

## Tana, a Healthcare Chatbot to Help Patients During the COVID-19 Pandemic at a University Hospital in Argentina

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### Abstract

*A Chatbot or Conversational Agent is a computer application that simulates the conversation with a human person (by text or voice), giving automated responses to people's needs. In the healthcare domain, chatbots can be beneficial to help patients, as a complement to care by health personnel, especially in times of high demand or constrained resources such as the COVID-19 Pandemic. In this paper we share the design and implementation of a healthcare chatbot called Tana at the Hospital Italiano de Buenos Aires. Considering best practices and being aware of possible unintended consequences, we must take advantage of information and communication technologies, such as chatbots, to analyze and promote useful conversations for the health of all people.*

### Keywords:

Public Health, COVID-19, chatbots

### Introduction

According to the World Health Organization (WHO), the excessive increase in the volume of information on a particular topic during a disease outbreak such as the SARS-COV2 Coronavirus pandemic is called Infodemic. It includes false or misleading information in digital and physical environments that causes confusion and health risk-taking behaviors [1]. It also leads to mistrust in health authorities and undermines the public health response. Faced with this challenge, the WHO called for the implementation of high-quality, non-pharmacological public health measures to share information, suggest behaviors, and offer emotional support to the population. The Centers for Disease Control and Prevention (CDC) in the United States and the WHO itself have suggested and used chatbots for this purpose.

A Chatbot or Conversational Agent is a computer application that simulates the conversation with a human person (by text or voice), giving automated responses to people's needs. Depending on their complexity, they can handle simple goal oriented tasks, or full conversations. Some of them use artificial intelligence (AI) techniques to learn from human conversations, understanding the user's intent and analyzing the context of the conversation in order to improve their responses.

Health chatbots can be beneficial to patients, as a complement to human care. Administrative chatbots are cost-effective, as they can serve multiple users at the same time, 24 hours a day. This is particularly useful when human operators cannot respond to peak demand or outside of normal business hours. But they also present some drawbacks such as the absence of empathy, the scarcity of adequate answers or the misinterpretation of the provided information, leading to user frustration. Clinical

chatbots are more complex, but seem to be useful for initial assessment or triage.

During the COVID-19 pandemic, the use of chatbots grew exponentially in the health field, to collaborate both on administrative and clinical tasks. To counteract the infodemic, chatbots can narrow the gap between reliable information and action by passing on step-by-step instructions, providing advice on social behavior, and recommending behavioral changes for the population [2]. In addition, they can offer initial support and counseling, alleviating the front-line healthcare workload. Different chatbots such as the WHO bot on WhatsApp have been used to provide timely and quality information for the population. The CDC coronavirus self-checker helps patients on deciding when to seek testing or medical care if they suspect being exposed to COVID-19 (whether by symptoms or by close contact with another confirmed patient). This article shares our experience with the design and implementation of two different healthcare chatbots at Hospital Italiano de Buenos Aires during the COVID-19 pandemic.

### Methods

#### Setting

Hospital Italiano de Buenos Aires (HIBA) is a non-profit organization with a health services network in the Autonomous City and the metropolitan area of Buenos Aires, Argentina. It has 2 tertiary teaching hospitals, 45 outpatient centers and almost 300 associated private practices. Every year, it receives 45,000 inpatients and 3 million outpatient consultations. The hospital has developed and upgraded a homegrown information system for the last 20 years. It integrates different administrative and clinical applications, like the Electronic Medical Record (EMR), allowing the paperless operation of all hospital processes. It was certified as level 7 in the EMR adoption model by HIMSS (Healthcare Information and Management Systems Society). For more than 10 years the Hospital has had a Patient Portal (PP) where patients can find their information (eg. study results, discharge reports), get appointments, or ask for medication delivery. In addition, it is a secure channel to communicate with health professionals through store and forward messaging, or by online teleconsultations. For example, during the 2019 winter the Tele-Influenza Program solved hundreds of simple cases with a high satisfaction rate [3]. Through the PP, patients can fill help desk tickets for administrative issues, and from 2019 they can also reach the Contact Center by web chat.

