Multichannel services for patient home-based care during COVID-19⋆

Ailton Moreira[1][0000−0003−1168−5861], Maria Salazar[2][0000−0002−1218−0980], and Cesar Quintas[2][0000−0001−6075−7185] Manuel Filipe Santos[1][0000−0002−5441−3316]

[1] ALGORITMI Research Centre / LASI, University of Minho, Guimarães, Portugal
ailton.moreira@algoritmi.uminho.pt
mfs@dsi.uminho.pt
[2] Centro Hospitalar Universitário do Porto, Porto, Portugal
{msalazar, cesar.quintas}@cuhporto.min-saude.pt

Abstract. At the beginning of 2020, the Worldwide Health Organization (WHO) declared a pandemic caused by the COVID-19 virus. In this sense, this article describes an experiment carried out in a Portuguese health institution during the Covid-19 pandemic between March and July 2020. The number of cases of infection increased exponentially and health facilities were forced to adapt to the circumstances. Due to the health facility limited resources they had to be innovative. A new modality of care service was introduced in which patients were admitted to home-based care to receive medical follow-up. The modality introduced focuses mainly on multichannel interaction between patients and health professionals. Two channels of interaction were made available to patients in home-based care to interact with health professionals. Also, a back-office platform was designed to support health professionals in the management of patients diagnosed with the disease and all the processes related to patient remote follow-up and their decision-making.

Keywords: Multichannel Services · Remote Patient Follow-up · COVID-19 · Healthcare Services.

1 Introduction

The COVID-19 pandemic has increasingly reinforced the need for healthcare institutions to deal with patients in home-based care [20]. Currently, patients who do not need continuous and particular medical care, are admitted to home-based care [5]. Before the pandemic, mainly patient with diabetes was admitted to home-based care when they didn't require particular medical care. With the pandemic, this situation had a significant change [9, 7], as patients that didn't require in-person treatment are admitted to home-based care. This practice has numerous advantages for both the healthcare institution and their health professional and the patients [8].

⋆ Supported by organization CHUP.

The present article focuses on this modality implemented during COVID-19 at Centro Hospitalar Universitário do Porto (CHUP) [12]. Due to the high number of infected patients with SARS-COV-2 and with the limited resources healthcare facilities had, they started to admit and recommend patients without symptoms to home-based care. To validate the applied approach, a research question was outlined for this article: **Was the use of multichannel services able to meet the needs of the patient while they were under medical surveillance?**

In this sense, this article seeks to investigate and comprehend whether the patient's needs were met while they were under medical surveillance in home-based care during the COVID-19 pandemic.

This article is structured in seven sections. First, an introduction to the topic is made. Secondly, a background is presented. In the third section, the materials and methods used are described. Section four presents the implementation process of the multichannel services, as well as the applications developed. In five, the results are presented. Lastly, discussion and conclusions are drawn.

2   Background

Multichannel interaction in healthcare services is just getting started, with health institutions increasingly focusing on patients and the care services they provide [15]. In this regard, how health institutions interact and communicate with their patients is critical for a positive user experience for both patients and the health professionals who provide these services. Multichannel interaction solutions have played an important role in ensuring that patients receive the service they expected and that health professionals can provide these services in the best working conditions in this process of communication and interaction between the two parties for the provision of care services [14, 11]. Several studies and pilot projects have been implemented in recent years with new concepts and models tailored to the needs of each institution [2, 8, 5, 9]. This article is based multichannel conceptual model proposed for healthcare services by Ailton et al (2020) [13, 15].

2.1   Agency for Integration, Diffusion and Archive of Medical Information (AIDA)

AIDA is an interoperability platform specifically designed to solve the problem of integrating information from multiple systems based on multi-agent technologies that make an Health Information System interoperable [1]. AIDA's platform consists of several modules with different functionalities and characteristics, all based on the interoperability of services and devices [4]. Since it was developed by a research group at the University of Minho, AIDA is already the main tool that guarantees interoperability in several Portuguese health organizations.

