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Procedia Computer Science 177 (2020) 534–539

Procedia Computer Science

www.elsevier.com/locate/procedia

International Workshop on Helthcare Open Data, Intelligence and Interoperability (HODII)
November 2-5, 2020, Madeira, Portugal

A Conceptual Model for Multichannel Interaction in Healthcare Services

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Abstract

Multichannel interaction services have grown and evolved a lot in many sectors and their potential has been demonstrated in terms of monitoring and engaging with customers. In healthcare, has a tremendous impact on health organization as well to patients. In a multichannel interaction, environment patients can interact with health professionals across many channels without losing previous interactions, i.e. patients have a continuity of services across different channels. This paper aims to introduce a conceptual model of multichannel interaction in healthcare services. The model addresses all main actors involved in the process of multichannel interaction. The model proposed was validated through a proof of concept with a proposed artefact designed during the pandemic of new coronavirus COVID-19.

Keywords: Conceptual Model; Healthcare Services; Multichannel Interaction; COVID-19, Coronavirus Pandemic

1. Introduction

The multichannel interaction service is a practice in which organizations interact with their customers or potential customers through multiple channels of interaction without losing the previous interactions. To organizations ensures the continuity of interaction between them and their customers or potential customers, they need to explore and create a multichannel interaction environment. To create that environment, organizations must identify the main actors that are part of a multichannel interaction. The actors are customers, IT infrastructure, the services available, as well as the organization itself and its respective employees. To implement the multichannel interaction service, is proposed in this paper a conceptual model to be applied in the healthcare service. The proposed model has two levels of abstraction, one is low-level and the other is high-level of abstraction. The high-level model is a very generic and global model where only high-level layers are identified. On the other hand, the low-level model is more detailed, in which the actors that make up each layer of the model are identified with more detail. This paper aims to present the conceptual model

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1877-0509
10.1016/j.procs.2020.10.074

proposed for multichannel interaction, as well as its description and validation (proof of concept). The validation of the model was carried out in a project developed in the context of the pandemic of COVID-19 at *Centro Hospitalar Universitário do Porto* (CHUP).

2. Related work

2.1. Hospital 4.0

The work presented in this article is part of a bigger project that is being developed within the scope of Hospital 4.0. The era of Industry 4.0 is currently experiencing with numerous innovations in all sectors of activities [1]. Healthcare organizations are also following this trend and, are heading towards the era of Hospital 4.0 [2] that takes full advantage of Industry 4.0 but, in this particular case, it's applied to emerging technologies and innovative solutions in the healthcare area. The conceptual model proposed in this article is based on a previously published study in which was introduced what would be an idealization of multichannel interactions in healthcare [2]. Hospital 4.0 is based mainly on the interoperability of services, Internet of Things, Internet of Medical Things, and all the services offered to patients. Based on the previous publication [2], a conceptual model for multichannel interaction in healthcare services was developed. The model will take full advantage of the new Hospital 4.0 paradigm and its advantages. The model shows that are moving into an era where the focus of the business of healthcare organizations becomes the services provided to patients and their continuities in different channels of interaction.

2.2. AIDA

Agency for Integration, Diffusion and Archive of Medical Information (AIDA) is an interoperability platform designed specifically to address the problem of integrating information from multiple systems and addressing interoperability, confidentiality, integrity, and data availability, i.e. is a platform based on multi-agent technology systems that makes the HIS interoperable [3, 4, 5, 6]. AIDA's platform consists of several modules with different functionalities and characteristics, all based on the interoperability of services and systems. 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 [6]. AIDA has intelligent agent systems that ensure interoperability between different heterogeneous information systems. AIDA's objective is to integrate, disseminate and archive a large amount of data from different heterogeneous sources (departments, services, units, computers, medical equipment). The platform has set of features such as high power for manage changes in the system, ability to customize objects, high availability, accessibility and timely support, high security of the information and the system, technologically modern, ease of maintenance, simplicity of using the system, and difficulty in the controlling agents and its activities [3, 4, 5, 7]. This paper will present one application that belongs to AIDA platform (AIDA Work) in particular AIDA Work - Module COVID-19. This module was designed during the pandemic of COVID-19 that was implemented at CHUP.

