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Automatic Speech Recognition System to Record Progress Notes in a Mobile EHR: A Pilot Study

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Abstract. Creating notes in the EHR is one of the most problematic aspects for health professionals. The main challenges are the time spent on this task and the quality of the records. Automatic speech recognition technologies aim to facilitate clinical documentation for users, optimizing their workflow. In our hospital, we internally developed an automatic speech recognition system (ASR) to record progress notes in a mobile EHR. The objective of this article is to describe the pilot study carried out to evaluate the implementation of ASR to record progress notes in a mobile EHR application. As a result, the specialty that used ASR the most was Home Medicine. The lack of access to a computer at the time of care and the need to perform short and fast evolutions were the main reasons for users to use the system.

Keywords. Speech recognition software, mobile applications, electronic health records

1. Introduction

Clinical records are a significant part of the daily workflow of healthcare professionals. Documenting the evolution of patients in clinical history is critical to the continuity of care processes. However, this task consumes much of the work time of users, most of whom in many cases must dedicate overtime [1], increasing their labor burden. Concerned about speeding up the clinical documentation process, professionals use inappropriate methods such as omission of data or use of copy/paste in progress notes [2] of the Electronic Health Record (EHR), reducing their quality.

As an opportunity for technological improvement to facilitate clinical documentation, the incorporation of an automatic speech recognition system (ASR) to the EHR has grown in recent years. This technology allows the sound recognition of words and their automatic decoding, providing users with the possibility of performing records in a synchronous and agile manner.

The literature on the implementation of ASR integrated to the EHR in mobile format for clinical settings is scarce. Although there is published evidence that evaluates the risks and benefits of using the system [3], and comparisons of this against

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traditional methods (keyboard) [4], the outcomes are mixed and it remains uncertain whether the technology is a help or a hindrance.

We published previously, in 2019, our internal development of ASR and performance results obtained from our institution [5]. In this paper, our objective is to evaluate of the pilot phase and subsequent implementation of ASR to record progress notes in the mobile EHR application of the Hospital Italiano de Buenos Aires.

2. Methods

2.1. Clinical Settings and Application Design

The Hospital Italiano de Buenos Aires (HIBA), located in Argentina, is a high complexity institution dedicated to integral health care. It has state-of-the-art technology, being a HIMSS Level 7 organization with an internally developed Health Information System (HIS), which captures both healthcare and administrative information. It has a web-based, problem-oriented, patient-centered EHR.

In 2018, the Department of Health Informatics (DIS) at the HIBA developed the ASR system built under client-server architecture. The server is networked within the hospital, and the client is a mobile application that integrates the mobile EHR and consumes the ASR service of the server. The ASR functionality allows users to record progress notes of the patient from the mobile EHR progress module by recording a voice note. Once the dictation is finished, the user can edit the text before saving it or even make multiple recordings on the same one (Figure 1).

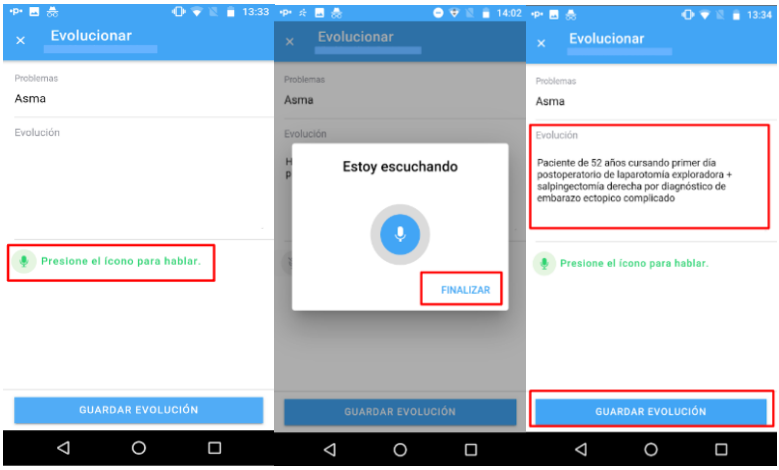

Figure 1. User interface for the record of progress notes using ASR in the EHR mobile app.

2.2. Study Design:

A descriptive study of the pilot phase and the first year of the subsequent implementation of ASR in the mobile EHR application for physician users in the inpatient setting between December 2020 and May 2022 was conducted. Both

quantitative and qualitative exploration methods were carried out, assessing user experience.

The pilot phase was carried out during December 2020 and January 2021 in the Gynecology and Obstetrics service, being chosen given the linguistic richness of a clinical-surgical specialty. In February 2021, the Home Medicine service requested to have ASR to facilitate its record in real time in the EHR during the medical visit to the patient, so this specialty was included in the pilot.

Users of both services were instructed in the use of ASR through training. The pilot phase was developed only for users with Android devices since this was the most used operating system. In addition to this, the iOS development was not finished yet. Users were given an APK file to install on their smartphones.

After the pilot phase was completed in February 2021, the ASR model was developed for new medical services, including Surgery, Medical Clinic and sub-areas of these specialties. Implementation began in March 2021, covering users with both Android and iOS devices.

