



Research article

A maturity model for omnichannel adoption in health care institutions

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ABSTRACT

Omnichannel adoption in healthcare service has recently become widely discussed as healthcare institutions struggle to keep up with changing patient expectations and technological advances. However, the need for a standard model for addressing this issue has left many healthcare institutions working to implement effective strategies. This study aims to establish a comprehensive model to evaluate adopting an omnichannel strategy in healthcare. To this purpose, two main objectives were pursued: i) identify and describe the different stages of maturity in adopting omnichannel strategy by healthcare institutions; ii) address the gaps identified in the literature and propose a roadmap to be followed to attain greater maturity levels. This roadmap is presented to healthcare institutions based on a gap analysis done regarding the adoption of an omnichannel strategy by healthcare institutions. Thus, a survey was conducted through online questionnaires in which ten Portuguese public hospitals participated. The survey data were collected, transformed, and analyzed using statistical methods to evaluate and make the proof-of-concept of the proposed model to identify the level of maturity regarding omnichannel strategy adoption. The results showed that Portuguese institutions participating in this survey are between the early and mid-stage of omnichannel adoption. Among the participants, it was possible to identify the healthcare institution's current level and the dimensions they lagged off and should improve to reach the next level regarding adopting the omnichannel strategy. Lastly, the findings and insights obtained from the data analysis provided valuable indications regarding omnichannel strategy in Portuguese healthcare institutions that participated in this study. Guidelines and directions were provided for future research on omnichannel maturity in healthcare.

1. Introduction

The pursuit of omnichannel adoption emerges as a critical strategy to carve out an environment where multiple communication channels converge seamlessly, fostering a cohesive user experience. In healthcare, omnichannel strategy is an intricate and multi-faceted concept encompassing various dimensions. It refers to how healthcare institutions implement and integrate their omnichannel processes to proffer a uniform user experience for patients and care providers [1,2]. Besides, omnichannel adoption in healthcare has become increasingly important due to the growing demand for patient-centric care and the ongoing digital transformation in the healthcare sector [3,4].

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For the benefits of omnichannel adoption to be realized, healthcare facilities institutions need to develop the right strategy for implementing these services properly [5–8]. By contextualizing this study in Portuguese healthcare institutions, the nuances of implementing such strategies pose unique challenges, which cover technological infrastructures, human resources, and organizational culture [2,4,8].

The Portuguese National Health System has an extensive health information system that covers almost all aspects of a good system's performance. However, some gaps have been highlighted, such as the need for effective data connection between different departments and facilities, issues related to patient privacy, and legal issues for data binding and patient centralization [2,4,7]. Furthermore, there is also a lack of articulation capacity between the different care services and the lack of motivation of health professionals due to work overload [7,8].

Although previous studies address different strategies for digital transformation in healthcare services [2,7,9], the adoption of omnichannel still needs to be addressed. Therefore, this study attempts to cover the need to evaluate the adoption of an omnichannel strategy in healthcare institutions. The primary purpose of this article is to develop a measurement tool for assessing omnichannel adoption strategy in healthcare. The proposed model intends to support healthcare institutions in identifying areas for improvement and guide them in developing their omnichannel strategy adoption plan, as well as to determine their current state in the present ("AS IS"¹) and their level of maturity, which will provide insights into what their organization must do to accomplish a valuable omnichannel strategy implementation in the future ("TO BE"²). To this end, this study's primary objectives were persecuted.

- i. Identify and describe the different stages of maturity in Portuguese healthcare institutions' adoption of an omnichannel strategy.
- ii. Addresses the gaps identified in the literature and proposes a roadmap to attain greater maturity levels.

To achieve objective i), a survey will be applied using Portuguese healthcare institutions, where the current level of adoption of its omnichannel strategies will be assessed. For objective ii), the omnichannel model assessment results are analyzed through a cross-mapping between the Care Continuity Maturity Model (CCMM) and Capability Maturity Model Integration (CMMI) maturity models. Finally, a set of guidelines and recommendations will be defined based on the analysis and evaluation of each participant's responses to the survey.

This article is divided into six sections: an introductory section, a background section with a brief review of omnichannel interaction, omnichannel evaluation and maturity models that inspired and led to the design of the proposed omnichannel model, a methods section with the methods used in this study, a results section with the analysis of the survey data, a discussion section of the findings, limitations, and future work, and, finally, the conclusion section.

2. Background

This section will present the main concepts regarding the different topics used in this study. Because there is no established standard for adopting omnichannel strategies in healthcare, researching and reviewing existing information on this topic became imperative. It was also searched for how maturity models can be used to evaluate an omnichannel strategy. This enables a deeper and more comprehensive understanding of the maturity models, how they are designed, and how they can be applied in healthcare institutions to evaluate their maturity level. The main concepts researched in the literature are presented below.

2.1. Omnichannel interaction

Omnichannel interaction in healthcare services refers to the ability of patients to engage with care providers across multiple channels, seamlessly transitioning from one channel to another without losing context [1,10,11]. This approach has increased importance in care services as patients demand more personalized and convenient care experiences. Patients can receive care services through various channels in an omnichannel environment. Healthcare organizations can leverage these channels to provide an integrated and continuous patient experience, enhancing patient engagement and overall patient satisfaction [12,13]. However, to achieve the full potential of omnichannel interaction in care services, healthcare organizations must invest in technology, health professionals training, and data analytics to ensure seamless and efficient coordination of care services across all channels. Besides, care providers must also provide privacy and security measures to protect patients' clinical information across different channels [14–16].

2.1.1. Omnichannel interaction benefits

Adopting omnichannel strategies has become increasingly popular in healthcare services due to its many benefits. There are many benefits of adopting an omnichannel strategy. The following benefits are presented as the most common ones identified. One of the most significant advantages of omnichannel adoption is improving patient satisfaction. By providing patients with a seamless and consistent user experience across all channels, care providers can create a more positive patient experience and foster trust and loyalty [14]. Another benefit of omnichannel interaction is improving care coordination and service delivery through multiple channels to communicate with patients and coordinate care service. Thus, healthcare providers can ensure that patients receive the proper care at

¹ AS IS state of a process is the "now" state. It's how the process operates before you make any changes or improvements.

² TO BE represents the desired future state of the business process or system after implemented improvements.

the right time and place, guiding them to better healthcare outcomes and more efficient use of healthcare resources. Omnichannel strategy adoption also offers enhanced data analytics capabilities by collecting data from multiple channels and sources. This capability can give care providers a more comprehensive view of patient health and behaviors, thus supporting more informed decision-making and personalized care service [17]. Increased health professionals' efficiency is another significant benefit of the omnichannel strategy. By utilizing technology to automate routine tasks and streamline processes, health professionals can focus on providing high-quality care and engaging with patients more effectively [14,17,18]. Patients can interact with care providers through multiple channels, allowing them to access care services most conveniently for them [19]. Omnichannel strategy adoption aims to deliver a more significant competitive advantage for healthcare institutions by enabling a seamless and consistent patient experience across all channels and being a key differentiator between themselves and competitors to attract and retain more patients. The benefits of an omnichannel strategy in healthcare services are noteworthy and, as mentioned previously, can contribute to improved patient outcomes, greater efficiency, and a more competitive healthcare industry [15,19].

