Project Title

Medication Coach

Project Lead and Members

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Project members: Fong Qi Wei, Alicia Lin, Daryl Toh, Mark Jabigo, Sandra Xu, Tan Lien Chew, Yvonne Tan, Amanda Lim, Arsen Batagov, Lai Wen bin

Organisation(s) Involved

Tan Tock Seng Hospital, National Healthcare Group Polyclinics, National Healthcare MeshBio

Healthcare Family Group(s) Involved in this Project

Pharmacy, Medical, Healthcare Administration

Applicable Specialty or Discipline

Family Medicine, Operations

Project Period

Start date: 01 Jul 2022

Completed date: 30 Jun 2023

Aims

To pilot the development of a versatile modular engine embedded on a device which can:

a) Use an image to correctly identify medications by medication packaging or drug instruction label

b) Provide detailed comprehensive drug information drawing from a reliable source of those developed by our pharmacists

    c) Provide language translations to medication administration instructions sited on the drug instruction labels

Background

Knowing how to take medications is a challenge to many patients. This is especially so if patients are on polypharmacy whereby, they are faced with multiple medications and each of them may present in different look and appearance at different intervals of supply. Moreover, many patients are non-English literate or non-health literate enough to be able to read and comprehend the drug label information presented to them via the current manner. Often, patients may discard the packaging of the medications which the drug instruction labels are affixed to when they're at home, losing critical information such as what, how and when to take the medications. All these inevitably lead to non-compliance in medication intake, and some may even lead to patients doubling up or taking the wrong medications, a huge risk posed to patients' health and safety. Essentially, patients and caregivers have issues identifying and then gaining understanding about the medications. Current solutions suffer from poor accessibility or from inferior reliability of information. In studies by Miller in 2016 and Chima in 2020, it was found that Health Literacy was positively associated with adherence especially for Cardiovascular and Diabetes patients, whom are usually those with polypharmacy.

Methods

Developing and validating of the working models for MedCoach engine to analyse and read medication packaging and drug instruction labels:

- Tech collaborator with input from the team built, train and test the medication packaging recognition models.
- Tech collaborator captured and annotate images of the drugs and label samples provided by institutions.
- Tech collaborator subsequently added medication label recognition into the MedCoach model.

- The team validated accuracy and provided feedback into the recognition models to test out various scenarios and drug types.

Content development

- Pharmacy teams developed contents for the database including translations of the information on the drug labels, as well as general and comprehensive drug information (such as common drug indications and medication information leaflets, or other sources) and drug images.

- Pharmacy teams generated a harmonized database of drug information across TTSH and NHGPh.

- Generate relevant databases which are versatile to link to the recognition models.

- Pharmacy teams segmentized medication instructions and its 4 translations to facilitate translation of labels.

Putting the Medication Coach Engine Together

- The team worked together to ensure the contents and model are portable and integrable into NHG HAP.

- Conducted Failure Mode Effect Analysis to identify and address potential failure modes in the use of the MedCoach engine.

Results

		Party responsible for deliverable			
S/N	Deliverables	TTSH	NHGP	NHGPh	MeshBio
1	Create validated models / algorithms which can identify drug names from medication packaging.	√ (provide expert domain knowledge)	√ (provide expert domain knowledge)		√ (provide technical capabilities)
2	Create validated models / algorithms which can read drug instruction labels.	√ (provide expert domain knowledge)	√ (provide expert domain knowledge)		√ (provide technical capabilities)
3	To determine the list and to provide 500 drugs from both NHG Pharmacy and TTSH for the POC.	√		√	
4	Development of a localised database which links drug names to drug information, as found in current medication information leaflets.	√		√	√
5	Development of a database which links medication administration instructions, such as dosages, cautionary and auxiliary drug instructions in English, and to other languages.	√		√	√
6	To develop a User Interface which can demonstrate the MedCoach Engine's capabilities	√ (provide expert domain knowledge)	√ (provide expert domain knowledge)	√ (provide expert domain knowledge)	√ (provide technical capabilities)
7	To conduct qualitative testing of the Proof of Concept *1	√	√	√	

(Row 2: In progress; others completed ✔)

The POC was able to achieve the above deliverables 1, 3 to 7. In terms of accuracy, the model was able to accurately identify 83% of the drug types in its primary packaging of differing modes (Tubes, Strips, Vials, Packets, Inhalers, Pens and Bottles). For strips, it had achieved a higher accuracy of 88% compared to the other options (see Figure 2).

