

RESEARCH ARTICLE

Digital health solutions implemented by Sanitas hospitals to maintain continuity of care during COVID-19 pandemic.

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Abstract

Introduction: Digital health facilitates patient-centered, accessible, safe, and more efficient care, through technologies such as telemedicine, big data, bots, artificial intelligence, and other technologies. Undoubtedly, its implementation has been accelerated thanks to the COVID-19 pandemic, where they have demonstrated their effectiveness, by maintaining continuity of care and facilitating early interventions thanks to the analysis of data and the deployment of bots, telemonitoring and virtual care platforms.

Objective and methods: Prospective observational study to describe the digital health solutions implemented by Sanitas hospitals, a health insurance company with around 2 million costumers, 5 teaching hospitals and many outpatient health care facilities throughout Spain, to maintain continuity of care during COVID-19 pandemic. We outline the results of using the Sanitas telemedicine platform (video consultations and Connected Health application) and chatbot.

Results: During the first 2 months of the COVID-19 outbreak, we have experienced an exponential increase in the number of video consultations, coming from an average of 300 a day before the COVID-19 crisis to around 5000 a day, going from 27.058 virtual visits made during 2019, to 114.598 in the first 5 months of 2020. The Connected Health mobile phone application allowed to remote monitoring 95 patients after hospital discharge for COVID-19 infection, measuring vital signs with a connected pulse oximeter, answer health questionnaires daily, and alert the medical team who received alerts for pain from 80% of patients and a decrease in oxygen saturation in 12% of cases. Bots has also helped to fight the COVID-19 crisis, making information available by providing the best answer to patients whenever they want it 24/7. Our bot SanIA has experienced 16.858 consultations about COVID-19 during the first 2 months of the outbreak.

Conclusions: Digital health, throughout video consultations, telemonitoring platform and bots, has helped to maintain continuity of care during the COVID-19 crisis. The COVID-19 pandemic has brought a sudden change in the adoption of digital health strategies, which will undoubtedly continue in the long term, and has served us, both health staff and the population, to be better prepared for this next digital age.

Key Words: Digital Health, Telemedicine, Bot, Artificial Intelligence, COVID-19.

Introduction

The irruption of technology in healthcare is an increasingly evident reality, driven by the rise of digital transformation. From this convergence between health and digital technology is born the so-called digital health, which not only provides us with a

toolbox that supports the development of innovative patient-centered care models, promoting accessibility, quality, safety and efficiency in all areas of health, but it is a cultural transformation of traditional medical care, through disruptive technologies such as telemedicine, mobile

health, applications, artificial intelligence (AI), bots, sensors and other devices, which we will discuss below (1).

These new digital technologies allow building a different relationship with the patient, focused on their needs, transparent, agile and continuous 24 hours a day, where the user enjoys much more information, participation and autonomy. They have the potential to simplify both administrative and healthcare processes, to improve the quality and reduce the cost of medical care.

Telemedicine and internet of things

Mobile devices and applications create the digital channel, where healthcare can be delivered anywhere. The video consultation is a clear example of this, being very useful for disease control, follow-up after discharge from the hospital, and in emergency services, where it has a high resolution capacity, reducing waiting time.

The Internet of Things is simply the networking of physical devices over the Internet, providing them with connectivity and facilitating a great exchange of high-quality data. This allows patients to use connected sensors that measure all kinds of physiological variables, medication adherence, and perceived health status, making it easy for physicians to remotely monitor a patient's health in real time. This has led to the creation of connected health platforms, which allow telemonitoring of patients with wearables linked to mobile applications that support behavior modification through behavioral techniques and gamification. The data is managed in the cloud by software that allows alerting healthcare personnel of a

clinical deterioration and thus acting early (2). There is sufficient evidence that telemedicine reduces healthcare costs, improves the health of the population and the customer experience in health care (3).

Artificial intelligence

AI is intended not only to change the way we diagnose and treat, but to redesign health care, impacting on three levels: in doctors with fast and accurate image interpretation; in healthcare systems, by improving workflow and the possibility of reducing medical errors; and in patients, by allowing them to process their own data to promote their health (4).

AI can help the insufficient number of doctors to treat the growing number of patients more efficiently, through digital diagnosis and monitoring of diseases, through interaction with sensors, facial recognition, voice analysis and use of interactive virtual assistants, which can be implemented on mobile phones around the world and facilitate universal access to low-cost, predictive, personalized healthcare 2.0 (5).