2.1.2. Omnichannel interaction concerns

Adopting an omnichannel strategy is a beneficial approach to overcoming healthcare industry challenges; however, it is essential to identify, understand, and overcome the gaps. The need for integrations between healthcare systems and platforms is one of the significant hurdles to essential data exchange between different healthcare systems [19]. Also, the need for a proper patient clinical data view is another concern that omnichannel strategy adoption aims to overcome and provide a unified view of these data across different channels [20]. The data inconsistency and lack of continuity of interaction among different channels are concerns that the omnichannel strategy also aims to overcome. Besides, the omnichannel strategy seeks to solve the problem of channel overload that affects many services provided through a single interaction channel. Security and privacy policies are other identified concerns that must be addressed. Poor IT training is another concern that this approach aims to address in care services. Most healthcare institutions limited IT resources allow health professionals to be more effective and efficient when using new technology in care services. Lastly, the healthcare system fragmentation is another concern that must be addressed to achieve a seamless experience across different care providers' facilities and services [13,19,21].

After identifying the benefits and concerns of the omnichannel strategy, an omnichannel model was designed based on the findings identified. The model addresses the identified challenges and gaps and proposes a standard omnichannel model for healthcare services. Moreover, an adapted approach of the Delphi method was used to validate the designed omnichannel strategy model with several experts from the healthcare domain and academic domains. This helped us better understand the gaps identified in adopting an omnichannel strategy. Thus, drawing on our knowledge in general about omnichannel adoption and applying this knowledge to the health sector, we were able to design a model that addresses this domain's unique challenges and opportunities. The resulting model provides a roadmap for healthcare institutions to adopt an effective and sustainable omnichannel strategy that benefits patients and care providers.

2.2. Omnichannel Model Dimensions

The importance of omnichannel strategy adoption in healthcare cannot be overstated, but the lack of a standardized model has left

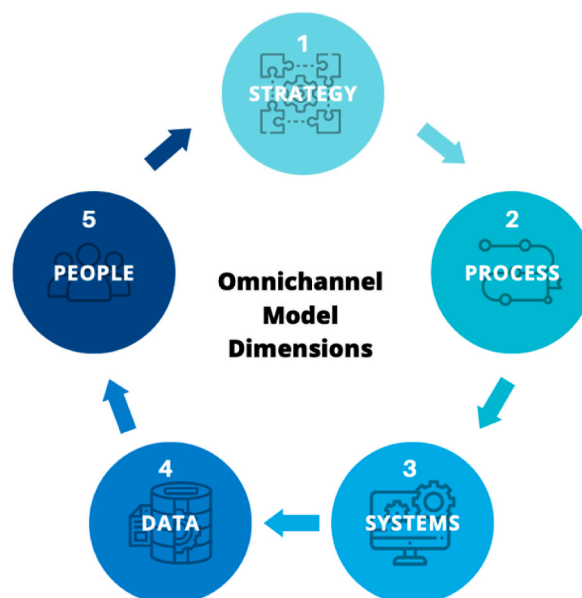


Fig. 1. Omnichannel model dimension.

many institutions struggling to implement effective strategies. Effective omnichannel strategy adoption in healthcare requires careful planning and consideration of key focus areas. A previous study [22–24] allowed us to identify the key dimensions of omnichannel adoption. The dimensions were identified based on a combination of an analysis of the Continuity of Care Maturity Model (CCMM) levels. Thus, Fig. 1 presents the proposed omnichannel model focusing on these dimensions, strategy, process, systems, data, and people, which are all critical for successful omnichannel strategy adoption in healthcare services.

By carefully assessing and addressing gaps or weaknesses in each dimension, healthcare institutions can develop a more robust and effective omnichannel strategy adoption. The assessment, however, considered the individual components and how they interact to create a unified and seamless patient experience. It assures that the omnichannel approach is not only practical but also long-lasting. Below, these five dimensions are described in detail.

- **Strategy** - The strategy dimension focuses on aligning the omnichannel approach with the institution's overall business objectives, requiring a strategic mindset to formulate an effective plan. Defining a strategic plan for omnichannel adoption in advance allows for a clear timeline and plan for success. Those in the early stages should focus on providing services across multiple channels to create a solid foundation. As they scale services, the patient-centric focus becomes more critical, embedding positive user experience in organizational culture [10,16,24–27].
- **Process** - The Process dimension evaluates the hospital's ability to integrate the omnichannel approach into its existing processes, requiring a streamlined approach to ensure efficient implementation. Processes and workflow must be adequately designed and proactive rather than reactive as an afterthought. Organizational processes must match patient experiences to close any gaps and optimize the business [13,22–24].
- **Systems** - The System dimension assesses the healthcare institution's technological infrastructure, emphasizing the need for a reliable and scalable system to support omnichannel adoption. Hospital workflow and process management systems are critical to omnichannel adoption in healthcare institutions. Legacy systems and the capabilities of organizational systems must be evaluated carefully, as they can have a significant impact on the implementation of an omnichannel strategy [23,24,28,29].
- **Data** - The Data dimension scrutinizes the healthcare institution's data management system, highlighting the importance of effectively collecting, analyzing, and utilizing data across all channels to drive decision-making. Quantitative and qualitative measures and key performance indicators for all contact channels can boost healthcare business performance [22–24].
- **People** - The People dimension examines the readiness of health professionals to adopt the omnichannel strategy, emphasizing evaluating their skills, knowledge, and adaptability to new technology and processes. Healthcare institutions need skilled professionals and a diverse team to adopt an omnichannel strategy successfully. Information Systems and Technology are valuable tools for providing quality care, but patients need to be informed and encouraged to use them [23,24,27,30].

Through a comprehensive review of multichannel and omnichannel strategies [14,18,23,25,31], we were able to identify these five critical dimensions of omnichannel adoption that healthcare institutions should prioritize and evaluate when implementing this approach into their care services. These key dimensions are fundamental characteristics that healthcare institutions must consider when incorporating an omnichannel approach into their operations. Besides, identifying these dimensions aims to answer objective i) outlined in RQ.

2.3. Omnichannel evaluation

Plenty of research has been done in the available literature to investigate the hurdles and benefits associated with implementing omnichannel interaction in care services [13,17,19,30,32]. Furthermore, most of these researchers are theoretical and need to provide practical assistance to address the highlighted issues efficiently. An omnichannel adoption model was proposed to bridge the gap between theory and practice. The foundation of this model is built upon previous research on both multichannel and omnichannel interaction within healthcare services [13,27,30,32]. Thus, the omnichannel model was combined with maturity models to evaluate the maturity level. Through this combination, healthcare institutions can use the designed omnichannel model to assess and identify their current maturity level. Selected maturity models used to evaluate the omnichannel model are presented below. Thus, this evaluation allows healthcare institutions to successfully implement and assess the omnichannel strategy and outline a plan and roadmap to overcome previously identified challenges and gaps.

2.4. Maturity models

Maturity models are responsible for describing a set of stages or levels through which organizations can progress as they improve their processes, capabilities, and performance. These models can help organizations assess their current level of maturity in the present ("AS IS"), identify areas for improvement in the future ("TO BE"), and set goals for future development. They typically include a set of criteria or indicators that define each maturity level and guide moving from one level to the following [33]. Two maturity models were inspired to design and propose the omnichannel model in healthcare service. These maturity models are the Continuity of Care Maturity Model (CCMM) by the Healthcare Information and Management Systems Society (HIMSS) and the Capability Maturity Model Integration (CMMI). CCMM [34,35] is based on eight stages of development that address interoperability, information exchange, care coordination, and patient engagement to manage health efficiently at the population and individual levels. It assesses the implementation of IT infrastructure by healthcare service providers to optimize clinical and financial outcomes. The benefits of the model include providing guidance for designing a sound strategy, taking timely measures involving all stakeholders, and standardizing IT

systems, as well as privacy and patient engagement [34,36,37]. This maturity model was used to help identify and elaborate the question for each dimension identified in the omnichannel model, which served as criteria for determining the level of omnichannel maturity adoption.