3. Multichannel interaction in healthcare services - conceptual model

Multichannel Interaction in Healthcare Service is an approach that is based on the interaction between patients (through their preferred channels of interaction) and health professionals, as well all the technical IT infrastructure required to create the multichannel interaction environment [2]. In this approach, the model becomes decentralized and will focus on the patient (patient-centralized), different from what used to be a centralized model focused on the healthcare organization [2].

The conceptual model proposed in Figure 1 for multichannel interaction in healthcare services between patients and health professionals aims to take advantage of emerging technologies from Hospital 4.0 to provide better quality service to patients.

Figure 1 represents the high-level abstraction of the model proposed. The model has three main Layers the patient layer, the coordination layer and the care provider layer. Each layer has a set of different actors and intervenient that allows the interaction across multiple channels. These actors and intervenient will be detailed on the following subsections.

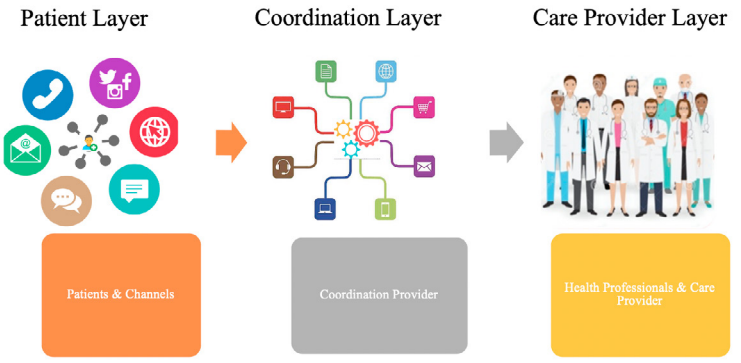

Fig. 1. Conceptual Model of Multichannel Interaction in Healthcare Services

3.1. Patient layer

The patient layer consists of the patient and the different channels of interaction that he/she has at disposal to interact with the care provider. Currently, patients have a variety of channels to choose from to interact with care providers. These channels are social media, web app, mobile app, email, phone call, SMS, and virtual nurse. All of these channels represent a touch-point for interaction with care providers.

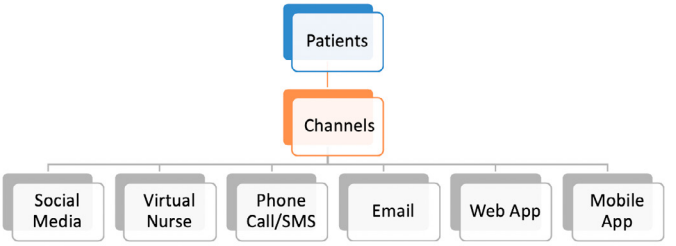

Fig. 2. Patient Layer

The patient layer is focused on patients and the interaction channels with the care provider. This model aims to emphasize the patients and the way they interact with the care provider, i.e. the model is patient-centred. With this model, the patient has a variety of channels of interaction that he/she can choose from to interact with the care provider. The information is available to the patient on every channel, and it is independent of the channel selected.

3.2. Coordination layer

The coordination layer handles all the interaction from different channels that the patient uses to interact with the care provider. This layer is very important because it is there all the coordination and interaction management with the different channels will be carried out and unifying these interactions in a single service on the care provider side.

The coordination layer coordinates, manages and integrates all interactions between the different channels that patients use to interact with the care provider. This layer is responsible for ensuring the continuity of services regardless of the channels of interaction as well as the integration of requests in a single service for the care provider so that the provider has only one touch-point to interact with the patient. This layer is essential to validate the model and how it should operate. This layer does all the service integration management, channel management, service continuity management, data persistence, and data management that is presented to patients, as well how patients are connected (through their preferred channels) to provide a continuous and personalized service to them. Also, this layer has to guarantee the reliability and consistency of the data in the interaction between patients and health professionals in all channels whenever necessary.