The evaluation of the user experience during the pilot phase in Obstetrics and Gynecology service and Home Medicine service was carried out through system usability scale (SUS) questionnaires to users in order to know the acceptance and usability of the system. With regard to the analysis of the records performed, the ASR usage logs from December 2020 to May 2022 were reviewed. Finally, individual telephone surveys were also conducted to the 6 most active users during the last 3 months of implementation identified in the usage logs.

3. Results

With respect to the pilot phase, a total of 22 records were made, 4 of them corresponding to the Gynecology and Obstetrics service and 18 to Home Medicine. A total of 8 users were involved: 3 of them belonged to Gynecology and Obstetrics and 5 to Home Medicine. The results of the SUS questionnaire showed that 100% of the users perceived ASR as easy and not very complex to use, and most agreed that other users could quickly learn to use ASR. Although users generally found ASR's functionality useful, they highlighted that *"the system is very useful for "short" record progress notes, but not so useful for "long" ones, such as daily records or those where laboratory results or other studies need to be reported"*.

Regarding the post-implementation evaluation logs, 272 progress notes performed between December 2020 and May 2022 were included in the review of ASR usage logs. The total number of medical specialties involved that used the system was 20. Among them, those that represented the highest percentage of records performed were Home Medicine (54.4%), Medical Clinic (18.8%) and Family Medicine (6.6%) (Table 1). The total number of users involved was 55.

Table 1. Number of record progress notes performed with ASR and users involved for each medical service.

Medical Services	Records	Users
Allergy	1 (0.36 %)	1
Cardiology	1 (0.36%)	1
Medical Clinic	51 (18.8%)	10
Pediatrics	7 (2.57%)	2
Pediatric Gastroenterology-Hepatology	1 (0.36%)	1

Gynecology	1 (0.36%)	1
General Gynecology	1 (0.36%)	1
Ambulatory Medicine and Primary Care Pediatrics	4 (1.47%)	2
Home Medicine	148 (54.41%)	15
Family Medicine	18 (6.61%)	7
Geriatric Medicine	2 (0.73%)	1
Palliative Medicine	1 (0.36%)	1
Neonatology	1 (0.36%)	1
Neurology	5 (1.83%)	3
Nutrition	16 (5.88%)	1
Obstetrics	3 (1.1%)	2
Ophthalmology	3 (1.1%)	2
Breast Pathology	1 (0.36%)	1
Pain Management - Anesthesia	6 (2.2%)	1
Urology	1 (0.36%)	1
Total	272 (100%)	55

The number of progress notes performed with ASR per year were 9 during December 2020, 137 during the entire year of 2021 and 126 from January to May 2022, representing 3.3%, 50.37% and 46.33% respectively.

The evaluation of the implementation through telephone interviews was performed with 6 users, 2 of them belonged to the Medical Clinic service and the other ones to Family Medicine, Home Medicine, Pain Management and Neurology. The operating systems used were Android in 4 of the cases and iOS in 2 of them. As for the type of medical care carried out using ASR, 5 were for teleconsultations outside the hospital institution and 1 for home care.

As for the users' perceptions of the ASR system, the main reasons for choosing to record progress notes with this tool were: *"Comfort", "Simplicity and speed", "Usefulness and simplicity because you don't have to type", "It makes it easier to enter what I have trouble typing on my cell phone", "It's useful for when you don't have a computer nearby"*.

Among the perceptions regarding the functioning of ASR, the following stand out: *"75% of the time it works properly. 25% of the time it was slow, so I ended up writing. I didn't need to close the app, I could write it right there", "It is usually slow and the words come out wrong", "When I press the ASR button, the dictation tool does not open", "Sometimes it hears words that are wrong but I fix them and that's it"*.

4. Discussion

In this study, we attempt to describe the results of the evaluation of a pilot phase and first year post-implementation of the automatic speech recognition system to record progress notes in a mobile EHR.

When using the ASR tool to perform progress notes, the users' perception of saving time is evident given that, especially in the case of home medicine physicians, they did not have to spend time creating them when returning to their homes and that explain the largest amount of progress notes that they did. This time saving was reported in the study by Lyons et al, where after using this technology for 6 months, 51% of the physicians involved reported time savings [6].

Lessons learned based on our experience which we recommend taking into account to implement an ASR system to increase user adherence and acceptability are as follows:

- Have a planned strategy for the implementation and integration with the EHR.
- Assess user characteristics such as level of technological expertise and usage level of mobile devices, dictation experience in other applications, current methods of recording in EHR and use of templates.
- Train users in both the operation of the system interface and also the manner in which they should speak so as to achieve accurate dictation.
- Evaluate the type of mobile device owned by users at the beginning of the project and prior to implementation.

5. Conclusions

To conclude, the evaluation of the implementation in our hospital shows that speech recognition technologies integrated to the EHR in mobile devices allow healthcare professionals to optimize the time dedicated to clinical documentation by speeding up the task of recording progress notes. This is particularly relevant when medical consultations are quick or performed at the patient's home and the information that needs to be dictated by ASR is short and low complexity. However, it is essential to know the characteristics of the institution's users from the beginning, in order to provide them with a system that best suits their workflow at the point of care. In addition, adequate training must be provided for the implementation to be successful.

We consider that future research is needed to continue understanding users' perceptions of this system in clinical environments and to outline how it can be used when a larger volume of data entry is required.

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