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Literature Review

Influential Factors for Hospital Management Maturity Models in a post-Covid-19 scenario – Systematic Literature Review

Vanessa Bertholdo Vargas[1] *, Jefferson de Oliveira Gomes[1], Priscila Correia Fernandes[2], Rolando Vargas Vallejos[3] and João Vidal de Carvalho[4]

[1] Department of Mechanical Engineering and Aeronautics, Instituto Tecnológico de Aeronáutica - ITA, São José dos Campos, Brazil
[2] Bio Engineering Laboratory, Instituto Tecnológico de Aeronáutica - ITA, São José dos Campos, Brazil
[3] Universidade Federal de Goiás, Goiânia – Brazil
[4] CEOS.PP, ISCAP, Polytechnic of Porto, Porto, Portugal
***Corresponding Author:** vanessavbv@ita.br

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ABSTRACT

The importance of Maturity Models in healthcare is proven to support, monitor and direct healthcare organizations to better plan and execute their investments, developments and processes. In this work, two literature reviews were collected: one of them focuses on the identification of the main maturity models developed in the health area, the similarities and gaps between them, identifying what are the Influencing Factors for each model studied, and the other is the identification lessons learned for hospital management during the Covid-19 pandemic. Combining these two lines of investigation, it can be concluded that, in order to better prepare, adapt and make health systems more resilient, it is fundamental that future Maturity Models begin to map agility in diagnosing diseases, scale of exams, process of hospital disinfection and technological infrastructure, focusing on ICTs such as ML, LMS, DL, Robot Assistance, Actuators, Big Data, Blockchain, Smart Wearables, Delivery Drones, Artificial Intelligence, Internet of Things, Augmented Reality, Virtual Reality, Sensors and Cloud Technology. These IFs are identified as gaps for existing MMs in the sector. Allied to this, it is indicated that the future MMs consider expanding their focus in supply chain, services and applications, monitoring and, mainly, patient safety and care, given the importance that these IFs demonstrated in coping with the pandemic.

Keywords: maturity model, healthcare management, Covid-19 lessons learned, resilience, patient safety, technology.

INTRODUCTION

Health institutions together with government organizations are beginning to realize that the reasons associated with the inability to properly manage health processes are directly related to the limitations of technological infrastructures and the inefficiency of their management (Freixo and Rocha, 2014; Sharma, 2008). To ensure that plans and actions have an impact, a monitoring and evaluation process is important (Cruz et al., 2019). If countries measure and track their progress and maturity in digital and management health then they can identify key gaps to inform policy development, scale and systems integration and investing in human resources and financial capital (Mechael and Edelman, 2019).

In the last four decades, several Maturity Models have been proposed, differing in the number of stages, Influence Factors (IF), and areas of intervention (Rocha, 2011). However, in the health area, the investigation of this problem is still in an embryonic phase, the Maturity Models for the health area are still poorly consolidated and present problems that have not yet been solved (Carvalho et al., 2019). Several studies highlight the importance of facing the challenge of finding adequate models to use in facilitating, evaluating, and measuring the success rate of projects in health systems (van Dyk and Schutte, 2013).

This literature review aims to consolidate the main maturity models for the health area as well as their characteristics, levels, dimensions, the relationship, and gap between them. And then, it will be possible to develop broader, assertive, and need-oriented maturity models for global health systems, contextualizing and including the needs that the Covid-19 pandemic has caused.

METHODOLOGY

Two literature reviews were collected: one on the health Maturity Models and the other one is about the lessons learned from hospital management in the pandemic Covid-19 scenario.

The research aimed to identify publications on the topic in recent years, as well as the notable seminal works that gave rise to these recent developments, to better understand the concepts and methodologies relevant to the field. The searches were carried out in the databases "Scopus", "Web of Science" and "PubMed".

The first search combined the keywords "maturity model" and "health care" or "health" in the "Summary" filter during the period from 2000 to 2022. Articles that did not have their complete structure available were removed (278), the same for articles developed for other areas (48) and those had incomplete information for analysis or duplicates (9). Finally, sixty-seven articles were selected and some (4) seminal works that were cited several times among the sixty-seven selected articles were added.