3   Materials

The data used in this article were collected from the Porto University Hospital Center (CHUP), which had a positive pilot experience with the implementation of a multichannel interaction solution in healthcare services during the first wave of the pandemic. These data pertain to patients who tested positive for COVID-19 but did not show any symptoms (asymptomatic patients) and were admitted for home-based care due to resource and health professional limitations at CHUP. The focus of this article will be solely on patients admitted for home-based care and their interactions with health professionals during the period of medical surveillance.

Table 1. COVID-19 numbers at CHUP

Indicators	Total
Patients with COVID 19 at CHUP	1794
Patients in Home-based Care	862
Patient Interactions	12605
CHUP Monit	11612
Telephone Contact	993

The COVID-19 data collected between March and July 2020 is displayed in Table 1. A total of 1794 COVID-19 patients were admitted to the hospital during that time. 862 patients didn't exhibit several symptoms, thus they didn't require in-person medical care. These patients were ultimately admitted to home-based care to avoid overloading the care facility resources. They had two ways to communicate with the health professionals that were monitoring their health conditions at home-based care. In total, they had 12612 interactions while receiving home-based care, of which 11612 occurred via CHUP Monit (a web application made specifically for these patients to log their SARS-COV2-related symptoms), and 993 occurred via a telephone contact that was made available to these patients to engage in direct communication with the accompanying health professional.

4   Multichannel Services implemented during COVID-19

First, its presented a simplified version of the COVID-19 workflow implemented at CHUP befoe discussing the multichannel model implemented.

4.1   COVID-19 Workflow

Patients who did not have severe COVID-19 symptoms were admitted for home-based care for the hospital to better manage its resources [19]. Figure 1

depicts, in a simplified form, the hospital workflow in the context of COVID-19 emergencies. The focus of this article will be on the interaction channels that patients use to communicate with health professionals. Patients admitted to home-based care were given two interaction channels to communicate with health professionals: CHUP Monit and a telephone contact that allowed patients to intercommunicate directly with the health professionals who were monitoring them.
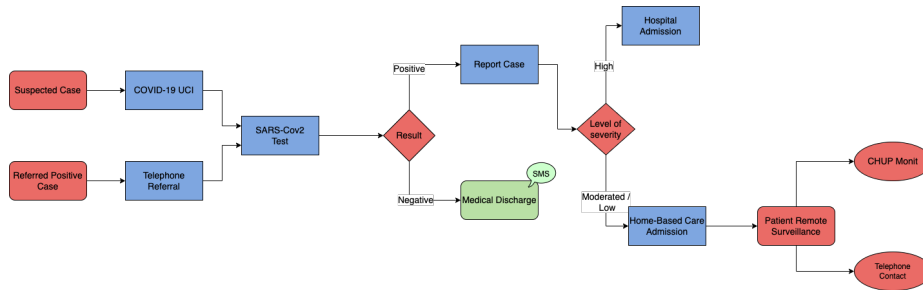

Fig. 1. COVID-19 simplified flow

- **CHUP Monit** - web application designed specifically for patients admitted for home-based care to interact with health professionals and track the evolution of symptoms caused by the COVID-19 virus while they were under medical surveillance.
- **Telephone Contact** - Patients admitted to home-based care were given a phone number to contact health professionals directly as an alternative channel of interaction with health professionals while they were under medical supervision.

These two channels enabled health professionals to follow-up the patients as the symptoms caused by the COVID-19 virus evolved. The workflow starts with the initial contact with CHUP (telephone referral or emergency) and continues with attendance at the COVID-19 service, triage, and referral to hospitalization or home-based care, in of patient low severity or lack of symptoms.

Patients admitted for home-based care continued to receive medical monitoring and follow-up. When these patients do not show any further symptoms for a specified period or test negative for the SARS-CoV-2 virus or fulfilled the healthcare regulatory restrictions, they had a medical discharge. This paper will focus on the last part of the workflow designed for the channels used by patients during the period that they were under medical surveillance.

This paper will concentrate on the channels through which patients interacted with health professionals while under medical surveillance, as presented in the final part of the workflow.

