REVIEW JURNAL

“ A SMART VIRTUAL ASSISTANT ANSWERING QUESTIONS ABOUT COVID-19 “

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VIRTUAL ASSISTANT: A TOOL FOR HEALTH CO-PRODUCTION IN COPING WITH COVID-19

ABSTRACT

- **Objective:** untuk menggambarkan pengembangan asisten virtual sebagai alat potensial untuk produksi bersama kesehatan dalam mengatasi COVID-19.
- **Method:** Ini adalah studi penelitian produksi teknologi terapan yang dikembangkan pada bulan Maret dan April 2020 dalam lima tahap: 1) tinjauan literatur, 2) definisi konten, 3) elaborasi dialog, 4) uji prototipe, dan 5) integrasi dengan media sosial halaman.
- **Results:** tinjauan literatur mengumpulkan beragam bukti ilmiah tentang penyakit ini berdasarkan publikasi Kementerian Kesehatan Brasil dan dengan berkonsultasi dengan artikel ilmiah. Konten tersebut dibangun dari pertanyaan-pertanyaan yang paling banyak ditanyakan masyarakat, pada bulan Maret 2020, dibuktikan dengan Google Trends, yang didalamnya muncul topik-topik sebagai berikut: konsep penyakit, cara pencegahan, penularan penyakit, gejala utama, modalitas pengobatan, dan keraguan. . Elaborasi dialog didasarkan pada Natural Language Processing, maksud, entitas dan struktur dialog. Prototipe diuji di laboratorium dengan sejumlah kecil komputer pengguna di jaringan lokal untuk memverifikasi fungsionalitas kumpulan aplikasi, kesalahan teknis dan visual dalam dialog, dan apakah jawaban yang diberikan sesuai dengan pertanyaan pengguna, menjawab pertanyaan dengan benar dan terintegrasi ke Facebook.
- **Conclusion:** asisten virtual terbukti menjadi alat pendidikan kesehatan yang berpotensi memerangi "Berita Palsu". Hal ini juga mewakili bentuk komunikasi kesehatan yang berpusat pada pasien yang mendukung penguatan ikatan dan interaksi antara profesional kesehatan dan pasien, serta mendorong produksi bersama di bidang kesehatan.
- **DESCRIPTORS:** COVID 19. Pandemi. Informasi medis. Penerapan informatika medis. Teknologi Informasi. Pemrosesan bahasa alami. Kecerdasan buatan.

INTRODUCTION

At the end of 2019, the first cases of unknown etiology pneumonia were recorded in the city of Wuhan, China. Initially, these cases were related to the patients' contact with a seafood market from Huanan. In January 2020, samples were collected from a patient that showed evidence of a new coronavirus identified as Severe Acute Respiratory Syndrome coronavirus-2 (SARS-CoV-2), called coronavirus 2019 (COVID-19). In 2002, the Severe Acute Respiratory Syndrome Coronavirus (SARSCoV) was identified in China. In 2012, the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) was identified in Saudi Arabia. This is the third time that the coronavirus family has been identified in the last 20 years at the global level[1].

COVID-19 spread rapidly across all continents to the point of being considered an infection of pandemic proportions, emerging as a global public health concern, with involvement degrees varying from asymptomatic infection to severe disease and mortality[2]. On May 22nd, 2022, SARS-CoV-2 resulted in 525,872,788 confirmed clinical cases of the disease at the global level and 6,278,246 deaths of patients worldwide[3].

The treatment for COVID-19 is based on symptom management, in symptomatic patients, in the prevention of complications resulting from the disease. Non-pharmacological interventions are also important tools in the fight against the pandemic[2–4].

As the pandemic was caused by a new coronavirus, the population was somewhat not aware of the health-disease process. This led people to search for information, often in sources targeted at health professionals or in texts with no scientific grounds, making room for guesswork and promulgation of false or Fake News[5]. While there was also dynamism in the advancement of knowledge with new publications and health recommendations, as new discoveries were made, new variants emerged, vaccines against the virus were gradually developed and new medications were authorized for use, a fact that further accentuates the need for education in health.

In this sense, education in health is indispensable to combat disinformation, as it allows the scientific knowledge conceived by health professionals to reach the population in an easy-tounderstand language. The preventive measures and dissemination of knowledge about COVID-19 refer to co-production in health, a concept that has been associated with strategies aimed at establishing partnerships among health professionals, patients, family members and companions to promote patientcentered care[6–7]. Such partnerships strengthen safety of the patients, as they assume a leading role in their own health care, through the active participation of individuals and mutual co-responsibility[8].

