# **Feasibility of an AI-based Interactive Voice Response (IVR) system for patient-reported outcome measures (PROMs) collection**: a scalable solution to collect patient centred real world evidence

Acceptance Code:

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## Objective

Electronic patient-reported outcome measures (ePROMs) are essential for both clinical practice and research. However, collecting ePROMs via standard technologies such as SMS or Email poses significant challenges, particularly for elderly individuals and those with visual impairments. Interactive Voice Response (IVR) technologies offer a promising solution by enabling patients to respond to ePROMs via phone calls, thus enhancing accessibility and engagement.

However, phone-based ePROM collection introduces its own set of challenges. Verbal responses must be accurately transcribed amidst varying speech patterns and background noise.

Moreover, patients may veer off-topic during conversations, complicating data interpretation.

AI-powered speech recognition technologies can accurately transcribe spoken responses, even in noisy environments. Furthermore, Natural Language Processing (NLP) techniques enable the interpretation and categorization of transcribed responses, mapping them to the appropriate ePROM options.

Our aim was to develop and test an IVR solution for the collection of ePROMs in real word context, leveraging Artificial Intelligence (AI) for processing and mapping voice responses.

## Method

The IVR PROM collection pretest was preformed in a public mid-size hospital in the north of Portugal. EQ-5D-3L questionnaire was used, since it is a simple and generic quality of live questionnaire widely used in real-world-evidence studies and pharmacoeconomics. The Portuguese version of the EQ-5D-3L questionnaire was adapted in order to be implemented through an IVR questionnaire. A convenience sample of 32 patients was selected among Portuguese patients with Arterial Fibrillation who were using Promptly Collect software with informed consent.

To implement IVR PROMs collection, we preformed the following steps:

**01. Phone Call Provider Integration:** Integrate with a phone call provider for automated call handling, ensuring reliable and scalable delivery of IVR services.

**02. Speech-to-Text Conversion:** Employ an AI model to convert speech to text, accurately transcribing patient responses.

**03. Mapping Answers to ePROM Options:** Utilize another AI model to map the patient's spoken responses to the corresponding ePROM answer options. This involves NLP techniques to ensure the AI accurately interprets the patient's answers and selects the appropriate response.

**04. Data Storage and Analysis:** Securely store raw audio recordings and transcribed text data. Metadata such as caller ID and call duration are captured for contextual insights. Data analysis and quality assurance processes validate the accuracy of the mapped responses.

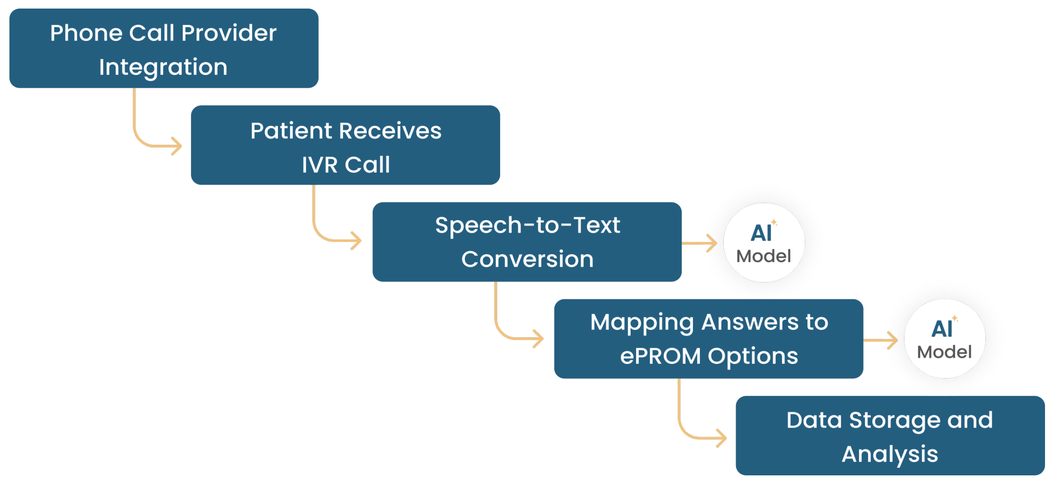


Fig. 1 - ePROM IVR Collection: Implementation Plan.

After implementing, we evaluated in a real-world environment: the percentage of patients who answered the calls, how users interact with automated voice response IVR systems, if users comprehend questions and answer in a proper way, if users hang up the call without finishing the PROM questionnaire and the accuracy in mapping free answers to open questions to answers options correctly. Call status analysis was performed with the Mixpanel tool.

## Results

We have selected 32 patients to receive the call in Portuguese language. From the total pool of patients, 2 of them (6.25%) had their phones turned off and 2 patients (6.25%) had not answered the phone or rejected the call.

The remaining 28 patients answered the IVR call (87.5%). From these 28 patients, 13 (46.4%) reached the end of the call by answering all the EQ-5D-3L questions. Patients that have reached the PROM questionnaires' end, the average call duration was 114 seconds (almost 2 minutes).

Concerning usability, some problems related to user difficulty understanding the IVR, background noise and poor dictation were identified.

- Difficulty understanding if need to press numbers on the keyboard or just answer via voice
- Permanent or sporadic background noise
- Difficulty understanding what the chatbot said and asks for repetition.
- Poor dictation not perfectly understood by the system

Overall, system performance rates were 52.7% (29 out of 55 questions) among patients who answered the calls and 80.0% (21 out of 26 questions) among patients who answered the calls under ideal conditions.

From those call pathways, we have analyzed all the individual answers and calculated the system performance under different conditions.

| Criteria | Explanation | Performance rate |
|---|---|---|
| All calls in real-life conditions | The questions being answered with voice and/or "background" | 28.6% (20 out of 70) |
| Only patient-answered calls | The questions being answered with voice | 52.7% (29 out of 55) |
| Only patient-answered calls under ideal conditions | The questions being answered in good audio conditions | 80.0% (21 out of 26) |

## Conclusions

This pretest shows that it is possible and useful to use IVR to collect patient reported data. However there are some challenges to address in the future as the background noise and understandability. Next steps will be to improve this technology using more recent and improved models, apply this technology to more complex PROMs and perform a psychometric validation.