Another great application of AI is the chatbot or conversational bot (shortened form of robot), which is a programme that simulates having a conversation with a human being. It is able to process messages in natural language, issued by the user through keyboard or audio systems and it generates responses sent again to the user. These automated voice conversation virtual assistants are useful for managing tasks with minimal human-machine interaction, or for health problem management, such as helping to improve weight loss or gain (6) or helping depression (7) or to deal with

COVID-19 crisis. Bots can make information available at a scale well beyond telemedicine approaches due to automation and this can provide support for people who cannot afford care, who can't communicate well in English, or who prefer anonymity. These approaches can be developed to tie to institution-specific resources and that will enhance customer service by providing the best answer to patients whenever they want it, without having to wait and without variability based on who answers the phone (8). They are accessible any time, allowing patients to obtain answers 24/7 and to avoid wait times on hold before reaching a human. Bots have a higher handling capacity than any human. A single chat bot can simultaneously have conversations with thousands of people no matter what time of day. Regardless of the volume of calls, every question may be answered immediately.

The objective of AI is not to replace doctors but to expand our skills, since its greatest potential lies in the analysis of large amounts of data that will allow replacing part of the doctor's routine work. Therefore, AI will not displace doctors, but those who embrace its advantages will end up displacing those who do not use it (9).

Big data and Real world data

Big data is a large data set that can be computerized to uncover patterns, trends, and associations, particularly those related to human behavior and interactions. The development of new AI algorithms and the increase in the number and quality of the data allow the analysis of unstructured biomedical texts and in turn extract

information from sensors and notes from the electronic medical record. Although there is an ethical obligation to protect the privacy of patients, they express their willingness to provide their data to medical records if they are kept confidential.

Real World Data (RWD) is data related to the health status of the patient and / or the provision of health care collected on a routine basis, which can be obtained from a wide variety of sources with various uses in the clinical practice. There is a need for clear RWD documentation and communication between patients and the medical team. Patients provide information that is complementary but different from the adverse events classified by the doctor, since these tend to underestimate the symptoms of the patients, having shown that severe symptoms are not reported in clinical trials in up to 76%. The data suggests that RWDs are more sensitive to differences in treatment-related toxicity than clinically classified adverse events, reflecting the importance of proactive symptom management in high-quality healthcare. Incorporating RWD into clinical care can improve outcomes over standard care. Numerous trials have shown that outpatient symptom monitoring improves communication between the patient and the medical team, quality of life, symptom management and survival (10), and in turn the satisfaction of the medical team (11) and clinical decision support. Efforts for this integration of RWD must include the perspectives of all stakeholders, including patients, families and providers.

Digital health in the covid-19 pandemic

Digital health offers significant opportunities to reshape today's healthcare systems. From the adoption of electronic medical records to mobile health applications and other disruptive technologies, digital health solutions have promised better quality of care at a more sustainable cost. At times like this pandemic, the most adverse scenarios often provide an opportunity to develop and test the ability of these digital health technologies to increase the efficiency of healthcare systems.

While clinical staff remain on the front line to protect citizens from the pandemic, healthcare system managers reduce the infection rate by deploying digital healthcare solutions, to avoid nonessential patient contact with the health care system and to improve the control and diagnosis of COVID-19 (12).

Methods

This is a prospective observational study with the digital health solutions implemented during the COVID-19 pandemic by Sanitas hospitals, a health insurance company with around 2 million costumers, 5 teaching hospitals and many outpatient health care facilities throughout Spain, to maintain continuity of care during COVID-19 pandemic. We outline the results of using the Sanitas telemedicine platform (video consultations and Connected Health application) and chatbot between March and May, 2020.

For the analysis of the data, usual descriptive statistical techniques have been used.

Results

This is a prospective observational study with the digital health solutions implemented during the COVID-19 pandemic. Some examples of these strategies deployed in our company have been: Facilitate the registration of citizens in personal health platforms by using a mobile application for appointment management; Expansion of the virtual visit system that allows the doctor to make a videoconference with the patient directly from the electronic medical record; Establish a synchronous and asynchronous communication channel between the citizen and the health professional; Develop chatbot for self-evaluation of the disease COVID-19; Enable web access to the electronic medical record through virtualization technologies that ensure that health professionals can continue their work, including medical visits, from home (telework) during the period of confinement; Reduction of bureaucratic barriers in medical care processes by allowing patients online access to their medical reports and pharmacies to treatment plans through electronic prescription systems; Or managing the emotional state of citizens through the implementation of chatbots, applications or web services that allow self-assessment and identify risk cases to contact them proactively.