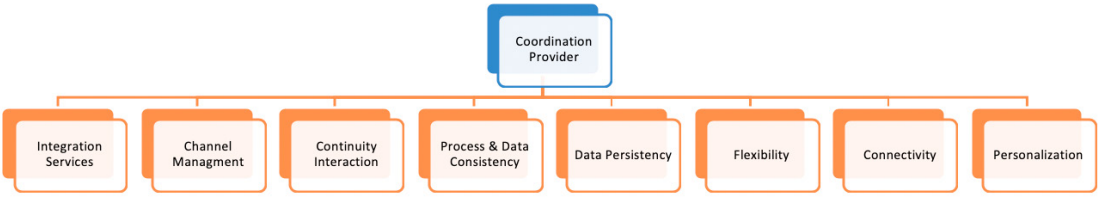

Fig. 3. Coordination Provider Layer

3.3. Care provider layer

The care provider layer is where the health professionals are located, where the business rules are defined as well as its respective business logic, the clinical data of the patients are in this layer as well all the other business data and the database.

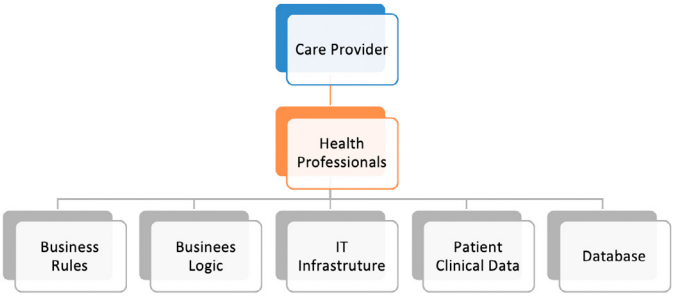

Fig. 4. Care Provider Layer

The Care Provider layer is health organization and all the health professionals such as nurses, doctors, administrative staff, technicians and secretaries, among others, who somehow integrate with patients are located. It's also in this layer that all the logic and rules of the business are defined. All clinical records of the patients are stored. This is a layer with a certain degree of importance as it determines everything that will be made available to the patient through the patient's choice channel.

4. AIDA work

AIDA Work is one of many applications that belong to the AIDA platform, and it aims to manages workflow in different context and fields of work at CHUP. It had to be adapted due to the pandemic of COVID-19 to follow-up 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 are cured. To this end, the COVID-19 module was designed in AIDA Work, which allows health professionals to follow-up and continuously monitors infected patients through a multichannel environment even when patients are not admitted to the hospital. To complement the COVID-19 module in AIDA Work, a web app (CHUP Monitor) was designed to patients so that they can register the symptoms they have and receive continuous monitoring by health professionals.

4.1. Module COVID-19

The COVID-19 module of AIDA Work is designed to receive, grouping, follow-up and monitoring all interactions with patients infected with COVID-19, from the moment they make their first contact with CHUP. Through this

module, health professionals can interact with patients regardless of the channel the patient chooses to use. To ensure that patients can have the continuity of services provided regardless of the channels they choose to interact with the hospital, a *openEHR* standard data model was used [8, 9]. Based on this data model, it was possible to dynamically coordinate all information in dynamic forms made available to patients to interact with health professionals. Instead of having the forms previously defined for patients, the forms are generated dynamically, and all the information entered is recorded and coordinated in the COVID-19 module of AIDA Work based on the *openEHR* standard modelling [10].

4.2. CHUP monitor (Web App)

CHUP Monitor is a web app designed to be used by patients infected with COVID-19 that are followed-up remotely at home. It aims to be used by patients which they had to make daily registration about their health condition with regard to COVID-19 symptoms. CHUP Monitor uses dynamic forms based on *openEHR* standard modelling [10]. Patients had used the CHUP Monitor to report their evaluation of COVID-19 symptoms twice a day. Also, they could access the historical information that they had registered. CHUP Monitor was very well accepted by the patients with COVID-19 because they had a new way to interact with health professionals even in a situation when they aren't admitted at CHUP.