#### Materials and Methods

Implementing chatbots in health requires to be safe and effective, since a basic premise in medicine is "primum non nocere":

above all, do no harm. Ross Koppel and his team from the University of Pennsylvania published an opinion article in JAMA (Journal of the American Medical Association) that identifies 12 aspects to consider before, during and after implementing chatbots in health [4]: Patient safety; Scope; Trust and transparency; Content decisions; Data use, privacy and integration; Biases and equity in health; Conflicts of interest; Cybersecurity; Legal and registration aspects; Research and development questions; Governance, testing and evaluation; and Support for innovation. On the other hand, just as when a person speaks in different contexts and with different interlocutors, the tone, form and content of the conversations must be identified. Srin Janarthanam [5] proposes to design the conversational experience by leveraging 13 domains according to his Chatbot Design Canvas V2. Both frameworks were used to coordinate the health chatbot project at the HIBA. Different metrics of implementation advancement and success were taken into consideration. A qualitative and quantitative approach was used.

## Results

In 2020, during the Coronavirus Pandemic (COVID-19) and the consequent preventive and mandatory social isolation (quarantine) imposed in Argentina and many other countries, there was an incredible increase in medical teleconsultations at the HIBA, as well as on contacts for administrative concerns. The hospital adopted different strategies to inform the population and health personnel about the coronavirus, including dedicated websites and information briefs that were displayed at the PP, and also sent by email. It also decided to implement a project that had been brewing since 2018 on chatbots in health. A multidisciplinary team from the Health Informatics Department designed the conversational experience, and set the rules, the natural language processing for text understanding and generation, the exchanges, the web services and the knowledge base with the answers to the patient's frequently asked questions (FAQs). Two Bot profiles were created using the Chatbot Design Canvas V2 by Srin Janarthanam, taking into account that the conversations differed in context (e.g. Tana as administrative chatbot vs. clinical chatbot in teleconsultation).

### Administrative Chatbot

Tana, the administrative chatbot, was integrated into the PP web chat in April 2020. After logging-in the web version of the PP and opening a chat conversation, Tana welcomes all patients and offers to answer FAQs on different topics such as: telemedicine, appointments, pharmacy, billing, and even verified information on coronavirus and dengue. If the queries are not answered, or if patients prefer, this virtual assistant refers them to a specialized human operator who solves their concern live. Tana also allows automated appointment management (request, modify, cancel) and will progressively incorporate more automated executive functions. The COVID-19 and dengue answers were created based on the best information available including the FAQs from WHO and PAHO, and were validated by HIBA specialists. They are periodically updated in the knowledge base.

Some of the chat and chatbot metrics from our dashboard can be seen in Figure 1 and 2. Initially, the growing demand for support surpassed the regular answer capacity leading to long waiting times, and a high patient dropping rate in their chat queue. The implementation of Tana engaged almost every patient in a conversation. Around 20 to 30% asked for referral to a specialized human operator line, but some of them left the chat before being called.

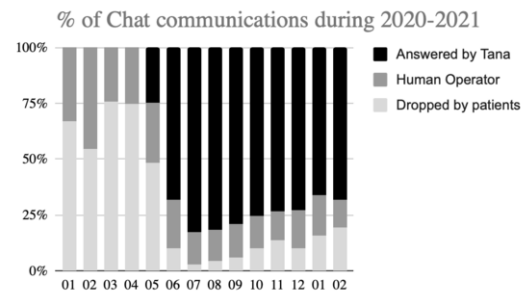


Figure 1— Evolution in the percentage of chat communications per month, from January 2020 to February 2021, stratified by type of answer: Answered by Tana (black); Answered by Human Operator (grey); and Dropped by patients (light grey).