CMMI [38] is a 5-step process improvement model used to enhance the quality of products and services. It provides a structured approach to improving business processes, offering a roadmap based on proven best practices. CMMI is highly adaptable and customizable, allowing organizations to tailor it to their specific needs and circumstances, making it valuable for organizations operating in rapidly changing industries. The model promotes a culture of continuous improvement through regular process evaluations, resulting in higher-quality products or services [39]. The CMMI model was inspired by and used as a reference to build the omnichannel maturity model for healthcare service.

This section endeavors to furnish a succinct contextualization of the concepts underpinning this research. In addition, it aims to provide a guiding thread, and a clear understanding of the topics covered in this study, thus maintaining its coherence and consistency in how they can relate to the objectives of the study initially established.

3. Methods

3.1. Delphi technique

The Delphi Technique is an approach for capturing and refining expert thoughts and insights on a given topic via organized conversation among experts. This strategy seeks to achieve agreement through repeating rounds of questionnaires mixed with extensive feedback sessions [40–42]. Each phase builds on the previous one, gradually refining the collective agreement. The core strength of the technique lies in its ability to distil diverse viewpoints into a coherent narrative, harnessing the collective intelligence of the participating experts [40,42]. This technique was used to validate the omnichannel maturity model designed.

3.1.1. Problem identification and questions Elaboration

The first phase of the Delphi method involves identifying the problem to be addressed. In this case is the validation of the omnichannel maturity model for healthcare services. Thus, this phase necessitates a thorough understanding of the model's purpose, scope, and potential impact in the healthcare sector. Once the problem has been clearly described, the next critical step is to create questions for experts. These questions were created to gather careful and helpful feedback from the selected experts regarding the maturity model designed. The precise structuring of these questions guarantees that the experts' feedback gives useful insights for enhancing the model throughout through an adapted Delphi process.

3.1.2. Expert selection

To ensure a comprehensive validation of the omnichannel maturity model, four experts were meticulously chosen for their distinct yet complementary perspectives. One expert hailed from the academic field, bringing theoretical and methodological rigour to the evaluation but with deep knowledge and understanding of healthcare information systems. The other experts were from the healthcare domain, with deep knowledge of healthcare information systems, thus providing practical insights and real-world applicability of the model. This diverse expertise was crucial to balance the theoretical foundations with practical relevance, thereby enhancing the robustness and applicability of the model in healthcare services.

3.1.3. Iteration process

An adapted methodology was employed to implement the Delphi technique, wherein a single iteration was conducted. The objective was not to attain consensus but to validate the applicability and practicality of the proposed model. As delineated in the study [43], defining the metrics to achieve consensus using the Delphi method is often challenging. Consequently, it was decided to conduct only one iteration to verify that the dimensions constituting the model are coherent and relevant within an omnichannel context in the healthcare sector.

After the expert's selection process, the iteration process begins. They were introduced to the omnichannel maturity model through a structured questionnaire. They were asked to provide their opinions and feedback on various aspects of the model. This process aimed to capture their reactions, identify any obvious issues, and gather suggestions for improvement. The feedback collected was meticulously analyzed to pinpoint common topics, areas of agreement, and any divergent views that required further exploration.

3.1.4. Finalization

Interaction with different experts ensured that multiple perspectives were addressed and incorporated, resulting in a comprehensive, robust and resilient model. The omnichannel maturity model was then meticulously prepared, reflecting the insights gained during the application of the adapted Delphi method. This validated model was subsequently presented for application in healthcare services, demonstrating its practical relevance and theoretical soundness.

3.2. Study design and participants

The selected types of study design for this research are survey and quantitative analysis. The survey research method aimed to collect data from study participants, and the quantitative analysis was applied to the data gathered from the survey to validate the proof-of-concept of the proposed omnichannel model. Combining the survey with quantitative analysis enabled the evaluation and

validation of the proposed model in Portuguese healthcare institutions participating in this study. It provides a comprehensive overview of omnichannel adoption in these Portuguese healthcare systems, with implications for future development and implementation of omnichannel strategies. The Portuguese National Healthcare Service data shows that Portugal has 51 leading public central healthcare institutions [44]. From this universe, a sample of 15 hospitals from the northern, center, and Alentejo regions were selected [45].

The main selection criteria used to choose the hospital institutions that will participate in the study is the influx of patients (a significant number of interactions with patients). Three typologies were defined based on patient influx flow to better understand the different characterizations of hospital sizes in Portugal. This characterization allows hospitals to be differentiated into three groups based on their size: large size (type 3), medium size (type 2), and small size (type 1). Since the study focuses mainly on adopting and evaluating the omnichannel interaction strategy in Portuguese healthcare institutions, patient influx was the most preponderant criterion for selecting the hospitals to participate. Thus, five hospitals representing each type were invited to participate in the survey to provide a better analysis of hospitals (Table 1).

Other eligible criteria used for complementing the selection of the hospital participants were public Portuguese hospital institutions, type of facilities, total units, region, and covered area, based on public data available on the NHS portal [44,46]. The hospitals selected based on the applied criteria are representative of the region. Among the ten hospitals that took part in the survey, 60 % belonged to the northern region of Portugal, 20 % were from the center, and the remaining 20 % were from the Alentejo region of the country. At least 30 % of the participating hospitals that answered the survey are social service public healthcare institutions (see Appendix 1).

The survey participants were chosen based on their knowledge of healthcare services, information systems, and healthcare business, thus selecting hospital IT/information systems department directors [47]. The directors of 15 hospitals were contacted, and ten responded to the survey.

3.3. Data collection and processing

The method used to apply the survey was a questionnaire, which was developed using Google Forms and sent to several healthcare institutions in Portugal based on the predefined criteria. The questionnaire consisted of ten questions, each focused on the five critical dimensions of the proposed model. Participants were asked to answer via an adapted Likert scale [48] ranging from A to E. A denoted the lowest level of omnichannel strategy adoption, and E represented the highest level. An appendix file (Appendix 2) is provided with all the questions and all the answer options for the survey from A to E. The response options were carefully mapped to the stage of development corresponding to each criterion, allowing a comprehensive assessment of each institution's level of omnichannel maturity.

Furthermore, the answers obtained were extracted and organized in a separate worksheet, where the data were treated, analyzed, and structured for a better understanding. The identity of the hospitals will not be revealed, keeping the data de-identified to guarantee the privacy of the information. This survey provides valuable insights into the current state of omnichannel adoption in Portuguese healthcare institutions that participated in this study and can serve as a valuable tool to identify areas for improvement for these healthcare institutions.

3.4. Statistical methods and analysis

The data collected were analyzed using a quantitative data analysis technique through mathematical calculations. The statistical method applied to the results was the weighted arithmetic mean (W.AVG), as not all data points contribute equally to the final average. The methodology allowed us to identify patterns in the data employed, provide a comprehensive understanding of the topic, and develop a robust and valid measurement model for assessing omnichannel maturity in healthcare services.

4. Results

A previously developed systematic review [23] helped us understand and formulate the key dimensions healthcare institutions should address when adopting the omnichannel strategy [23]. Moreover, more studies have contributed to a better understanding of these dimensions [1,13,49]. As previously demonstrated, the omnichannel model design comprises five vital dimensions in the healthcare institution: strategy, process, systems, data, and people. Identifying these dimensions helped us better understand and fulfil the first objective (i) outlined for this study. Moreover, healthcare institutions must create an adequate plan to address each of the dimensions of the proposed model to delineate the proper adoption of omnichannel interaction in their care services.

Table 1
Hospital selection criteria weight distribution.

Patient Influx	Typology	Invitation sent	Answers
>400K	Type 3	5	3
[100K–400K]	Type 2	5	4
<100K	Type 1	5	3

4.1. Findings

Below, an in-depth analysis of the survey results is presented for each model dimension to understand the adoption of the omnichannel strategy in different healthcare institutions that participated in this study. Aligned with objective i), the analysis of the results from the healthcare institutions will help identify each dimension's current state ("AS IS").

