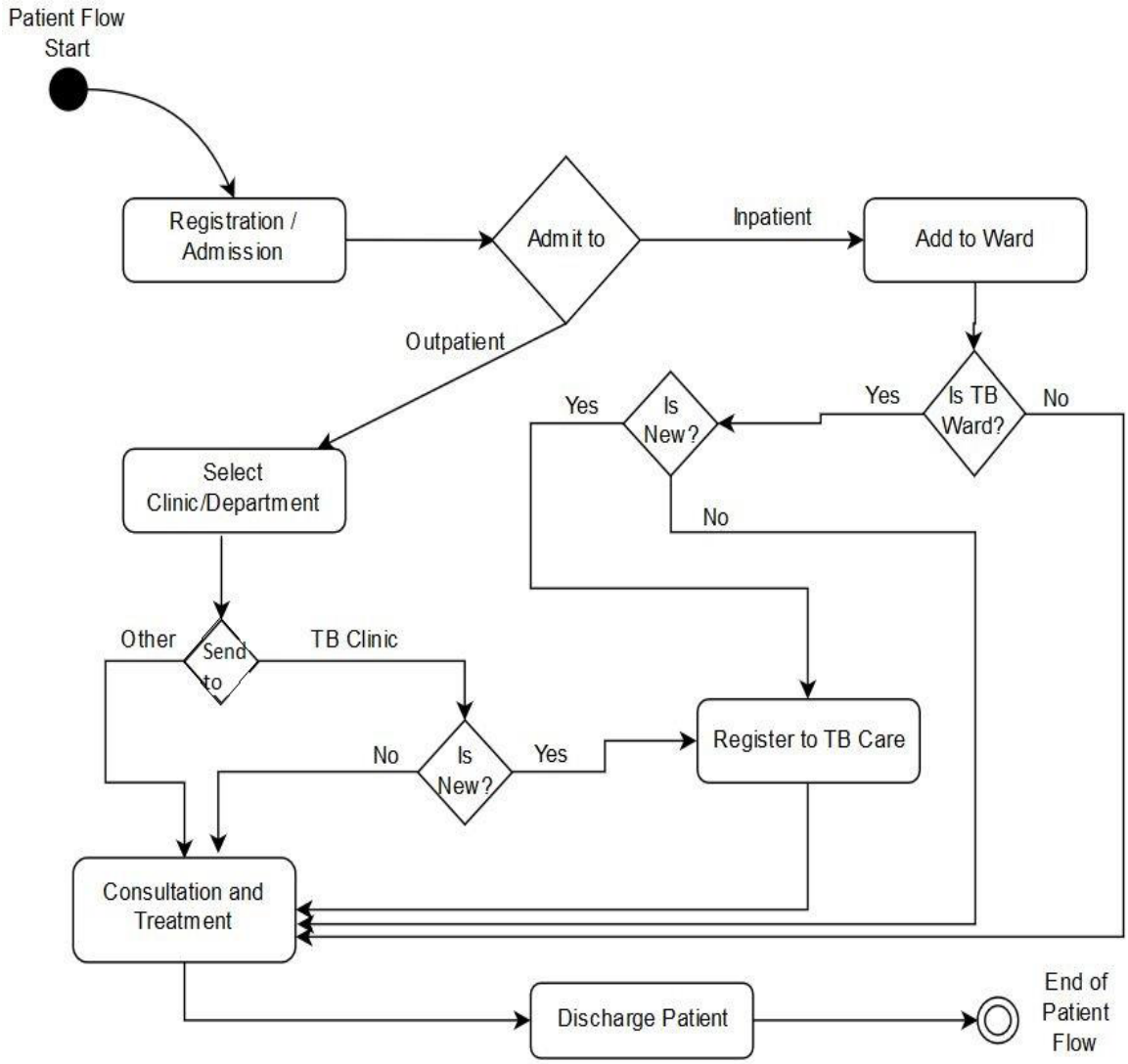

Figure 6: Patients flow with integrated TB Module in Care2x

The design of the system involved

- Architectural Design

After analysis of both primary and secondary data, a decision logic and a framework for the TB module development and integration in Care2x HMIS were developed.