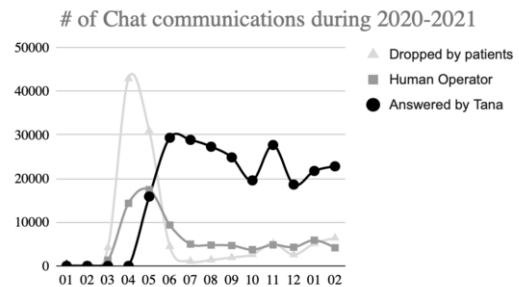


Figure 2— Evolution in the absolute number of chat communications per month, from January 2020 to February 2021, stratified by type of answer: Answered by Tana (black dots); Answered by Human Operator (grey squares); and Dropped by patients (light grey triangles).

### Clinical Chatbot

At the same time, there was a 10 fold demand for on-call teleconsultations. Thus, we designed another chatbot with a clinical profile to ask the patients some questions while they wait in the virtual queue, anticipating the usual inquiries that the professionals would do during the teleconsultation. This information would be useful, among other things, to identify those patients who need priority care as a triage. The challenges of this implementation included keeping quality and safety, while avoiding negative effects on physician-patient relationships and waiting times. We identified and wrote the initial questionnaire in partnership with the end users. It included the following domains: Reason for consultation and current illness; Problem List; Medication List; and Allergies. The chatbot was displayed within the PP teleconsultation workflow, as in Figure 3.

The clinical chatbot was tested and deployed in late October 2020. In November 2020, after one week of use, 1,348 users passed through the clinical bot during their teleconsultations. More than half of them (765, i.e. 57% of the total) voluntarily decided to answer the proposed questions. The patient answers were displayed in the EMR, being checked by health professionals before and during the patient virtual interview. In a small preliminary satisfaction survey among teleconsultation professionals, almost 80% of them were positive about the implemented tool. They highlighted that it allowed data collection previous to the clinical encounter, streamlining the process. Some respondents were concerned about patient answers that showed red flags, and therefore should have a different approach.



Figure 3– Screenshot with an example of the interaction between a fictitious patient and the clinical bot.

## Discussion

Although the infodemic cannot be eliminated, it can be better managed. We must adapt, develop, validate, and evaluate new evidence-based measures and practices to prevent, detect and respond to misinformation. We implemented a Bot called Tana that answered FAQs about different healthcare and administrative issues, including verified information on Coronavirus and Dengue. As the demand for chat support had skyrocketed, surpassing the Contact Center capacity, the chatbot implementation led to a higher user engagement diminishing the dropping rates. Even if some (or many) of these demands were not properly addressed by the chatbot and needed to be transferred, we had the chance to get those patient queries in order to analyze and enhance our answers. We believe that the transfer rate has been stable due to usual limitations of this type of FAQ chatbots, needing a proper fallback. We are investigating and developing a new AI conversational chatbot to add more intents. On the other hand, we incorporated a clinical bot that interviewed patients prior to unscheduled teleconsultations. Both have had a positive global reception from the users. Based on international experiences, we are working on systematic measurement instruments to assess the perception of professionals [6] and patients [7], in order to validate the satisfaction and safety of these tools.

With these innovative proposals, we are happy to contribute from the HIBA to the dissemination of initiatives such as chatbots to counteract the infodemic. Nevertheless, healthcare chatbots projects must take into account several considerations as stated by McGreevey et al [4], in order to achieve high quality and safety standards.

## Limitations

Our research was done in a single academic center using in-house developed software and thus might not represent other institutions.

## Conclusions

As a conclusion, chatbots in healthcare can be useful to answer patient needs, for clinical and administrative tasks. It may not replace but complement the human work. When safely and effectively deployed, they can solve growing demands, especially in times of personnel shortage such as an epidemic. Continuous monitoring of these tools is necessary to detect improvement opportunities, and avoid unintended consequences.

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