In this pandemic context, where social isolation is one of the main preventive measures, which depends on the behavior of society, machine learning, especially the use of Artificial Intelligence, used as a way to mitigate the pandemic, presents high-impact digital technologies to assist in coping with COVID-19. Some of these digital technologies are Virtual Assistants, Intelligent Assistants or Chatbots, which can be applied in the health field and developed with safe information about the disease, aiming at educating the population about the primordial topics, through interaction with the user, valuing individual and collective protection[9–10].

Among the educational contents that can be addressed are the main signs and symptoms of the disease, hygiene care and, if necessary, clinical referring in more severe cases of the disease to a reference health center. These measures, in addition to mobilizing co-production for improvements in health care, relieve overburdened health teams and direct the professionals' gaze towards patients that need more attention at that moment[7–11].

The objective of this study is to describe the development of a virtual assistant as a potential tool for health co-production in coping with COVID-19.

METHOD

This is an applied technological production research study developed in March and April 2020. The applied research modality is characterized by solving a current problem by finding an immediate solution[12]. The proposal of this paper was based on the development of a technological product, available to solve the population's doubts about COVID-19. The use of Information Technology and Artificial Intelligence has become indispensable tools for the development of the virtual assistant with secure information that facilitates people's health education.

The creation and development of the intelligent virtual assistant took place via the International Business Machine (IBM) Watson Assistant, a tool that requires no code for development. So that the objective was achieved, five consecutive stages were developed[13].

The first stage encompassed the literature review by searching studies and guiding materials that conferred scientific evidence about the new coronavirus. Based on that, the virtual assistant's theoretical content was structured. All the information and guidelines were based on manuals that describe the health recommendations issued by government agencies such as the Ministry of Health, and international references, including research studies carried out in countries that were the focus of the disease before it arrived in Brazil.

The second stage consisted in defining the topics that made up the prototype, that is, all the information that comprised the structure to assemble the content and, consequently, the questions answered by the virtual assistant. "Google Trends", a Google tool that indicates public search interest by the frequency with which a given term is searched, was one of the sources used as a basis for inferring the most searched queries about COVID-19 in March 2020. That strategy has been used by several countries precisely for showing a trend analysis based on topics related to the COVID-19 pandemic[14].

The third stage encompassed elaborating the dialog itself, that is, the interaction between the user and the algorithm, by means of the virtual assistant. From the user's input/question, the best answer is provided with the support of Artificial Intelligence based on the content structural information. Communication occurs remotely using message exchanges in an interactive environment between user and machine that addresses the user's doubts, according to previously defined instructions. In this stage, visual communication was also employed using images selected to compose the content of the virtual assistant, which were taken from health agencies or copyright-free images available on the Internet.

The internal communication of the virtual assistant used basically consists of four structures:
machine learning, entity, intentions, and dialog. The virtual assistant learns to recognize human language through Natural Language Processing (NLP), which describes computer programming to process human language data, divided into symbolic (rule-based) and statistical (machine learning) approaches. NLP is a type of Artificial Intelligence that seeks to teach human language to computers; thus, it can probabilistically examine the user's intentions[15–16].

The intentions are questions or contexts of the dialog in which the user can interact with the virtual assistant, and are recognized by the algorithm in a probabilistic way with the objective of understanding which question is most related to the previously programmed intentions[13]. The entities can be considered as an ancillary structure to the intentions, for example: in case the user directs a question using the name COVID-19, in this way, the system will understand that it will be related to all its possible variations.

A dialog is the definition of the interaction flow, beginning, targeting or finishing a conversation and built in a logical way[13]. Each information input by the user may direct navigation of the dialog to the point where it best matches the intentions and entities recognized by the virtual assistant, or even indicate that the user's question may be outside the scope of the conversation.

In the dialog, interaction with the user can occur not only through text but also through images, buttons or polls and, as a consequence, answering through these means, and also through others such as indications using web maps, complementary links, and/or other services. It is within the dialog that the logics that will direct the user in the assistant scope are built. During use of the virtual assistant, the human system manager will be able to observe within the interaction history how the machine's response selections occurred and improve its performance.