4.2   Multichannel Model Implemented

The implemented multichannel interaction model is made up of three tiers: the patient tier with the respective interaction channels, the coordination tier, which handles all of the integration and management of the data made available in the interaction channels, and the care provider tier, which accommodates health professionals and all of the technological infrastructure that is part of the model presented [13, 15].
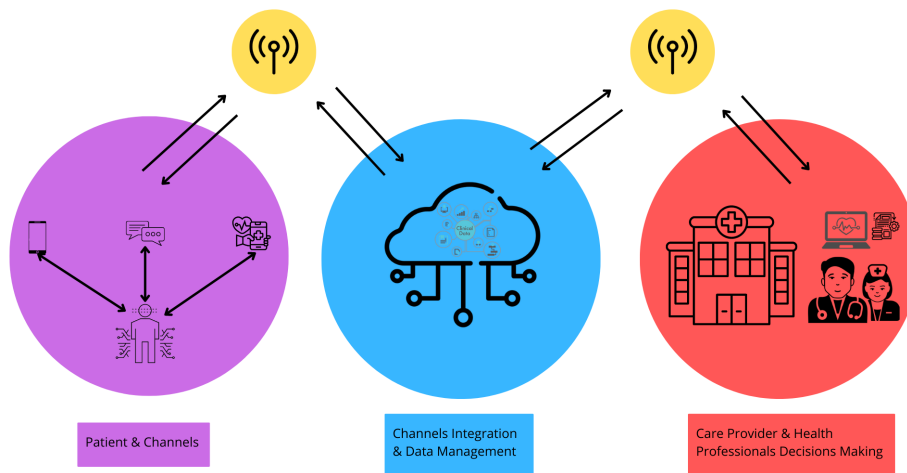

Fig. 2. COVID-19 simplified flow

- **Patient Tier** this tier has patients infected with COVID-19 and the interaction channels available to them to interact with the hospital and health professionals. The available channels are phone calls, web app, and SMS. Patients use these available channels to interact with healthcare professionals when they need them, to get help, or to get other types of information about their health condition.
- **Coordination Tier** this tier, coordinate and manage all the information made available to patients and healthcare professionals. This tier is the core of the solution because it is here that all patient data management is carried out, as well as in ensuring, the persistence of these data and their safety in different channels used by patients. This tier was crucial for all the interaction and continuity of services provided to patients, because is through this tier that all the interaction is managed, and all the patient health records are available in this tier. This tier is of course implemented in CHUP due to data privacy and data protection issues. Besides, only authorized healthcare professionals have access to this tier and information on it.

- **Care Provider Tier** this tier is the CHUP where the solution is implemented and all healthcare professionals who use the solution to follow up and monitor patients with COVID-19 from secretaries, nurses, doctors, and laboratory technicians, among others. Also, this tier is where all the technological infrastructure that supported the proposed solution is implemented. All the information processed, the databases, as well as the defined logical and business rules, are kept in this tier at CHUP to ensure and guarantee the privacy and protection of the patient's clinical data.

The CHUP Monit and the telephone contact used by patients are represented on the patient tier. To manage, integrate and present all the patient clinical data, a web app was designed to meet these needs. That web app was supported by many Healthcare Information Systems (HIS) and the AIDA platform. AIDA had an important role here because it used its intelligent agents to guarantee the interoperability of data to be presented to health professionals and patients [16, 1]. The AIDA platform was represented on the coordination tier. All the systems and applications used to implement the multichannel solution during the experiment carried out were implemented at the care provider tier. Physically both the coordination tier and care provider tier are located at the same facility. Also, the care provider tier is where is located all the health professionals that interact with the patient through multiple channels of interaction.

4.3   CHUP Monit

Following a diagnosis of Covid-19 virus infection, the treating physician evaluates the patient's status to determine if he may receive treatment at home for moderate and low symptoms or whether he has to be hospitalized for severe symptoms. Doctor follow-up is required daily for patients receiving home-based care. To speed up this procedure, a new web application was designed, allowing patients to communicate self-monitoring data.

The platform CHUP Monit, shown in Figure 3, was created to monitor and follow-up patients in-home care diagnosed with the COVID-19 virus. Through a specific form, the patients could register the evolution of their health status for medical follow-up during the home care internment. The following image demonstrates the records made by the patient about their health status with symbology that aid the data interpretation by health professionals.

Access to the patients was granted via the mobile phone number associated with the patient, who received a code via SMS for authentication. Besides, clear procedures were implemented to promote the efficient use of the web app. Whenever a new patient was admitted to home-based care, it was verbally informed to them and handed an informed leaflet about the two interaction channels they can use to interact with health professionals.