Among the seventy-one articles, twenty-nine maturity models aimed at health assessment stand out, the others are literature reviews on maturity models or studies on models already developed previously. **Figure 1** shows how this classification of articles took place based on the PRISMA Diagram.

PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) focuses on ways in which authors can ensure transparent and complete reporting of systematic reviews and meta-analyses (Liberati et al., 2009). This approach was chosen so that authors can more clearly analyse, choose and visualize the available articles.

The second search combined the keywords "Covid-19", "management" and "learning" in the "Summary" filter. A further twelve studies were added, taken from a website search engine that identified the most relevant and current websites, this search was carried out to obtain more up-to-date information on a subject that is relatively new. We removed the articles that had closed access (47), which were duplicated in the databases (19), which addressed "distance learning" and "machine learning for another area" (69), sixty-six articles were also removed that addressed health learning in general (e.g., how to treat diabetes and the elderly in pandemic times) because our focus is management learning and to facilitate the study, they were withdrawn. That leaves twenty-two articles on the lessons learned in the management of Covid-19. **Figure 2** shows how this classification of articles took place based on the PRISMA Diagram.

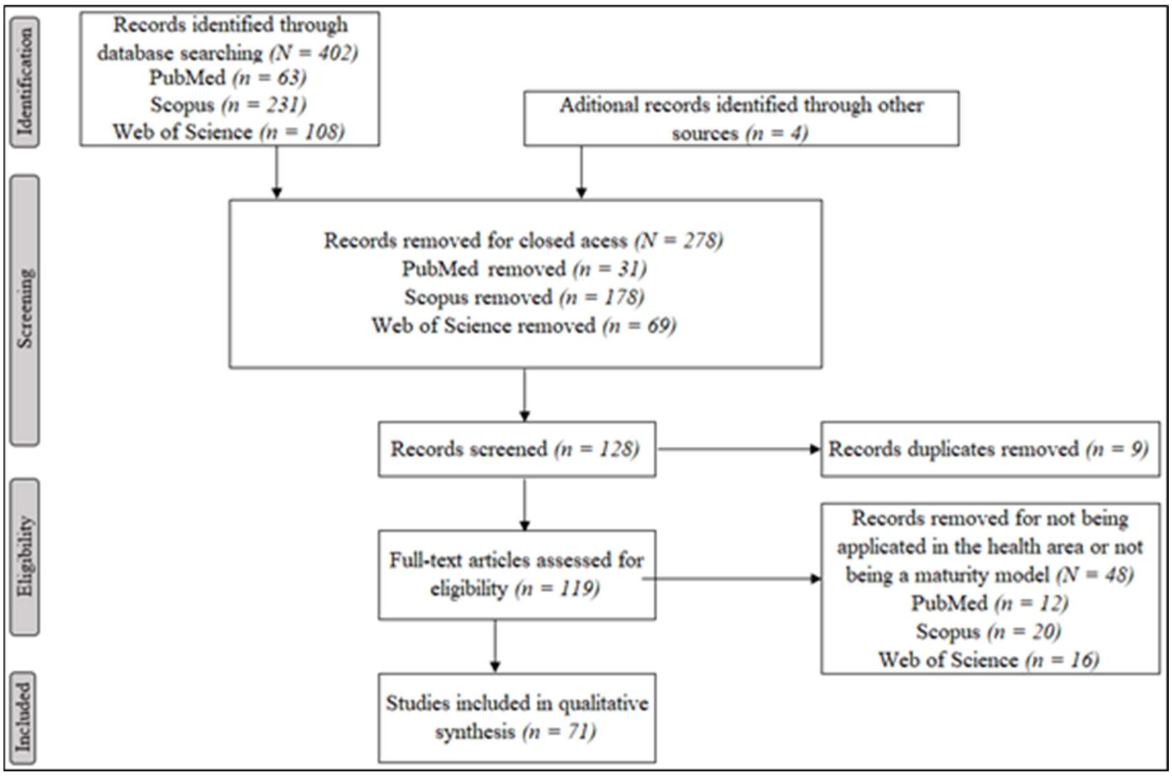

Figure 1. PRISMA 2009 Flow Diagram for SLR Maturity Models

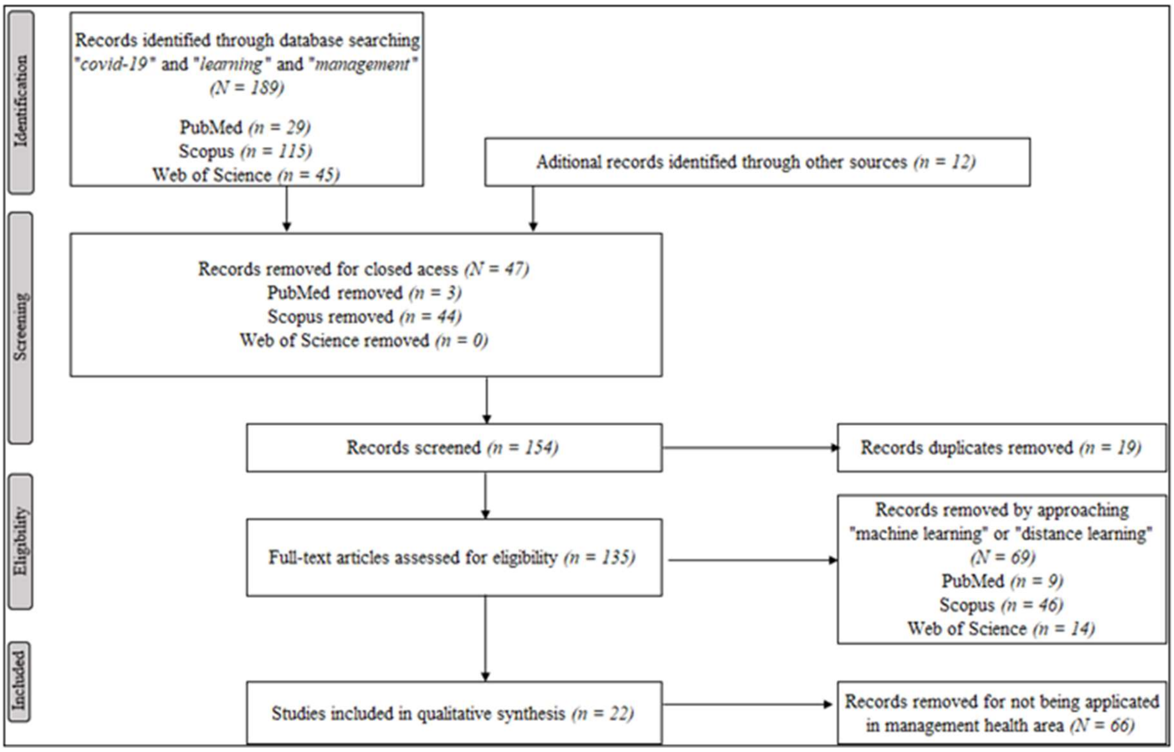

Figure 2. PRISMA 2009 Flow Diagram for SLR Covid

LITERATURE REVIEW

