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Designing a Digital Health Solution: A Platform for Automated Surveillance of Fungal Infection

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Abstract. Surveillance of invasive fungal infection (IFI) requires laborious review of multiple sources of clinical information, while applying complex criteria to effectively identify relevant infections. These processes can be automated using artificial intelligence (AI) methodologies, including applying natural language processing (NLP) to clinical reports. However, developing a practically useful automated IFI surveillance tool requires consideration of the implementation context. We employed the Design Thinking Framework (DTF) to focus on the needs of end users of the tool to ensure sustained user engagement and enable its prospective validation. DTF allowed iterative generation of ideas and refinement of the final digital health solution. We believe this approach is key to increasing the likelihood that the solution will be implemented in clinical practice.

Keywords. Design thinking framework, digital health solutions, invasive fungal infection, artificial intelligence

1. Introduction

IFIs are associated with high morbidity, mortality, and costly management most commonly affecting immunocompromised and critically ill patients. Traditional surveillance approaches for IFIs involve the examination of imaging reports, medical

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records, and anti-fungal drug dispensing data, as well as microbiology and histology results.

Our goal is to develop a functional and purposeful tool for automated routine surveillance of IFI. Here, we describe the process of designing a digital health solution centred around the needs of key stakeholder groups. The proposed IFI Surveillance (IFIS) tool employs a combination of AI/NLP techniques to detect episodes of IFI and provides a web-based user interface accessible by medical professionals to support surveillance and management of IFI in clinical practice.

2. Methods

We employed the Stanford University Design Thinking Framework (DTF), a systematic and collaborative approach for identifying and creatively solving problems, internationally recognised as a valuable route to human-centred innovation. The DTF consists of five phases: Empathise, Define, Ideate, Prototype, and Test. It is an iterative process that allows generation of possible solutions, development of simple prototypes, and refinement of the solutions informed by significant external feedback.

3. Results

The proposed digital solution involves extracting various data from the EMR and applying AI/NLP methodologies to detect episodes of IFI. For each data stream, an individual set of pre-processing and classification rules is developed to recognise characteristics suggestive of IFI. The final layer of the AI model leverages the combined data to detect an individual episode of IFI. Figure 1A illustrates the main components of the IFIS system and the transition of information from the hospital EMR system to the end user.

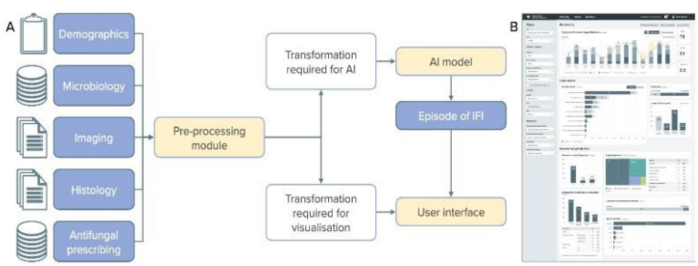

Figure 1. (A) Illustration of the data flow from the hospital EMR system to the end user. (B) Example of the designed user interface: infection monitoring dashboard.

4. Conclusions

The DTF can benefit the development of digital health solutions, encouraging practitioners to delve into a problem to find the root causes and empathise with the needs and constraints of stakeholders to design innovative, user-centred solutions. The reported process will lay the groundwork for further development and evaluation of the automated surveillance system for IFI before its implementation in healthcare settings.