- Decision Logic

This study developed a flow for TB patients in relation to the existed modules in Care2x HMIS. Once the registration and admission send the patient to TB clinic/department in the main system, the list of patients in TB clinic gets updated and a user of the module can then access the patient from the module. The patient, if is first time visit, provides additional information which is recorded via the module. Figure 6 describes the designed patient flow with integrated TB module in Care2x HMIS that would not affect the existed flow.

Module framework.

The framework shows that, all the modules including the TB module will share common database storage making the data available in all modules.

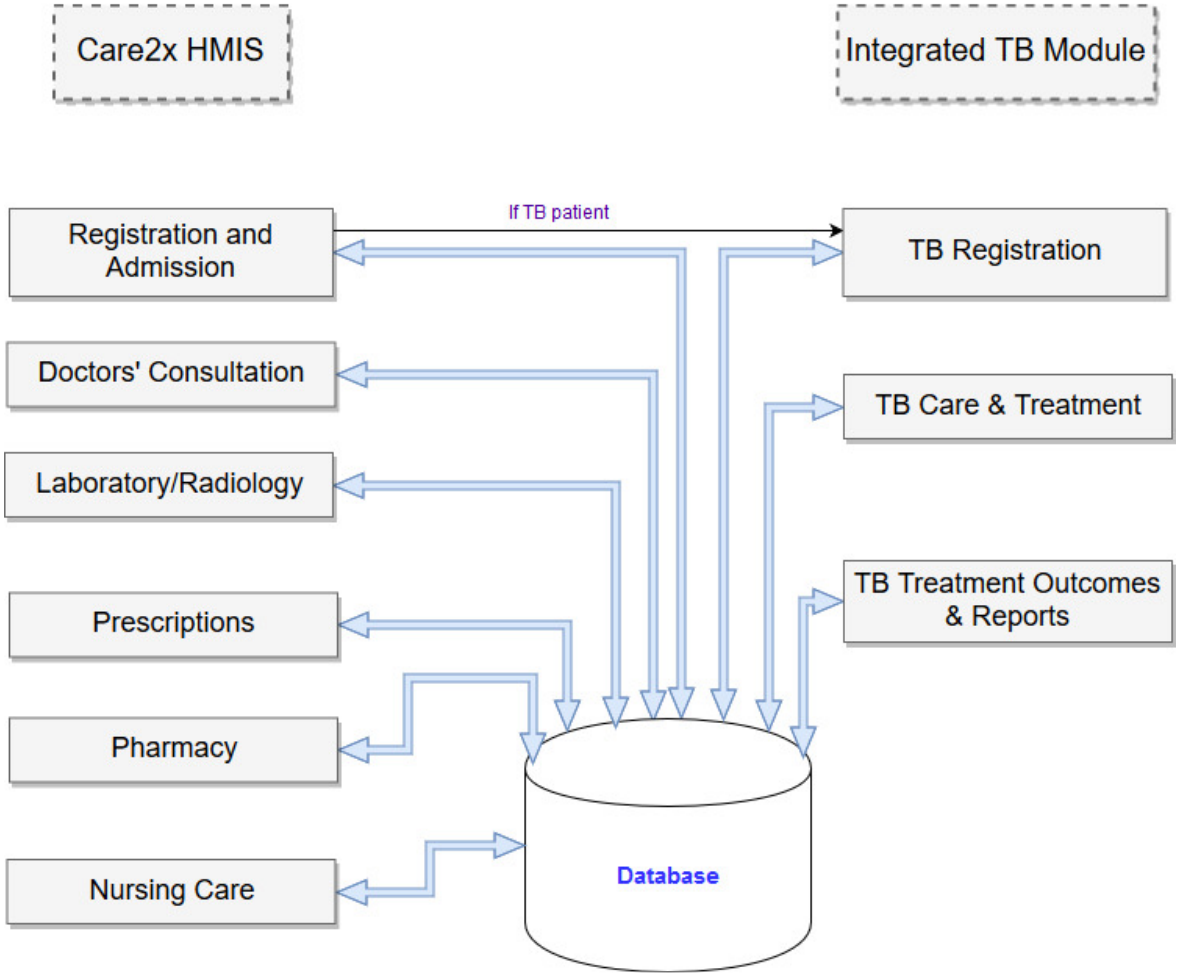

Figure 7: TB module development framework

Module Development Approach

- Development methodology

Any software development follows a methodology, that is, a set of rules and guidelines used in the process of planning, designing, developing, testing, setup and maintaining a software product. In following these set of rules and guidelines, a System Development Lifecycle (SDLC) is created. Several methodologies exist, however this study used agile methodology to develop the TB module in Care2x HMIS. Agile methodology combines iterative and incremental processes that are repeated over and over until customer satisfaction is reached. It follows the principles to satisfy customer, welcome changes, deliver working product often and other principles. The main advantages of agile methodology are reduced development time, active customer participation in the process and effective response to change that leads to customer satisfaction. The agile methodology is described in Figure 8