In this topic, we approach the literature review separately in two parts in which they occurred: maturity models in the hospital area and lessons learned in the management of hospital systems in pandemic times.

Maturity Models

Maturity Models have already proven to be an important support for organizations management, as they allow for a better positioning of the organization and help to find the best solutions for changes (Becker et al., 2009). Watts Humphrey first published, in 1989, the Capability Maturity Model (CMM) (Humphrey, 1989) the first maturity model, was developed for the field of information systems. The CMM was established to help organizations improve and augment their software processes and has been recognized as a standard Maturity Model (Team CPD, 2000).

In this regard, Maturity Models can be defined, in evolutionary progress demonstrating a specific skill or in meeting a goal from an early stage to a desired or normally occurring final stage (Mettler, 2011). In addition, Kirrane and colleagues (Kirrane et al., 2011) cite that Maturity Models are commonly used as a means of benchmarking, self-assessment, change management and organizational learning. Therefore, maturity models are presented for two distinct purposes of use: understanding how it operates and directing how to change it in favor of different or more useful ways of operating (Buckle, 2018). According to Fraser and colleagues (Fraser et al., 2002) all maturity models share the property of defining a number of dimensions at various stages of maturity, with a description of characteristic performance at various levels of granularity. Mettler (Mettler, 2011) adds that maturity levels generally range from three to six. Each maturity level includes a checklist to progress to the next level (Wetering and Batenburg, 2009).