- Strategy

Fig. 2 provides information on the status of the strategic dimension of omnichannel adoption in Portuguese healthcare institutions. The institutions that participated in this study have yet to define a clear path for their omnichannel strategy adoption, as evidenced by the fact that the responses vary from A to C option. The A option had 40 % of the answers, and the B and C options had 30 %. This indicates that they still need to have a clear omnichannel strategy plan or an omnichannel strategy. Still, implementation is partial in early-stage adoption, and they are making progress toward omnichannel interaction and have contextual insights to drive the following actions.

- Process

Fig. 3 a) shows the current focus of Portuguese healthcare institutions regarding the omnichannel adoption process and government.

Results from the survey reveal that while progress is being made in implementing omnichannel strategies in healthcare institutions, many still face significant challenges. Many participants are taking steps to streamline and align processes mapped to the clinical journey of patients, with 40 % reporting some progress in this area (option B). Additionally, 40 % of the survey participants know process gaps and actively take steps to simplify and align processes (option B). Moreover, 10 % of healthcare institutions reported having fully optimized business processes aligned with the needs of patients and health professionals, highlighting a clear gap in the market (option C). Finally, 10 % of healthcare institutions currently seek continuous healthcare process improvement to provide clinical decision-making support (option D). Despite these efforts, mapping the clinical path of the patients across all channels is still in its early stages, with only emerging progress in this area.

Fig. 3 b) presents the focus of Portuguese healthcare institutions and their process planning and execution tools. Results show that 20 % of the participants have an essential planning for-point solution regarding the process planning and execution tools (option A). However, 50 % or half of the participants have a documented plan to change the management process (option B). Upon initial analysis of the results, there's still a long way to go regarding process planning and execution tools, as around 70 % of the participants are still in the early-stage adoption. The remaining 30 % of the participants are divided equally between levels C and E (10 % each). Results

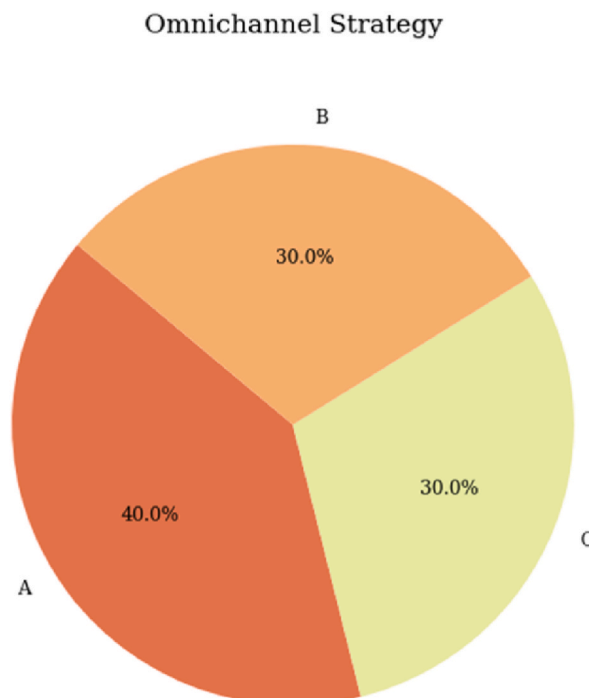


Fig. 2. Strategy dimension.

a) Process and Governance

b) Process Planning and Execution Tools

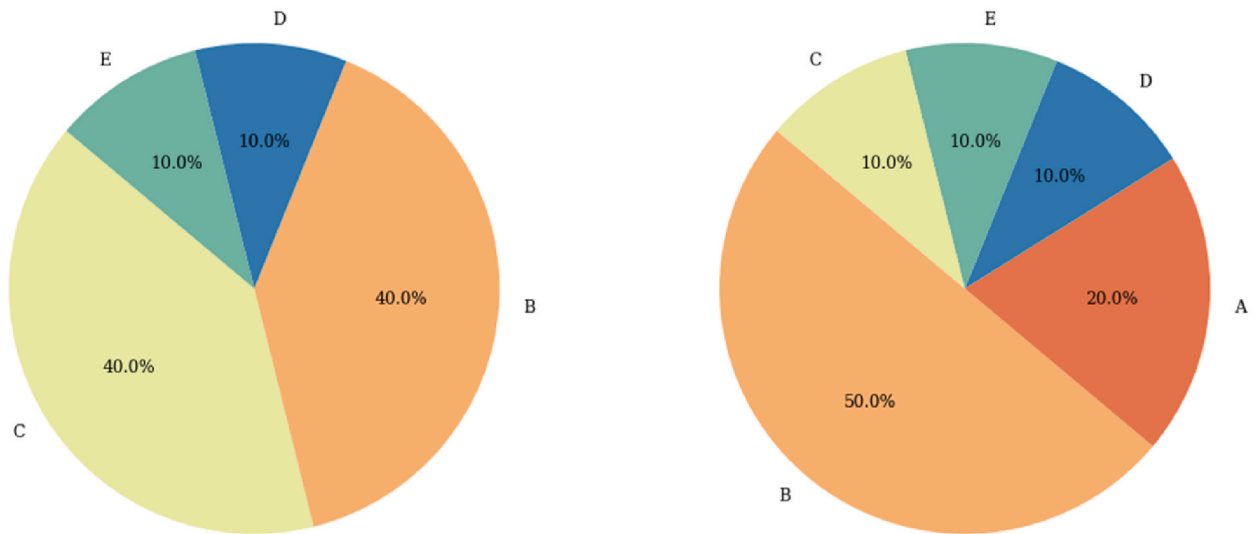


Fig. 3. Process dimension.

indicate that 10 % of the participants have shared healthcare plans tracked with task coordination, alerts, and reminders (option C).

Additionally, 10 % of the participants (option D) have patient clinical data entry, personal targets, and alerts in place regarding process planning and execution tools. Lastly, the remaining 10 % of the participating healthcare institutions (option D) have already implemented near real-time care community-based health records, patient profiles, and healthcare tracking capabilities. Despite participants' low adoption of process planning and execution technologies, there is an encouraging indicator of improvement in the healthcare business. It is also emphasized that many institutions are still in the early adoption stage. Furthermore, among the participants, it was possible to identify a substantial variation in the level of implementation of process planning and execution tools. Some participants have already made enormous progress, but others are still in the early phases of development. As a result, this

a) Application/System Focus

b) Integration

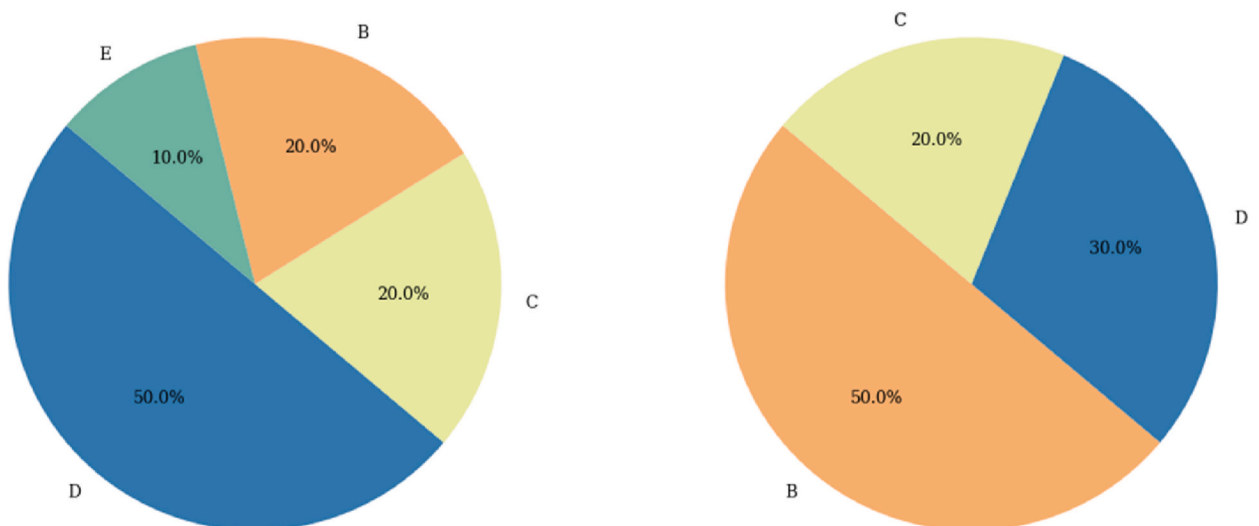


Fig. 4. Systems dimension.

indicates the issue’s complexity and the need for continuing investment and innovation.