For Medication Label recognition under S/N 2, the model requires additional refinement. Results are captured in Figure 1. More major enhancements to the recognition model were required to handle special instructions, frequency and route as they encountered the greater inaccuracy there.
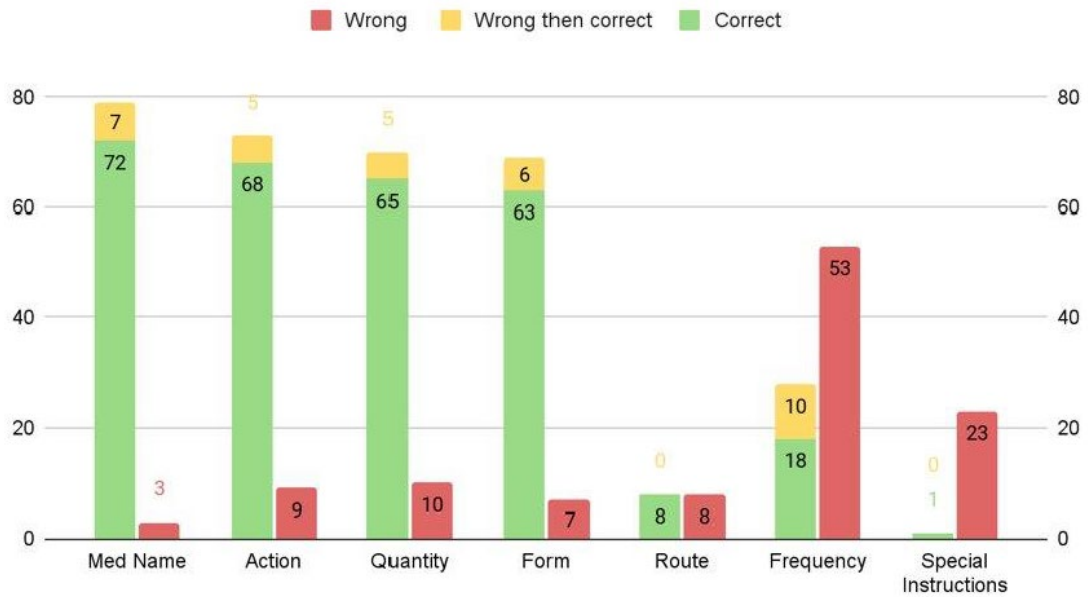
Results as of 13 June 2023

Legend: Wrong (red), Wrong then correct (yellow), Correct (green)

Figure 1: Accuracy for drug label recognition as of 13 June 2023.

Primary Packaging Identification

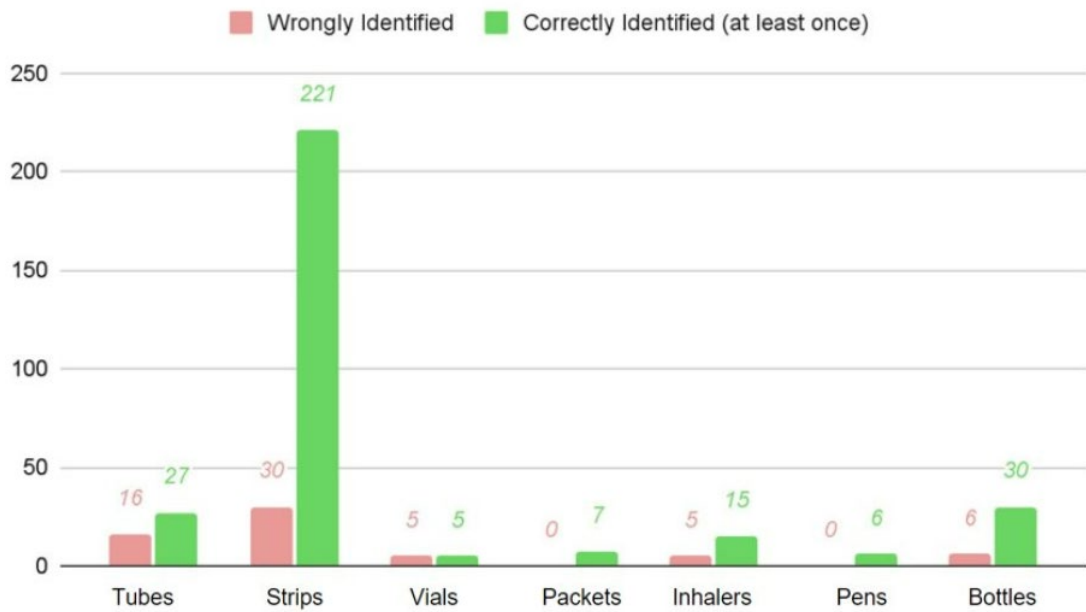Legend: Wrongly Identified, Correctly Identified (at least once)

Figure 2: Accuracy for drug packaging recognition.

FMEA

The project team conducted a FMEA towards the end of the POC to identify key failure causes that need to be addressed subsequently. The team recognizes there are limitations to the technology in achieving 100% accuracy rate, and agreed on the need to take additional measures in addition to the technology to improve accuracy.

Lessons Learnt

Through the medication label translation process, the various institutions identified that the format used for medication instructions were unique in terms of sequence of the instructions, numbering format, and expressions for special instructions. In addition, the various translations between English, Chinese, Tamil and Malay allowed the team to observe a trend in differing sentence structures for the various languages as sections of information were segmentized to facilitate translation.

Conclusion

The MedCoach POC was able to embark on all of the deliverables and by large able to produce acceptable results. Mainly, the MedCoach engine is able to identify drug packaging. Label instruction recognition will require further development, in the next phase of the project. The POC also allowed various institutions to think through the development of databases for drug information, medication information leaflets, and administrative instructions for medication towards alignments in method to provide patients with more standardized information and facilitate closer working opportunities with each other.

Additional Information

MedCoach was presented to Minister for Health, Mr Ong Ye Kung at CHI INNOVATE with media coverage on Vasantham channel.

Project Category

Technology

Digital Health

Keywords

Optical Recognition, Machine Learning, Drug Image Recognition, Medication Literacy

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