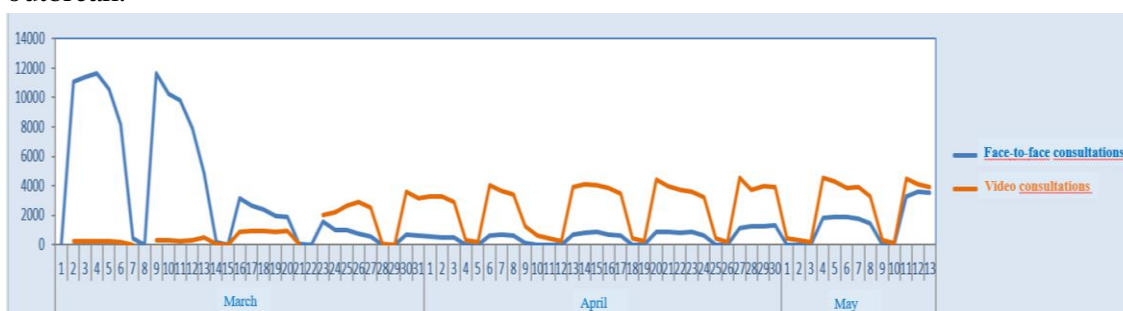
This supposes the creation of a new communication channel that guarantees equity in access, a change in the model of care provision with a reduction in personal visits and training of clinical personnel with adaptation to new technologies. It also implies the design of new financing models

such as the recognition of virtual visits as a billable service.

Its benefits are to establish a formal and secure communication channel between the citizen and the health professional, decrease non-essential visits to health centers by citizens, thus reducing the risk of infection for both citizens and health professionals and ensure continuity of care.

During the first 2 months of the COVID-19 outbreak, we have experienced an exponential increase in the number of video consultations, coming from an average of 300 a day before the COVID-19 crisis to around 5000 a day, going from 27.058 virtual visits made during 2019, to 114.598 in the first 5 months of 2020 (Figure 1).

Figure 1. Number of video consultations during the first 2 months of the COVID-19 outbreak.



The Connected Health telemonitoring platform is a mobile phone application connected to a pulse oximeter and the medical team. It has been used by 95 patients (64% male with a mean age of 54 (SD 26-81) years) after hospital discharge for COVID-19 infection. The mobile phone application, allowed to measure vital signs and answer health questionnaires daily, and alert the medical team that could be

contacted by video consultation. The application allowed the detection of alerts for pain (80% of patients) and a decrease in oxygen saturation (12%). No patient required hospital readmission or presented complications. The application allowed strict monitoring of symptoms and quality of life. The main symptom was severe pain (59% of patients) followed by anxiety or depression (25%).

Figure 2. Connected Health application: screenshots

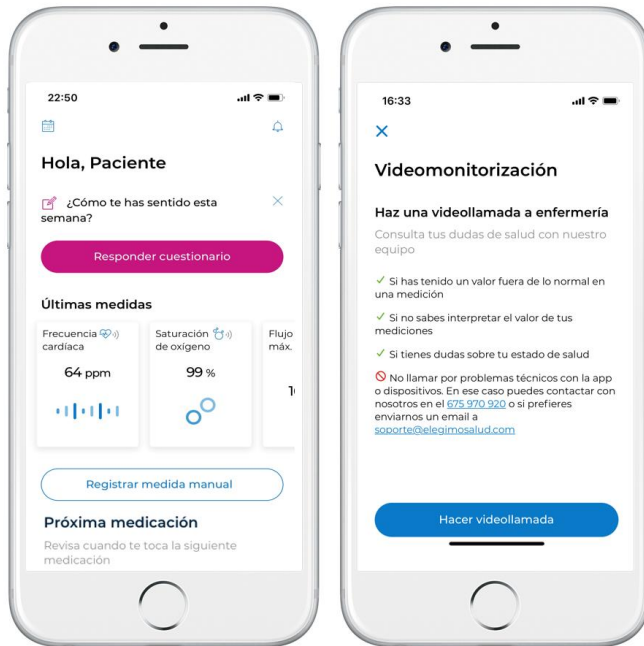
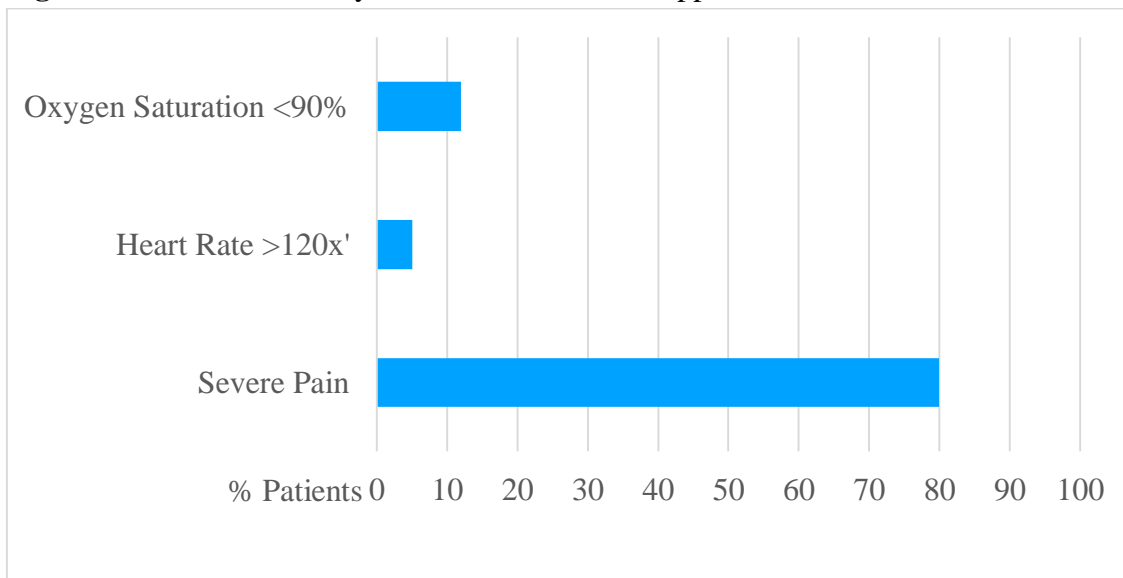