- Systems

The survey responses regarding the focus of applications/systems on omnichannel adoption are presented in Fig. 4 a).

Analyzing the results about application/systems focus, it was possible to conclude that 20 % of the participants (option B) aim to focus on care services provided to patients by the care providers, emphasizing the importance of delivering quality care services across all channels to meet the needs of patients in an omnichannel environment. Similarly, 20 % of the participants (option C) aim to focus on health professionals, patients’ user experience, and quality of service, recognizing the importance of investing in people to ensure the success of omnichannel strategy adoption. However, half (50 %) of the participants aim to focus on channel management, data consistency, and interoperability, indicating that many organizations recognize the importance of ensuring that information flows smoothly across all channels to create a seamless patient experience (option D). Interestingly, only 10 % of participating healthcare institutions aim to focus on the omnichannel experience itself, suggesting that while organizations understand the importance of omnichannel strategy adoption, they may still need help identifying how to execute it effectively (option E). The results highlight the distinct priorities of healthcare institutions regarding adopting an omnichannel strategy and suggest that there is still a long way to go before these healthcare institutions can fully harness the potential of an omnichannel approach to care service delivery.

The findings presented in Fig. 4 b) reveal that the healthcare institutions surveyed still strive to achieve a single-patient view. Half (50 %) of participants reported progressing towards this goal but needed to complete it fully (option B). However, 20 % of respondents mentioned that they are actively working towards integrating patient clinical records to provide a seamless user experience across all health facilities (option C). Interestingly, 30 % of participants indicated that their institutions are progressing in achieving consistency in data across multiple channels. However, there is still an opportunity for improvement in integrating all patient data fully for a complete single-patient view (option D). This would involve providing consistent patient clinical data and user experience across all channels, offering a single and real-time view of the patient’s clinical record.

- Data

The results presented in Fig. 5 a) highlight healthcare institutions’ diverse strategies for managing and exchanging data.

Notably, 40 % of participants (option B) reported utilizing data from multiple sources and promoting data exchange between patients and care providers. Similarly, 40 % of participating healthcare institutions (option C) reported supporting the integration of various data sources while maintaining well-coordinated policies for data governance. Additionally, it is intriguing that 20 % of the institutions shared data among multiple care providers and compiled it into a comprehensive record accessible to care providers and patients (option D). The healthcare industry employs various techniques to manage and exchange data, showcasing the complexity and diversity of approaches in this field.

Based on the analysis of Fig. 5 b), it can be inferred that most participants are still in the early process of implementing advanced data analytics capabilities. According to the results, 50 % of participants have a patient-centered clinical data presentation, and clinical data management is a top priority (option B). However, 40 % of participants indicated they have interconnectivity between channels and can obtain valuable insights from some channels. However, all channels must fully implement this (option C). Lastly, 10 % of participants consistently use predictive analytics based on clinical data to obtain real-time insights and support decision-making (option D).

The insights presented in Fig. 5 c) illustrate the performance measures of care services across multiple communication channels. It should be noted that most participating institutions (40 %) currently need more performance measures for care services across all communication channels, indicating a significant gap in monitoring and evaluation practices (option A). However, one-third of institutions (30 %) monitor quantitative performance measures in every communication channel, showcasing a more comprehensive

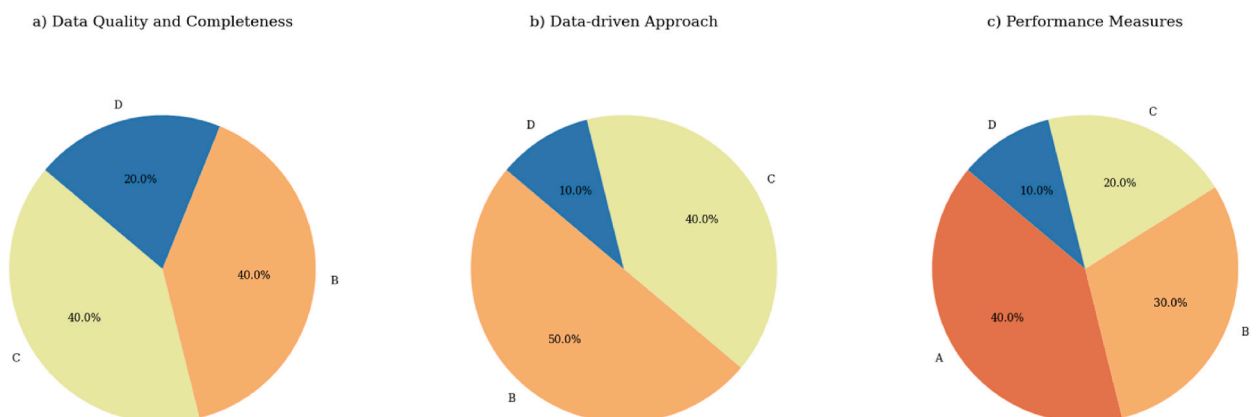


Fig. 5. Data dimension.

approach to tracking care service delivery to patients (option B). Additionally, 20 % of participants employ quantitative and qualitative performance measures to assess their performance in each channel. This indicates a willingness to use different tools and methods to improve service quality (option C). Lastly, a small but notable fraction (10 %) of participating healthcare institutions use quantitative and qualitative performance measures in different channels to facilitate decision-making, suggesting a more segmented approach to monitoring and evaluation (option D).

Healthcare institutions must develop effective performance measures to accurately capture the quality of care services delivered across all communication channels. This will enable them to identify areas for improvement and enhance the overall quality of care. The results highlight the urgent need for healthcare institutions to establish effective performance measures to monitor and evaluate care service delivery across all communication channels.

- People

Based on the results of the survey shown in Fig. 6 a), it appears that a significant proportion (40 %) of participants still rely on manual methods to track medical care services (option A). Only 10 % of participants have implemented automated systems for decision-making by health professionals (option B). Remarkably, 20 % of participants manage flow control from the start to the end, encompassing decisions and parameters (option C). Lastly, 30 % of participants reported that they performed data analysis to enhance the decision-making process in healthcare (option D).

The results presented in Fig. 6 b) indicate that 20 % of the hospital institutions surveyed continue to operate independently in healthcare services without a clear organization focus defined (option A). Additionally, 30 % of the participants have defined an organizational focus on channel operation consolidation (option B). Moreover, 40 % of participants stated that their organizational focus is internally integrating and interconnecting healthcare services. This suggests they have established internal processes and systems to facilitate data sharing and interoperability (option C). Finally, a smaller proportion (10 %) of the participants reported having an organizational focus on integrating and interconnecting healthcare services externally, implying that these institutions have formed partnerships and collaborations to promote seamless data sharing and interoperability with external stakeholders (option D).