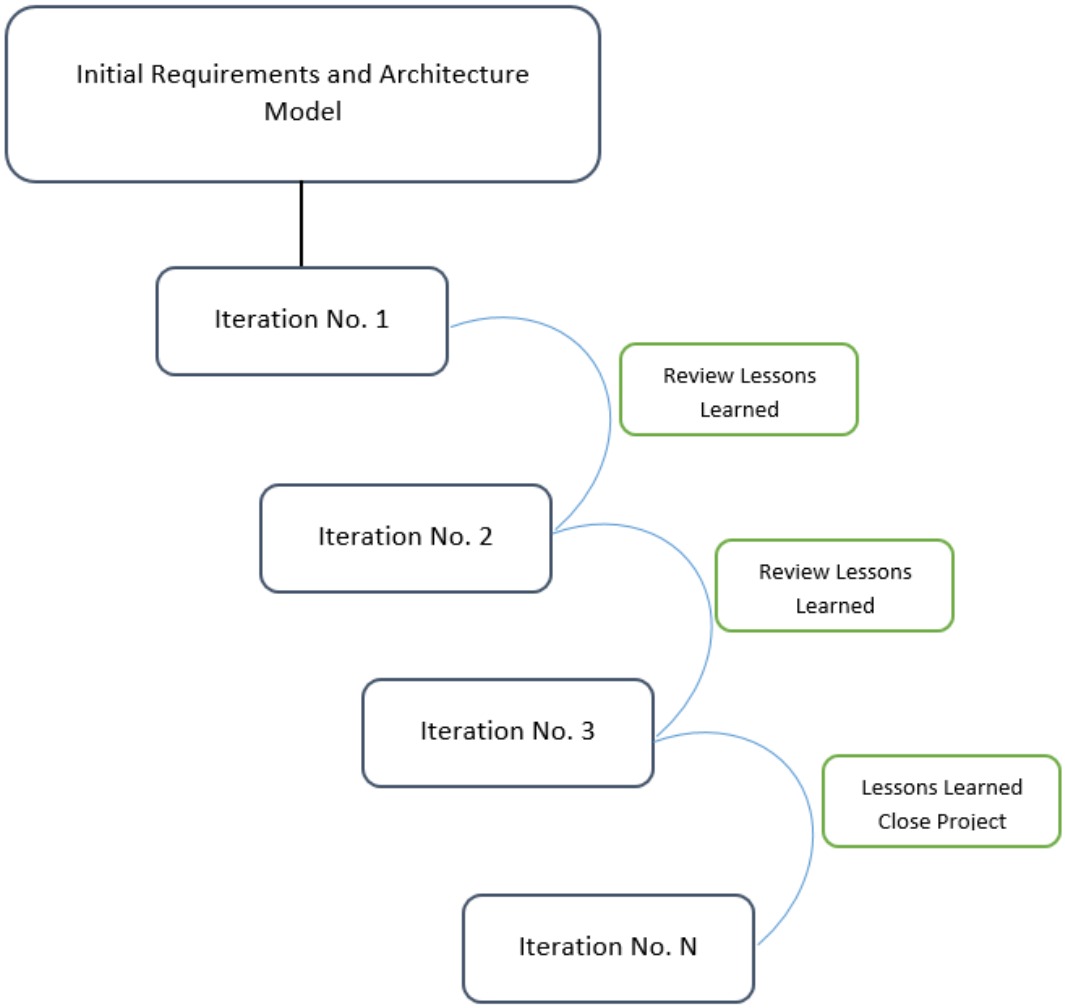

Figure 8: Agile methodology

The tools and techniques which were employed in the collection of data were included;

- Questionnaires
- Interviews
- Documents and
- Care2x HMIS review.

Results

- Kibong'oto Infectious Diseases Hospital (KIDH), formerly Kibong'oto National TB Hospital (KNTH) in Tanzania, management of TB care and treatment data used a paper-based system.
- With the developed TB module in Care2x HMIS, more TB patients could be served in relatively shorter time and activity work-flow run more smoothly. The integrated TB module in Care2x HMIS moreover, managed to eliminate the isolation which existed between the TB

patients' data kept in papers and other clinical data that were kept in Care2x HMIS. Therefore, the developed TB module integrated into Care2x HMIS improved the overall healthcare delivery to TB patients at KIDH.

Conclusion

- The use of e-health systems has become important for quality health care delivery, data recording and reporting. Health facilities that have implemented e-health HMIS have more effective and efficient service delivery, with potentially higher productivity, providing healthcare of greater economic and social value.
- However, most facilities employing HMIS, have either a missing digitized TB healthcare delivery module, or are running a separate system for TB care only or integrated TB care and HIV co-infected patients only. This makes facilities to run two parallel RR systems which are not integrated nor do they share data leading to isolation of patients' TB data from other clinical data.
- The deployed e-health system at KIDH, Care2x HMIS, had also most of the generic functions to support clinical care and treatment but missing a module for TB healthcare delivery, recording and reporting. All the care and treatment activities for TB patients were paper-based.