Figure 3. Alerts detected by the Connected Health application.



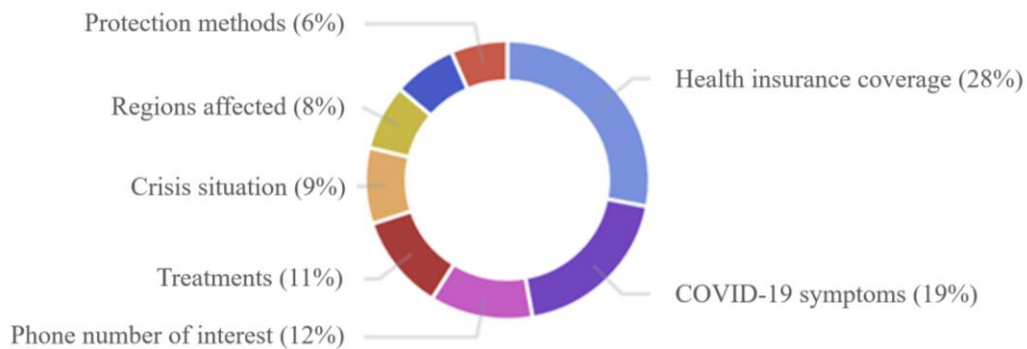
Bots has also helped to fight the COVID-19 crisis, making information available by providing the best answer to patients whenever they want it 24/7. Based on our experience with 16.858 consultations

about COVID-19 to our bot SanIA, during the first 2 months of the outbreak in Spain (Figure 2), most of the questions were about health insurance coverage and COVID-19 symptoms (Figure 3).

Figure 4. Number of bot consultations about COVID-19 during the first 2 months of the outbreak.



Figure 5. Reasons for querying the Bot SanIA (16.858 consultations)



As we have seen, all this advances in wireless technology, smartphones, and the Internet of Things have facilitated new ways to collect RWD in real time during hospital visits and in daily life (Table 1 and 2). These can generate very large data sets

capable of big data analysis. The integration of these electronic medical records and biometric data will allow the digital phenotype of the patient to be created and its integration in research and clinical care.

Table 1: RWD generated by the patient.




	Self-reported medical data: personal or family history, lifestyle habits, risk factors, treatments and their completion.
	Self-reported outcomes: disease symptoms, treatment side effects, and quality of life.
	Biometric or wearable data: heart rate, blood pressure, blood glucose, temperature, physical activity, sleep, location, ambient level of light and noise, weight, falls ...