4.2. Omnichannel Model Dimensions overview

Based on the data analyzed, a new chart was created that illuminates the maturity levels of each surveyed healthcare institution regarding different dimensions of the omnichannel model. The chart was created after transforming the accumulated data into a numerical format and calculating the arithmetic mean of each dimension. The resulting spider chart, as shown in Fig. 7, offers a detailed and straightforward comparison of all the dimensions for each hospital surveyed.

This chart is a valuable tool for healthcare institutions, allowing them to identify areas requiring further attention and improvement. By analyzing the chart, healthcare institutions can gain insights into their relative strengths and weaknesses in each dimension, allowing them to make informed decisions regarding resource allocation and strategy development. The spider chart is a versatile and

a) Patients and Health Care Professionals

b) Organization Focus

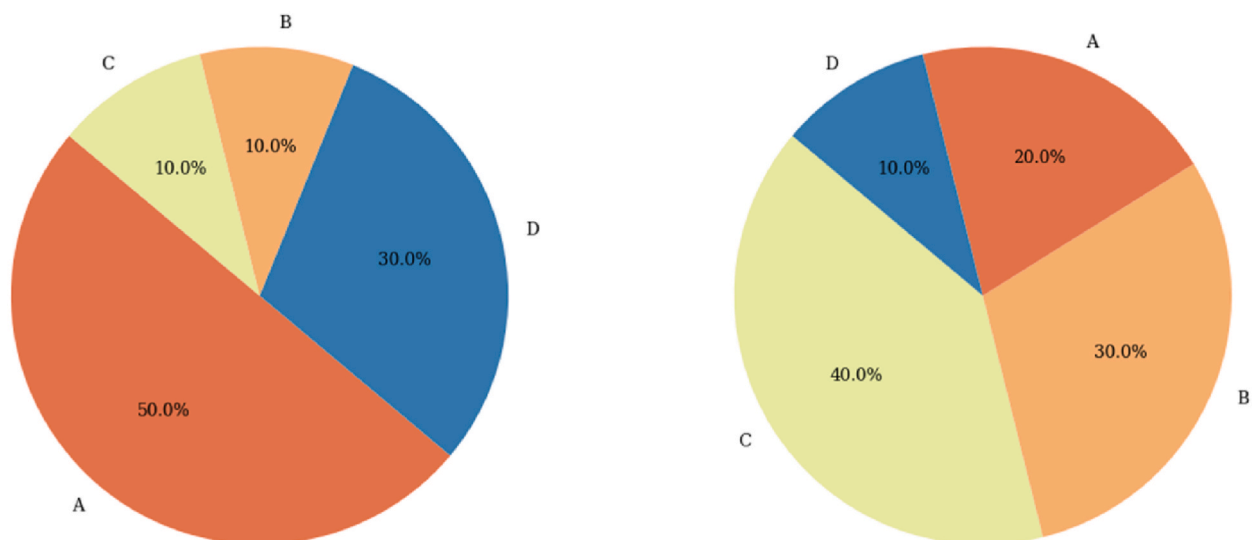


Fig. 6. People's dimension.

dynamic visualization tool that enables hospitals to evaluate their performance in multiple dimensions simultaneously, helping them to achieve their goals more efficiently and effectively. This chart also identifies the dimensions healthcare institutions must focus on to improve their maturity level and advance the quality-of-care service provided in an omnichannel environment. Currently, among the participants, it is worth noting that the strategy dimension is the dimension that needs more attention and dedication from healthcare institutions regarding omnichannel adoption.

The findings clearly emphasize the necessity of continued efforts to promote greater interconnectivity and collaboration among different healthcare institutions. This can improve patient outcomes and enhance care service delivery. Moreover, achieving this level of cooperation and integration requires notable efforts and a coordinated strategy from the healthcare institutions involved. Nevertheless, the potential benefits for patients and healthcare institutions make it worthwhile.

4.3. Maturity level analysis

Following the completion of individual evaluations of the criteria employed to assess the adoption of the omnichannel strategy in Portuguese healthcare institutions, a comprehensive analysis of the maturity level of each participating hospital entity is presented based on the completed survey. To preserve privacy and safeguard the identity of each hospital entity, identification data was anonymized, and generic identifiers (numbered from 1 to 10) were assigned. Then, a conversion was applied to the survey data, in which the letters (A to E) were converted to numbers (1–5), respectively. Upon this conversion, the maturity level range can vary between 1 and 5, with 1 corresponding to the lowest level (siloe) and 5 corresponding to the highest level (optimized) referring to the adoption of the omnichannel strategy. With a new data representation defined, a math formula was applied to calculate the arithmetic mean to find each participant’s weighted average and maturity level in the survey. The formula used is presented below.

$$\bar{x} = \sum (xi * p) / n$$

Table 2 presents the survey responses from each participating hospital institution, with two additional variables: the weighted average (W.AVG) and the Maturity Level. The W.AVG value was calculated by assigning a weight to each model dimension to determine the weighted average for each participating institution. This was achieved by adding the product of the responses for each criterion and their respective assigned weight and dividing the sum by the number of questions in the survey. Finally, the resulting W.AVG value was rounded to a positive integer, yielding a unitary value to determine each participating institution’s maturity level.

By applying the Delphi technique, presented earlier in the methods section, it was possible to reach a plausible consensus on the characteristics of the different levels of omnichannel maturity in healthcare services. An explanation of each maturity level is presented

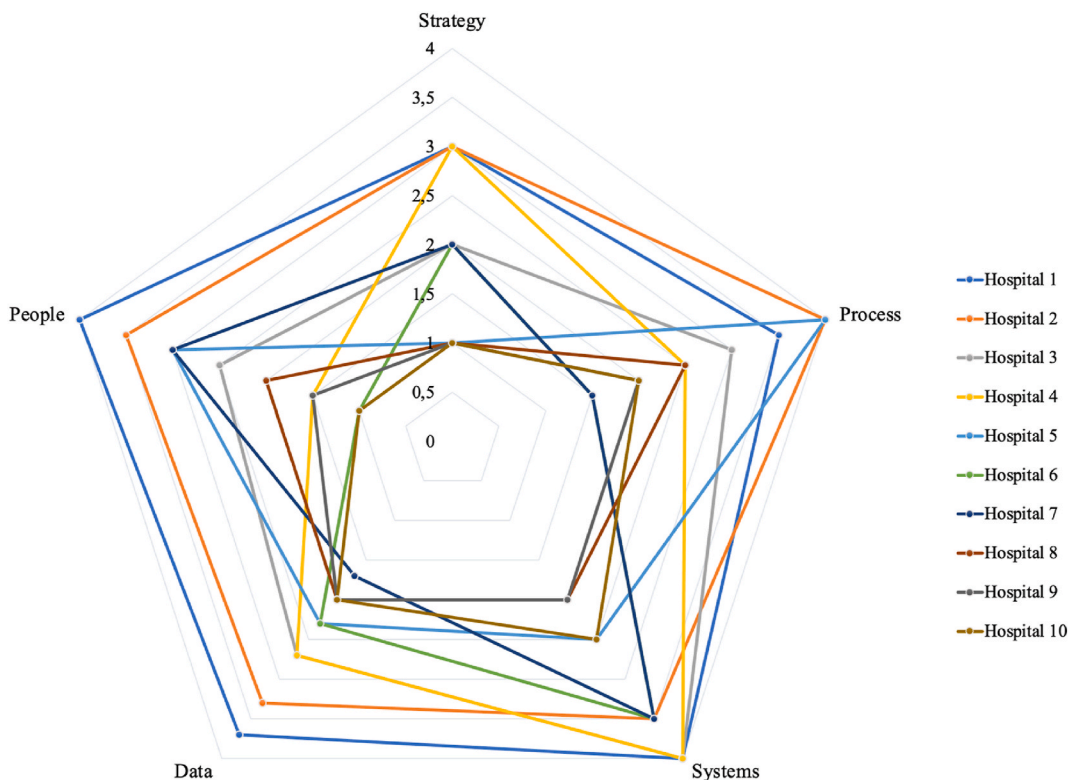


Fig. 7. – Omnichannel model dimension overview.