5. Conceptual model proof of concept

A proof of concept was used to validate the conceptual model of multichannel interaction in healthcare services presented in this paper. This validation occurred at the CHUP within the scope of the pandemic of COVID-19, were proposed and designed an artefact of multichannel interaction in healthcare services in which health professionals a way to follow-up and monitor patients infected with COVID-19. With this analysis, it's intended to carry out a detailed study of the model and identify all the actors in the proposed artefact and fit them into the conceptual model, to validate the model in a multichannel interaction environment. To validate the conceptual model proposed in Section 3, will be used the artefact designed and presented in Section 4 to validate the model. The artefact is divided into different layers according to the layers as proposed in the model. Based on the proposed model, in the artefact designed has patients and channels (web app, SMS and phone call) that correspond to patient layer, the COVID-19 module of AIDA Work that corresponds to the coordination layer and the CHUP (which has the health professionals and IT infrastructure) that correspond to the care provider layer. Figure 5 illustrates this separation of the designed artefact across these layers.

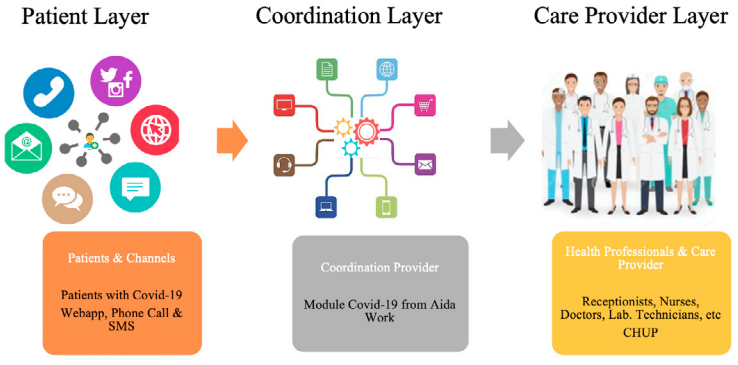

Fig. 5. Validation of Conceptual Model

As mentioned previously the artefact designed is split into three layer according to the conceptual model proposed. Based on the conceptual model proposed, the patient layer has the patients infected with COVID-19 and the interaction channels made available to patients to interact with CHUP. The available channels are phone calls, CHUP Monitor (dedicated web app), and SMS. Patients use these available channels to interact with health professionals when they need, to begin an interaction such as to get help or get other types of information about their health condition.

Then, the coordination layer is represented with the module COVID-19 of AIDA Work. All the multichannel interactions between patients and health professionals and data processed are coordinated through this layer. This coordination of services enables the continuity of services to provide to patients, i.e. patients could start the interaction through phone call and then went to CHUP. There the health professionals have access to the patient previous data to ensure continuity of the follow-up process. Finally, the care provider layer is where the proposed artefact is implemented, which in this case is at CHUP and all health professionals who use the proposed artefact to follow-up and monitor patients with COVID-19 such as nurses, doctors, laboratory technicians, among others. There are implemented all the IT infrastructure that support the designed solution and the business logic and rules are also defined at this layer to ensure and guarantee the privacy and protection of the patients clinical data.

6. Final considerations

The combination of the proposed conceptual model with the designed solution has shown that multichannel interaction in healthcare services is perfectly feasible and that it can have a huge impact on the healthcare services provided to patients. Proof of this is the success of the solution designed in the way it enabled and facilitated the interaction between patients and health professionals through multiple channels of interaction and facilitating the health services offered to patients and, increasing patient satisfaction with service received. As future work, it is intended to carry out further studies with the proposed conceptual model concerning multichannel interaction for healthcare services. The future studies will be used to disseminate the main results achieved with the proposed model, as well as the contributions that the multichannel interaction for healthcare services, both for patients and health organizations.

Acknowledgements

The work has been supported by FCT – Fundaçãao para a Ciência e Tecnologia within the Project Scope: UIDB/00319/2020.

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