Table 2: RWD Benefits

Developing Personalized Medicine: targeted therapies based on the history and genetic information of the patients.
Decision making: provide healthcare professionals with specific data and biostatistics information.
Variable analysis: they allow variables to be interrelated, being able to find probable events that until now were not related or to screen the information based on specific needs.
Analysis of treatments and quality of care: efficiency, safety and measurement of results.
Early diagnosis: and introduction of specific therapies for initial stages of the disease.
Optimization of resources: reduction of waiting lists, detection of poorly controlled or poor adherence patients, hospitalization, consultation time...

Discussion

Digital health, throughout video consultations, telemonitoring platform and bots, has helped to maintain continuity of care during the COVID-19 crisis.

Thanks to the implementation of digital strategies such as video consultation, a strong change has been observed in face-to-face visits to virtual consultations. Even after the outbreak of COVID-19, an

increase in the adoption of digital health solutions has continued to be observed. Many barriers to adoption have disappeared, at the same time that the general population and professionals are increasingly demanding technologies.

The high pressure on the health care system in a situation of extreme crisis has been a surprising engine of change. The lessons learned in the pandemic by COVID-19 have helped define future steps.

This study also demonstrates the efficacy of the Connected Health platform for the remote monitoring of patients after hospital discharge by COVID-19. The application has facilitated the measurement of oxygen saturation, symptoms and has allowed the detection and management of alerts by the medical team through video consultation. Other studies have shown that remote monitoring of patients to control COVID-19 symptoms at home is effective and safe, improving engagement and health education, while minimizing exposure to COVID-19 and the use of face-to-face medical care (13), specifically after hospital discharge, making early hospital discharge possible, reducing the hospital stay, the use of protective materials and healthcare costs (14).

A long-term digital health strategy and a robust health system have proven to be the foundation of the accelerated change process, such as a unique electronic health record system, fostering a rapid deployment of innovations. Digital health tools have been shown to be the main driver for reducing bureaucratic processes related to health, which has saved time for professional staff, avoided non-essential visits by citizens to health centers, and

decreased risks of infection for both citizens and health professionals. In addition, financial barriers to the adoption of digital solutions must be removed, payment systems must be adapted to facilitate their adoption, and deployment must be accompanied by incentives for healthcare providers (15).

In addition, it is essential to bear in mind that for digital health to be implanted in the long term, a true digital transformation of medicine will be required, which involves adapting multiple processes, such as the ability to obtain informed consent, the terms and conditions of use, verification of the identity and location of the patient and the use of secure platforms, among others. It is not just about digitizing the conventional, but creating a new innovative digital system, a profound change in the healthcare model necessary to take advantage of the benefits that technology offers us at this time.

It will require closer collaboration between health and social care services, especially with social health centers, and improve it through a stronger deployment of digital solutions, such as a single electronic medical record and telemonitoring and virtual care platforms.

The need created by the pandemic and the current acceptance of digital health solutions has opened a window to further implement the model in a system that has traditionally preferred face-to-face contact. Although evaluating the efficiency of adopting these long-term implemented digital health solutions is of utmost importance, the satisfactory experience will undoubtedly create great expectations about the convenience and accessibility of

virtual care, which will be difficult to reverse once the crisis COVID-19 decrease. Similarly, the regulatory changes invoked to support the widespread use of telemedicine can be equally difficult to reverse.

Beyond the clinical benefits, the changes generated by the COVID-19 pandemic have probably irreversibly altered the position of telemedicine in the health system. When speculation about telemedicine's potential primacy over in-person care previously seemed futuristic, it is now a reality practiced in multiple healthcare systems around the world. Using telemedicine platforms, healthcare personnel and patients are forced to a new normal that includes communicating with each other through video and audio. For physicians, this means rapidly developing skills in virtual relationship building, empathy, physical video exams, diagnosis and counseling, as study plans must be developed to train the medical team in these new skills and modalities to ensure the quality.

We must harness the power and ingenuity of the technology sector to combat these disease outbreaks, but keep in mind that

when these digital technologies are implemented to combat a pandemic, especially with regard to digital surveillance, it must be through a thoughtful and transparent process (16). The COVID-19 pandemic has brought about a sudden change in the adoption of digital health strategies, which will undoubtedly continue in the long term.

Conclusion

The past decade has seen unprecedented progress in digital health, accelerated by the COVID-19 pandemic, allowing for closer contact with patients. Digital health, throughout video consultations, telemonitoring platforms and bots, has helped to fight the COVID-19 crisis. We have the opportunity to create new approaches based on data to identify and intervene early in clinically significant events, and thus improve both the quality and quantity of life.

It is necessary to work to ensure that we are better prepared for the next pandemic, but this has undoubtedly helped us, both health personnel and the population, to be better prepared for this next digital age.

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