The fourth stage was characterized by testing the virtual assistant as a prototype in the laboratory, whether the answers provided were according to the user's question, and whether there were technical and visual errors in the dialog. In these tests, a reduced number of users in a local network were used, which allowed verifying the functionality of the set of applications. Continuity of the study shall be via the validation of the app usability, viability and validation.

The fifth stage encompassed creating a page for the project in a social network and integrating the virtual assistant with that media. The virtual assistant was created with the possibility of scaling its scope. Consequently, the network can be expanded to more users according to product's use need.
The study followed the national and international ethical standards on research involving human beings. However, as the research objective is to describe a technological innovation, the study waived approval by any Committee of Ethics in Research with Human Beings.

RESULTS

The virtual assistant was developed based on Artificial Intelligence techniques with the objective of providing diverse scientific information about COVID-19, as well as directing users to clinical care in cases of interactions with indication of symptoms.
1st stage – Literature review: diverse scientific evidence about the new coronavirus was gathered from the publications disclosed by the Brazilian Ministry of Health. Scientific articles published by countries such as China, where spread of the disease began, were also consulted to compose the theoretical content of the virtual assistant.
2nd stage – Building the prototype's content structure: from the identification of the most searched topics by the population, evidenced by the Google Trends tool, from which six topics emerged, as shown in Figure 1. In March 2020, the main searches made by the population in relation to COVID-19 were as follows: What is COVID-19? How can I prevent it? Which are the main forms of transmission? Which are the symptoms? Which is the treatment? as well as other questions that were grouped into doubts.

It is now worth clarifying some points in relation to the grouping of the themes according to their similarity. The content about vitamins was linked to the treatment because the population asked if they could use vitamins to treat the disease or reduce the risk of contracting it. The content about the mask was grouped with doubts because discussions were initiated about its use as a form of disease prevention, although there was still no official guidance from the health agencies. Another question hovered around a vaccine against COVID-19, which had not yet been developed; therefore, the population questioned whether the flu vaccine could be used to prevent COVID-19. From this identification, the answers were formulated based on all the scientific evidence identified in the previous stage to structure the content of the virtual assistant.

Figure 1 – Structure of the virtual assistant's content. Florianópolis, SC, Brazil, 2020.

3rd stage – Dialog construction: the virtual assistant was built based on four dimensions, namely: application of NLP technique, elaboration of intentions, entities and dialog structure. NLP takes place at the first moment in which a model is trained to identify human language and, thus, probabilistically recognize certain language.

Figure 2 shows examples of intention and dialog from the virtual assistant. The intention is the action associated with the user's question; in other words, the reason that lad him/her to make a question and might take place in different ways, depending on the language used. Based on the intention it is possible to observe how the virtual assistant conducts the dialog.

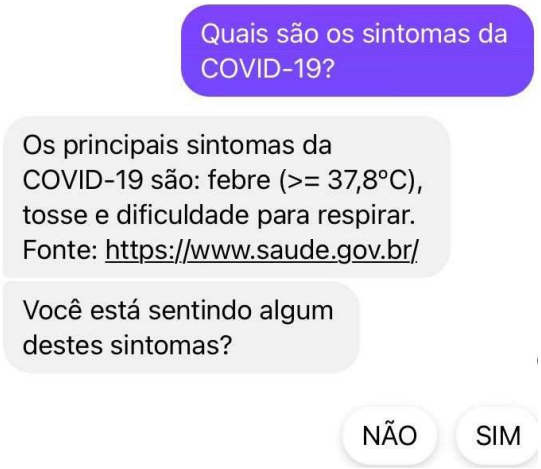

Figure 2 – Example of dialog between the user and the virtual assistant. Florianópolis, SC, Brazil, 2020.

Figure 3 shows an example of entity, which is recognized as the complement of the intention and allows adding synonyms to it, such as the different variations of the disease nomenclature. In interaction situations in which the content is out of the scope of the virtual assistant's content, the following message is presented: "I am sorry, but I did not understand. Can you ask again in some other way?"