Table 2
Maturity level of Portuguese hospitals for omnichannel adoption.

Organization	Omnichannel Strategy	Process and governance	Process planning and execution	Application/system focus	Integration	Data quality and completeness	Data-driven approach	Organization metrics	People	Organization focus	W. AVG	Maturity Level
Hospital 1	C	C	D	D	D	C	D	D	D	D	3.7	4
Hospital 2	C	C	E	E	B	D	C	C	D	C	3.5	4
Hospital 3	B	D	B	D	D	C	C	B	B	C	2.9	3
Hospital 4	C	C	B	D	D	D	B	B	A	B	2.7	3
Hospital 5	A	E	C	C	B	B	B	C	D	B	2.7	3
Hospital 6	A	B	A	D	C	B	B	A	C	C	2.2	2
Hospital 7	B	C	B	B	B	C	B	A	A	C	2.1	2
Hospital 8	B	B	B	B	B	B	B	B	C	B	2.1	2
Hospital 9	A	B	A	D	C	C	C	A	A	A	2.0	2
Hospital 10	A	B	B	C	B	B	C	A	A	A	1.8	2

below.

- **Level 1 (Siloed)** – at this stage, care providers have basic business processes and siloed operations without a unified omnichannel strategy, leading to disconnected services. Efforts to integrate various parts of the system are inconsistent and ad hoc. They lack effective health Key Performance Indicators (KPIs) and suffer from low-quality, incomplete data due to fragmented databases. This is the lowest level of maturity and there is a lot of space for improvement and growth at this stage.
- **Level 2 (Early-Stage)** – at this stage, care providers are transitioning to a patient-centric approach with a defined omnichannel strategy and some channel integration, offering an improved patient experience. They have begun documenting healthcare processes, with competent health professionals and emerging standards and best practices. Performance is tracked using quantitative KPIs, including profitability. Despite the initial improvements, there is still more space for improvements and growth in omnichannel strategy adoption.
- **Level 3 (Mid-Stage)** – at this stage care providers prioritize patient-centric values and contextual insights, simplifying and aligning healthcare processes with patient journeys. They focus on implementing best practices, training health professionals, and ensuring robust internal collaboration to meet patient expectations across all channels. Healthcare data starts providing insights across several channels, with an increasing emphasis on tracking quantitative health KPIs like patient health. With all these improvements underway, care providers are beginning to gain some useful insights, but there is still room to make further improvements and reach a higher level of maturity.
- **Level 4 (Managed)** – at this stage care providers embed patient-centric values in their culture, ensuring a consistently positive patient experience across multiple channels with a real-time view of interactions. They continuously test and refine new techniques to enhance healthcare operations and the patient journey. Predictive analytics and patient experience KPIs guide their future actions. An iterative approach can be taken to make further improvements and reach the next level.
- **Level 5 (Optimized)** – in this stage providers at this stage offer an optimized patient experience through complete integration and alignment of all channels, with a team deeply understanding healthcare strategy, processes and systems. They continually review and innovate their processes, seeking cutting-edge technology and opportunities to develop new services in collaboration with patients. At the highest maturity level, these care providers are redefining healthcare delivery with innovative models like virtual hospitals, designing bespoke solutions, and striving for "Empowered Wellness" by delivering truly connected care (this is the goal, to reach the highest level of omnichannel maturity).

Sorting [Table 2](#) in descending order of the W.AVG column, it is notably noticed that there is a significant variation in the W.AVG values, which vary from 3.7 to 1.8, corresponding to maturity levels that range from level 4 to level 2, respectively. It is verified that most Portuguese healthcare institutions surveyed, around 60 %, are still in the early stage of adopting an omnichannel strategy for care services (level 2 Early-Stage). Around 20 % of the participating institutions reached an intermediate maturity level (level 3 Mid-Stage), while another 20 % reached a more advanced maturity level (level 4 Managed). Intriguingly, the participating institutions still need to achieve the highest level of maturity in adopting an omnichannel strategy (level 5 Optimized).

Furthermore, the overall maturity level of the ten hospitals analyzed corresponds to level 3 (Mid-Stage) with a weighted average of 2.57, an intermediate value between levels 2 (Early-Stage) and 3 (Mid-Stage). According to the data from the surveyed healthcare institutions, there is still considerable room for growth and development in adopting a comprehensive omnichannel strategy for care services in Portugal.

The survey developed enabled the validation of the proposed omnichannel model and the evaluation of the current state of the participating healthcare institutions across the model's dimensions, as initially defined in objective i).

Cross-checking the selection criteria used to select hospitals for this study with the data obtained from the questionnaires, it was possible to conclude that there is a direct relationship between the influx of patients with a higher level of omnichannel maturity. This may occur because these institutions will have to interact with many patients due to their typology and population area covered (large urban centers). Furthermore, the data analysis indicates that implementing an omnichannel strategy in healthcare services is more than just contingent upon technological factors. Instead, it relies on a combination of elements, including strategic planning, human resources allocation, organizational culture, and technology infrastructure. Despite this, the survey results pinpoint specific areas needing heightened focus among participating healthcare institutions. Consequently, a series of measures and recommendations were identified and proposed to these institutions to address the areas where they present the most significant limitations.

5. Discussion

The findings will be discussed through cross-mapping between the selected maturity models (CMMI and CCMM) and the survey data to evaluate the maturity level of omnichannel adoption.

5.1. Omnichannel strategy maturity model evaluation

The maturity model measures organizational progress towards a goal by defining best practices from entry-level to fully developed [24,50]. [Table 2](#) presents the omnichannel strategy maturity evaluation [24,50], which is the result of applying the Delphi technique, where different characteristics were analyzed for each level of the omnichannel maturity model in health services, as well as a set of intrinsic factors. Also, some suggestions and indications for improvement for each level were identified by applying this technique [24, 50]. Regarding the maturity level of each participant in the survey ("AS IS"), [Table 3](#) presents a set of improvements, suggestions, and

recommendations for each level to enable healthcare institutions to progress in adopting the omnichannel strategy.

Through the successful accomplishment of objective i) outlined in this study, the different stages of development were effectively identified by each of the healthcare institutions that participated in the questionnaire. With this identification process regarding the chart presented in Fig. 7, it was possible to determine which dimensions are characterized by lower maturity levels and which have attained a higher maturity level. This achievement holds significant value as it enabled the individual assessment of each model dimension (Fig. 7), followed by an evaluation of the overall model (Table 2), thereby identifying the maturity stage of each healthcare organization. Furthermore, by determining the maturity level of each participating institution, it was possible to determine the gaps present within the model's different dimensions at each specific maturity level. Considering these findings, a comprehensive set of recommendations and suggestions was made, accompanied by a roadmap to advance each participating institution's maturity level. Moreover, regarding objective ii) outlined in this study, it was possible to identify each healthcare institution's maturity level and propose some suggestions and recommendations based on the data analysis, as shown in Table 3. Finally, the obtained general average shows that the surveyed Portuguese institutions are at a mid-stage level 3 regarding the adoption of the omnichannel strategy, demonstrating that there is still considerable space for improvement in several aspects to achieve new objectives regarding the omnichannel strategy adoption ("TO BE").