The patients who have used the web app to communicate with doctors recovered from the previous clinical condition in a shorter time and sent at least one update of the symptoms per day. They have been contacted whenever the
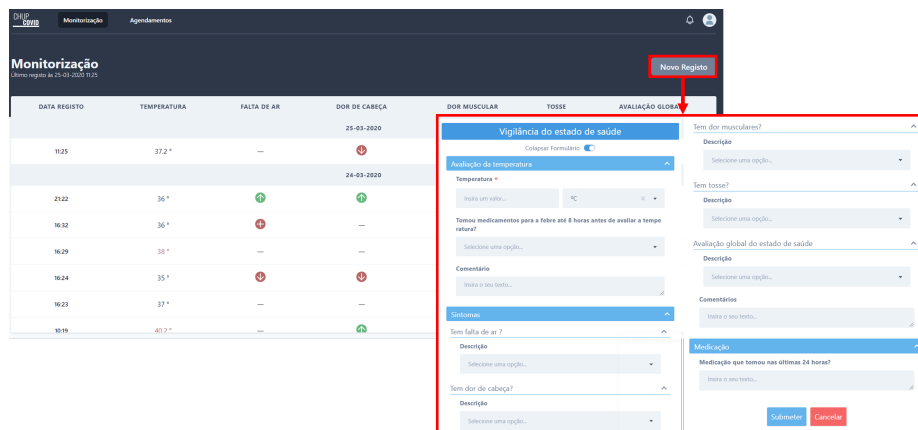
Fig. 3. CHUP Monit platform

clinical condition required and received orientations to act (e.g. medications, procedures).

The web app CHUP Monit, allowed us to provide alternative communication channels, developing and making use of an online platform to interact asynchronously with patients and to collect symptoms data. Besides, the forms used were modeled according to open standards specifications, such as openEHR, FHIRE/HL7, and SNOMED-CT for data coding and modeling, and for interoperation with internal and external information systems [17, 12, 10, 18].

4.4   Aida Contingency

As a back-office platform, Aida Contingency was designed to support health professionals' activities during the COVID-19 pandemic. This module is a web application with the purpose to manage COVID-19 workflow in different contexts and fields at CHUP. It had to be adapted due to the new coronavirus to accompany and monitor patients with COVID-19 from the moment they make the first contact with the hospital with possible symptoms of the virus until they had a medical discharge.

In a nutshell, AIDA Contingency enables health professionals to continuously monitor and follow-up infected patients through multiple channels of interaction remotely. Figure 4 shows the visualization of the monitoring report performed by the patient. Thus, the health professional can monitor the evolution of the patient's health condition and get in touch with him, if necessary.

5   Results

This section is presented the main findings gathered from the data collected and a brief analysis of these data.
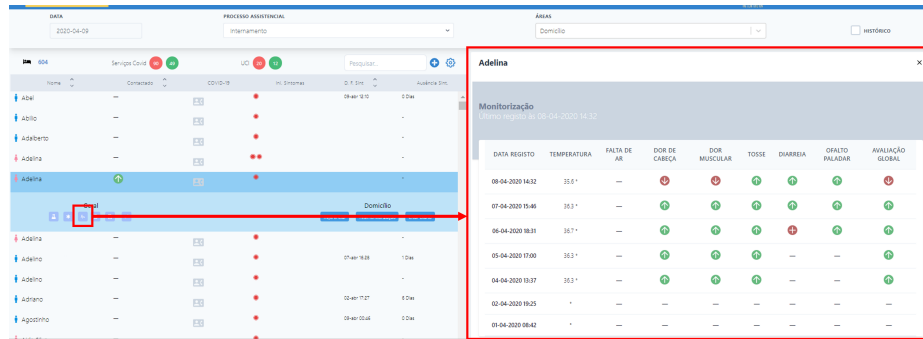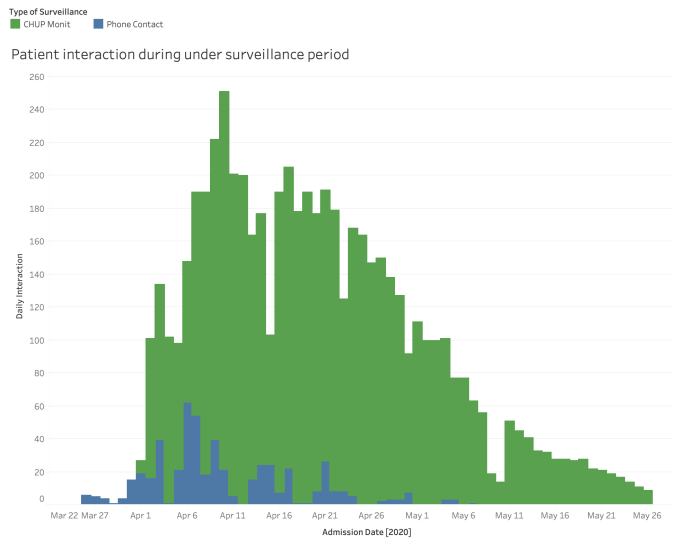
Fig. 4. AIDA Contingency platform