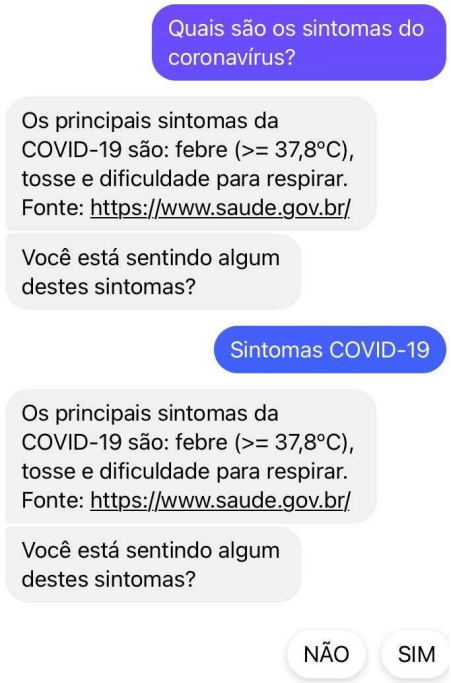

Figure 3 – Example of word recognition. Florianópolis, SC, Brazil, 2020.

The virtual assistant can also provide the map link to the address of the nearest healthcare institutions to the patient's residence. In this way, it can direct the patient to clinical care if symptoms of the disease are identified, as shown in Figure 4.

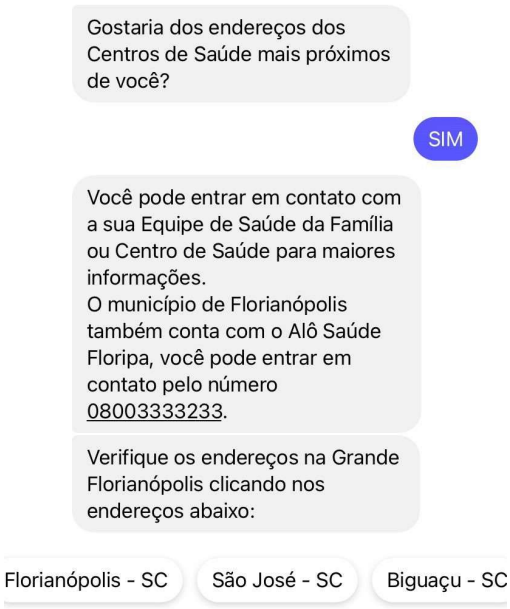

Figure 4 – Example of the virtual assistant functionality. Florianópolis, SC, Brazil, 2020.

4th stage – Testing phase: the prototype was tested in a laboratory with a small number of computer users on a local network to verify the functionality of the set of apps, technical and visual errors in the dialog, and whether the answers provided were in accordance with the user's question. The virtual assistant answered in a satisfactory way; in other words, it provided correct answers to the questions.

5th stage – Integration to a social media page: the fifth stage encompassed the creation of a page for the project in Facebook, called "*Enfermeira Virtual*" ("Virtual Nurse") and the integration of the virtual assistant to Facebook Messenger, which can be accessed by the population in any web browser or app, as long as it is connected to the Internet, allowing access to Android and iOS operating systems.

The virtual assistant remained available for two years, from March 2020 to March 2022. However, due to the costs to keep the tool available on the Internet and for content updates, it was decided to remove it. Also contributing to this decision was the fact that knowledge about COVID-19 is dynamic and, as new variants, vaccines and drugs authorized for use emerged, the content would need to be updated periodically.

Figure 5 presents the interface made available to the user when interacting with the virtual assistant in the social media:

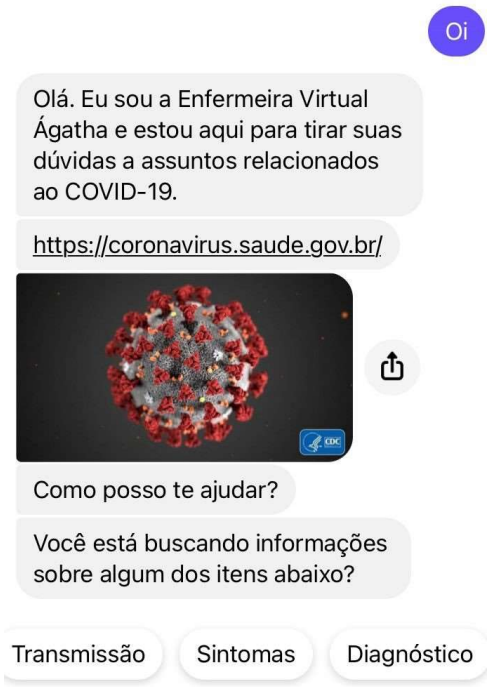

Figure 5 – Prototype interface. Florianópolis, SC, Brazil, 2020.