5.2. Mapping CMMI with CCMM maturity levels

Table 4 comprehensively maps the different maturity levels of Portuguese healthcare institutions that participated in this study concerning the HIMSS-CCMM maturity model. Based on the data obtained from the survey, we can determine that institutions classified as being at an early stage of adopting the omnichannel strategy are positioned at the levels of essential data exchange and primary system-to-system data exchange. Institutions at a mid-stage of maturity are located between structural and semantic interoperability levels. Finally, institutions that have achieved an omnichannel level of maturity are located between the levels of semantic interoperability and comprehensive records information engagement. This mapping provides valuable insights into the level of maturity of the surveyed Portuguese healthcare institutions in terms of their adoption of the omnichannel strategy and how this aligns with the internationally recognized HIMSS-CCMM model. By identifying the areas in which these institutions are lagging, these healthcare institutions can focus their efforts and resources on developing the necessary infrastructure and capabilities to achieve a higher level of maturity in adopting the omnichannel strategy.

Adopting an omnichannel strategy in healthcare services needs more than a mature institution. As a result, this adoption necessitates an openness to new technology and techniques, a dedication to patient-centered care services, and an emphasis on cooperation and communication across various departments and stakeholders. Furthermore, adopting only one dimension doesn't guarantee success in an omnichannel strategy. The availability and use of technology, health professional training and abilities, patient preferences, and legal and regulatory models must all be addressed. To successfully implement an omnichannel strategy, healthcare

Table 3
Omnichannel strategy maturity model evaluation.

Maturity Level	Maturity Stage	Characteristics				
		Business Challenge	Change Driver	Current Focus	Road-map Planning	Next Focus
1	Siloed	Cost of quality of service	Functional business process	Service-centric and business process	No omnichannel management plan in place	Revise old business practices and commit to basic omnichannel offerings
2	Early-stage	Unreliable channels and patient interaction	Patient-centric business process and cost management	Awareness of patient orientation and basic view of patient clinical record	Omnichannel roadmap, plan, and timeline identified	Document and refine the operational processes that let you provide good user experiences
3	Mid-stage	Cost of service provided	End-to-end responsiveness and continuity of healthcare service	Patient-centric values and contextual insights	Omnichannel management plan for selected patients' journeys implemented; later stages of roadmap now detailed	Improve user experience capabilities, use contextual insights to better understand users' preferences, and improve their experiences
4	Managed	Channel growth	Demand responsiveness and revenue growth	Patient-oriented and aligned; patient-centric values fully embraced and embedded in the health organization culture	Omnichannel management covers all patients' journeys; experiments identified to enhance the patients' experience	Utilize predictive analytics to personalize interactions across the different channels
5	Optimized	Enable patients' journey	Patient services growth and retention	Patient-oriented and aligned; continuous adaptation and focus on delivering positive outcomes proactively for patients	Continuous improvement and experimentation to enhance patients' experience	Develop new services and expand into new industries

Table 4
Develop new services and expand into new industries.

	Limited	Basic Data Exchange	Basic System-to-System Data Exchange	Structural Interoperability	Semantic Interoperability	Wide Records Information Engagement	Close Loop Care Coordination	Interconnected Healthcare Delivery Model
Siloed	✓							
Early-stage		✓	✓					
Mid-stage				✓	✓			
Managed					✓	✓		
Optimized							✓	✓

organizations must acknowledge that it is a continuous process that involves continual review, monitoring, and improvement. Regular assessments of progress, identification of areas for improvement, and strategic adjustments are necessary. While the proposed model in this study can serve as a helpful guide, a comprehensive approach that considers all relevant factors is essential for the successful adoption of an omnichannel strategy adoption in healthcare services.

Adopting an omnichannel strategy in healthcare requires a comprehensive assessment, personalized recommendations, and continuous improvement efforts. Using maturity models such as CMMI and CCMM (as presented) helps identify current maturity levels, gaps, and areas for improvement. Furthermore, organizational readiness, technological capabilities, patient-centered care, and effective communication between different actors (stakeholders) are essential to achieving omnichannel maturity in the healthcare domain. As outlined in the proposed model for implementing such a strategy, five key dimensions (strategy, process, systems, data, and people) serve as the foundation. Healthcare organizations can effectively adopt and implement the omnichannel strategy in their services by leveraging these dimensions. Thus, continuous monitoring, evaluation, and strategic adjustments across these dimensions are crucial to the sustained success of adopting an omnichannel strategy in healthcare services.

5.3. Limitations and future work

The main limitation of this study was the small number of healthcare institutions that participated in the survey. However, the hospitals that participated in this study were selected based on their typology as well as the level of patient influx they had. Even though the sample size is small, these hospitals meet the main selection criteria used to choose the hospitals and they are representative of different regions of the country. Therefore, the conclusions and findings obtained in this study cannot be generalized to a national or international level due to the sample size but are relative to the hospitals that participated in this study. Besides, it only focused on Portuguese public hospitals, which limits the generalizability of the findings to other contexts (private hospitals for instance). The study should be applied internationally to assess the maturity level of healthcare services globally. It is worth noting that some participating institutions were in the early stages of adopting the omnichannel strategy, meaning they had several limitations concerning an omnichannel approach. To address the identified limitations and obtain a more comprehensive understanding of omnichannel strategy adoption in Portuguese healthcare institutions, future studies should seek to expand the survey to all healthcare institutions in Portugal. Thus, this would enable a better sense of the status and progress of adopting the omnichannel strategy in care services and ultimately facilitate the development of effective strategies to improve the quality of care for patients worldwide. Besides, as part of this study, a report was elaborated and sent to each participant in the survey as part of the study's contribution. The report contains an analysis regarding the current level of omnichannel strategy adoption ("AS IS") and a set of guidelines, recommendations, and suggestions that these participants could follow to improve the care services provided by omnichannel interaction ("TO BE"). This was a premise that this study aimed to accomplish as it helps these institutions to provide better care services in an omnichannel environment.

6. Conclusions

This study aimed to validate the designed omnichannel maturity model by applying a survey with Portuguese healthcare institutions. Besides, it was possible to measure the level of maturity regarding adopting an omnichannel strategy. An omnichannel model and survey data analysis identified the current maturity level and proposed recommendations for Portuguese healthcare institutions surveyed to improve their omnichannel strategy adoption. Adopting an omnichannel strategy in healthcare services brings benefits and significant technological, cultural, and user challenges. The healthcare industry constantly evolves, and Portuguese healthcare institutions are no exception. To stay competitive and provide the best possible care service to their patients, healthcare institutions are now shifting to omnichannel communication as a strategic solution. However, implementing such a complex solution takes work. Healthcare institutions must carefully evaluate their existing infrastructure and develop a comprehensive plan that addresses the needs of both patients and healthcare providers. Only then can they successfully integrate omnichannel communication into their services and achieve their desired outcomes. Although some Portuguese healthcare institutions surveyed can provide care services to their patients through different interaction channels, our findings indicate that adopting the proposed omnichannel model will help them to follow and identify key areas they can improve. Also, at its basis, the proposed omnichannel model aims to help healthcare institutions better manage their resource for care services provided to patients in an omnichannel environment. Finally,

future work should expand the survey to a broader range of healthcare institutions and explore the international adoption of the omnichannel strategy in healthcare services.

Disclosure statement

The authors declare no conflict of interest.

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Ethical and informed consent

All participants were informed about the study's objectives and scope, and they consented to participate in the survey. The collected survey data were subjected to rigorous anonymization protocols to protect each participant's privacy and security.

Data availability statement

The data gathered and analyzed in this study are available from the corresponding author upon request.

CRediT authorship contribution statement

Ailton Moreira: Writing – review & editing, Writing – original draft, Visualization, Validation, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Francini Hak:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Manuel Filipe Santos:** Writing – review & editing, Visualization, Validation, Supervision, Resources, Project administration, Investigation, Funding acquisition, Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2024.e38526>.

Appendix

- 1 - Characteristics of Hospital Participants
- 2 - Omnichannel Model Survey

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