Fig. 5. Channels interaction used by patients

The chart presented in Figure 5 shows that patients preferred to use the digital channel instead of the manual channel to interact with health professionals The web app was by far the preferred interaction channel for patients to interact with healthcare professionals, given its portability and ease of use, combined with the low waiting time to interact with health professionals.
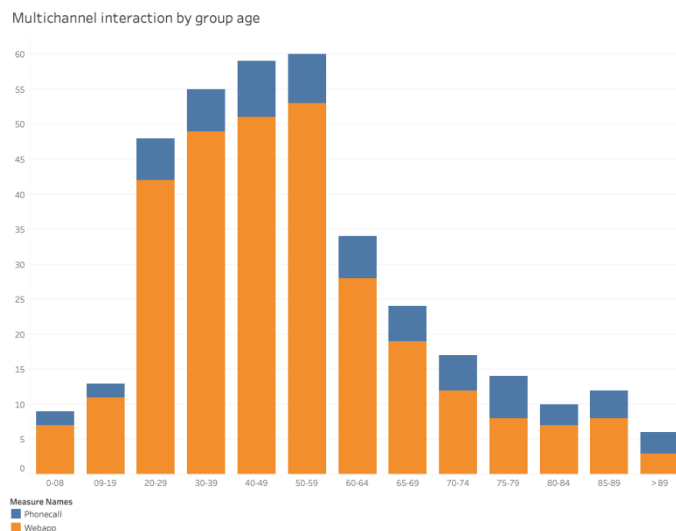

Fig. 6. Multichannel interaction by patient age group

The chart presented in Figure 6 contains information about channel utilization by patient age group. Based on this chart, it's possible to relate patients' channel utilization by each age group. Patients in the age group between 19 and 75 years old were the ones which had more interaction with health professionals the difference between the channels used was very high.

The CHUP Monit was the patient's preferred channel of interaction, as seen in the preceding Figure 5. Based on Figure 6, it is feasible to conclude that CHUP Monit (web app) was the channel that patients use the most to interact with health professionals across all age groups. Health practitioners didn't have to exert much effort to communicate with patients because telephone contact represents a relatively tiny share of interactions in each age group. Only when patients weren't utilizing the CHUP Monit or when the patient needed a medical discharge did they need to communicate with them over the telephone contact. The chart also highlights how crucial it is for patients to have access to a digital channel for communicating with medical practitioners. The use of digital channels reduces the health professionals' workload to follow up with the patients at home-based care. Overall, despite the large age difference between patients, the

CHUP Monit was the preferred interaction channel for patients to interact with health professionals, and it was well accepted by patients in general.
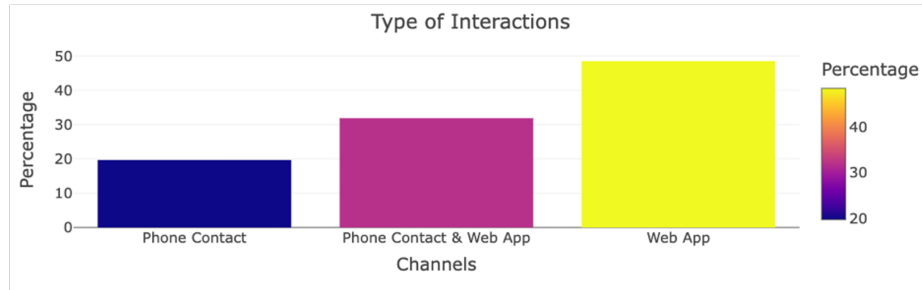