DISCUSSION

The virtual assistant was developed as a health education strategy for the population, as well as for clinical screening according to the risk degree measured from the signs and symptoms described. It was structured by the concepts of machine learning, which is characterized as a branch of Artificial Intelligence focused on algorithms that learn from available data. From this learning, it can create decision models to finalize tasks, that is, the ability to provide the best answer based on machine learning[15].

This tool can improve two-way communication in healthcare, as the patient asks questions in their language, that is, in the way they speak, and manages to make themselves understood by the virtual assistant. On the other hand, it allows health professionals to adjust the language used, facilitating understanding and enabling more informed and collaborative choices by the patients. This model can be characterized as a patient-centered approach to health care, enabling the understanding of patients' actions when faced with health information[17].

Patient-centered care based on co-production emerges from the interactions between the app user and the virtual assistant, as one emphasizes care responsive to the patient's preferences and the other contemplates active participation and co-responsibility in the results achieved[6–18]. With this, the process of providing information, answering questions and encouraging health-promoting behaviors, in the sense of highlighting preventive measures that depend on society, can contribute to coping with the COVID-19 pandemic.

Thus, with wider acceptance of such digital technologies by governmental organizations and the population, it is possible to expand them to other health areas in the future, such as for the control and monitoring of chronic diseases[11]. These digital health services enable better health care outcomes by monitoring users remotely[19].

The way people relate to each other and the health professional-patient relationship are changing. Digital technologies like apps favor the strengthening of the bond between users and health services (multiprofessional teams) through unique conditions and have the potential to encourage people closeness. The same digital systems enable the use of "intelligent" clinical protocols, facilitating the adoption of therapeutic measures as they evidence teamwork in a consensual and transparent way. Sensors such as wearables, robots, networks and technological systems for clinical and managerial decision-making support will sustain the intense interaction between users and health services[19].

Another way to apply the virtual assistant is employed in mitigating the effects of social distancing, enabling the connection between older adults and family members and friends, through the exchange of voice and text messages with the objective of promoting physical, mental and spiritual well-being. Thus, natural language recognition enables active and remote monitoring of daily activities, including geographic and epidemiological information for identification and treatment in case of aged people infected by the coronavirus[20].

As the new coronavirus emerges and grows to pandemic proportions, unscientific information about the disease is being disseminated in social and other media. Thus, associated with the pandemic, we also experienced an infodemic characterized by a large amount of information about a given situation that makes it difficult to solve the problem and confuses understanding; people start having difficulties distinguishing between unreliable information and evidence-based data. Therefore, the infodemic can be considered a public health problem due to the possibility of causing irreversible harms to the population's health. In this sense, one of the virtual assistant's action fronts is the character of education in health, denoting potential to combat Fake News[21].

This study presented limitations related to the Internet connection, which can cause interruption while using the virtual assistant. The virtual assistant is limited in its ability to provide information, as it is restricted to what it has been trained to do and according to its learning ability. In addition to that, not all people are comfortable communicating virtually. Despite these limitations, it is a technology with the use potential required to optimize health and nursing care, especially educational actions aimed at co-production in health.

CONCLUSION

The virtual assistant in health constitutes a tool for health education and, consequently, presents potential for combating Fake News, considering the possibility of providing the population with accurate information about COVID-19. It also represents a form of patient-centered health communication with the potential to strengthen the bond and interaction between health professionals and patients, promoting co-production in health.

Providing evidence-based information, answering questions and encouraging health-promoting behaviors, in the sense of highlighting preventive measures that depend on society, in addition to targeting health care according to the users' clinical conditions, can all assist in coping with the COVID-19 pandemic.

The potential of this study is highlighted by demonstrating the possibility of developing digital technologies for disease follow-up and remote user monitoring, impacting on better health care and Nursing outcomes. As the study continues, through product validation, use of the virtual assistant can be expanded and the development process can be replicated to other contexts.

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NOTES

ORIGIN OF THE ARTICLE

Extracted from the research project - "Virtual assistant: A tool for health co-production in coping with COVID-19", linked to the Graduate Program in Nursing, 2020.

CONTRIBUTION OF AUTHORITY

Study design: Fabrizzio GC, Oliveira LM, Costa DG, Erdmann AL, Santos SLG.

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Writing and/or critical review of the content: Costa DG, Erdmann AL, Santos SLG.

Review and final approval of the final version: Costa DG, Erdmann AL, Santos SLG.

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The study followed the national and international rules of ethics in research involving human beings; however, as the research objective is to describe a technological innovation, the study waived approval by any Committee of Ethics in Research with Human Beings