- The paper-based system for recording and reporting TB care and treatment data at KIDH was associated with lots of weaknesses and challenges that include: Low confidentiality and security of patients' treatment data, missing TB data elements that were skipped during the filling of TB cards, isolation of data, the system was time consuming, running costs and problems in reports generation. To overcome the said weaknesses and challenges, this study sought to introduce the use of ICT in TB care at KIDH by developing and integrating into Care2x HMIS, a module for TB care and treatment, with an aim of improving management of TB and eventually improve healthcare delivery to TB patients.
- This study, through interviews and review of the existed Care2x HMIS at KIDH, learned and understood the workflow of activities in TB healthcare delivery together with the architecture, design and functionalities of the existed HMIS. The collected requirements were used to develop and integrate into Care2x HMIS, a module for TB care. The developed TB module was successfully integrated into Care2x HMIS and put into use by the facility. It was found that, more TB patients could be served in relatively shorter time and activity work-flow run more smoothly. The integrated TB module in Care2x HMIS moreover, managed to eliminate the isolation which existed between the TB patients' data kept in papers and other clinical data that were kept in Care2x HMIS.

Recommendation

- This study focused on developing solution for digitization of TB care in one facility, however, it has shown that digitization of TB management is possible. The researcher therefore calls upon other facilities which do not use ICTs in management of TB to follow. On the other hand, the study has laid down a framework for further development to provide a national wide integrated solution for TB management through the use of ICT.

- Also, the provided solution by this study focused on a web-based module and data storage, however, the results of this study can be used by other researches as a benchmark for further development in other areas such as mobile integration for TB care through Unstructured Supplementary Service Data (USSD) for featured phones and mobile applications for smart phones. This would go with the nationwide ICT solution for TB management. Further, it is also possible to digitize reporting of TB suspected patients for immediate attention and tests which was not covered in this study.