Fig. 7. Multichannel interaction by patient age group

Figure 7 illustrates the crossing made between channel utilization for a more in-depth analysis of the data gathered. The percentage of patients who only used the CHUP Monit to interact with health professionals (approximately 48,4375%), the percentage of patients who only used telephone contact to interact with health professionals (approximately 19,6875%), and the percentage of patients who used both channels of interaction (approximately 31,875%) were identified on Figure 7.

An intriguing finding was that the use of both channels (CHUP Monit and telephone contact) was not proportional, but rather complementary, particularly in terms of decision-making by health professionals. When health professionals interacted with patients over the telephone contact, they maintained synchronous communication, which was more effective and efficient in providing information about the evolution of patients' symptoms and making decisions regarding medical discharge, or not, depending on the evolution of the symptoms.

The next section contains a brief overview of the findings derived from the data obtained, as well as the answer to the research question previously outlined for this article.

6   Discussion

The COVID-19 pandemic has demonstrated that the digitization of health services is a trend that will continue, and more healthcare institutions are following suit by broadening the scope of care services they provide to their patients through different channels of interaction.

The objective of this study was to assess if patients undergoing home-based care follow-up during the COVID-19 pandemic had their requirements fulfilled. To do this, the gathered data was analyzed and some charts were prepared.

Although the idea of telemedicine or remote medical treatment is not new, it has gained popularity with the pandemic and more health institutions are

adopting it as a strategy to follow. There are many models of telemedicine service for adoption today, each tailored to the requirements of healthcare institutions [6, 9].

In the case of the multichannel interaction model proposed in CHUP during the pandemic, together with the analysis of the data collected as well as the feedback from patients and health professionals, it was a very positive experience for all parties involved and there were significant gains with this implementation.

The use of two interaction channels also made it possible for patients to always be in contact with health professionals in the moments they needed. Through CHUP Monit, patients could report the symptoms they were experiencing. Case patients had any doubts they had telephone contact to call and clarify their doubts with health professionals. Due to the availability of these channels and the simplicity of using them together with the feedback from the patients and the analysis of the data, some conclusions were outlined. With the availability and use of the two channels of interaction was possible to fulfill the patient's needs during the period they were under medical surveillance.

Besides many studies carried out present similar conclusions regarding the use of different channels of interaction to communicate with a health professional [3, 2, 8, 9].

7   Conclusions

The realization of this article as well as the conclusions drawn from the data analysis came to reinforce even more that the multichannel service is here to stay in healthcare and that it can bring significant gains to the health institution.

There was a good acceptance by health professionals as it significantly reduced the level of effort required to carry out daily monitoring and manage patients during home-based care, by providing meaningful data to support quality clinical decision-making. On the other hand, from a total of 12605 interactions, only 993 (7.87%) were carried out by telephone contact. This means that approximately 92,3% of the time that professionals would have been devoted to contacting patients by telephone contact was freed up for other tasks.

There was a significant adherence of patients to the use of CHUP Monit to interact with health professionals since they felt that they were being part of the process and that they maintained direct contact with health professionals through the two interaction channels made available to them. Each one of the 862 patients in home-based care followed received an indication regarding how to use the CHUP Monit and to promote the use of the digital channel. Of these, 688 patients adhered to the CHUP Monit and, of these, 617 effectively reported their symptoms through the CHUP Monit (90%), which corresponds to a significant adherence.

In general, it was noted that there was a great gain in terms of interaction between the different stakeholders. The continuous interaction among the different stakeholders came to further strengthen the relationship between them and

the consequent trust in the services that health professionals were providing to patients in-home-based care [20, 6].

In this article, an aspect that must be considered by health institutions whenever they deliver care services in the different channels of interaction was addressed, which is to ensure that they can meet the needs of their patients in the services that are provided to them with the use of information and communication technologies.

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