Some Maturity Models aimed at health organizations were proposed. These models have their own specificities that distinguish them from models from other areas: they are still at an embryonic stage of development (Mettler, 2011; Rocha, 2011); Carvalho (Carvalho et al., 2019) in his research, he found that models in the health area are not comprehensive (i.e., they consider all areas and subsystems of health organizations); are poorly detailed (Carvalho et al., 2019); do not have the characteristics of the maturity stages structured by IF (Carvalho et al., 2019); and do not have a properly systematized process for a given system to advance to a higher maturity (Carvalho et al., 2015).

Twenty-nine maturity assessment methods in the health area were analyzed and they could be synthesized and compared. These models are described in **Table 1.**

Table 1. Synthesis and comparison of Maturity Models in the health area

Designation	Method	Health area	Levels	Reference
Electronic Medical Record Adoption Model (EMRAM)	Maturity Model	EMR Resources	8	(HIMSS, 2005)
Manchester Patient Safety Framework (MaPSaF)	Maturity Model	Patient safety	5	(Parker et al., 2006)
Quintegra Maturity Model for electronic Healthcare (eHMM)	Maturity Model	Focus on continuous improvement of health processes	7	(Sharma, 2008)
IDC Healthcare IT (HIT) Maturity Model	Maturity Model	Development of information systems	5	(Dunbrack et al., 2008)
PACS Maturity Model (PMM)	Maturity Model	Medical imaging communication and archiving systems	5	(Wetering and Batenburg, 2009)
NHS Infrastructure Maturity Model (NIMM)	Maturity Model	Technological infrastructure	5	(NHS Connecting for Health, 2011)
Hospital Cooperation Maturity Model (HCMM)	Maturity Model	Organizational, strategic and technical capabilities	4	(Mettler and Blondiau, 2012)
Health Usability Maturity Model (UMM)	Maturity Model	Electronic medical record (EHR) usability	5	(Staggers and Rodney, 2012)
Telemedicine Maturity Model (TMMM)	Maturity Model	Telemedicine	5	(van Dyk and Schutte, 2013)
Healthcare Analytics Adoption Model (HAAM)	Maturity Model	Data analysis	9	(Sanders et al., 2013)
Digital Maturity Self-Assessment (DMA)	Maturity Index	Digital transformation	0 to 1400 (score)	(NHS, 2013)
Continuity of Care Maturity Model (CCMM)	Maturity Model	Patient care coordination	8	(HIMSS, 2014)
Outpatient Electronic Medical Record (EMR) Adoption Model (O-EMRAM)	Maturity Model	EMR for outpatient facilities	8	(HIMSS, 2016a)
Digital Imaging Adoption Model (DIAM)	Maturity Model	Medical images	8	(HIMSS, 2016b)
Adoption Model for Analytics Maturity (AMAM)	Maturity Model	Analytical resources	8	(HIMSS, 2016c)
Hospital Information System Maturity Model (HISMM)	Maturity Model	Hospital information systems management	6	(Carvalho et al., 2019)
Infrastructure Adoption Model (INFRAM)	Maturity Model	Healthcare infrastructure and technology resources	8	(HIMSS, 2018)
Maturity model of logistical capabilities in home medical care services	Maturity Model	Logistical capacity	6	(Gutiérrez et al., 2018)
Clinically Integrated Supply Outcomes Model (CISOM)	Maturity Model	Supply chain	8	(HIMSS, 2019)
Interoperability Maturity Model (IMM)	Maturity Model	Interoperability of health services	5	(Kouroubali et al., 2019)
Health Maturity Assessment Tool (IS4H-MM 2.0)	Maturity Index	Information systems	5	(PAHO and WHO, 2019)
Global Digital Health Index (GDHI)	Maturity Index	Digital transformation	5	(Mechael and Edelman, 2019)
Maturity model for technology platforms in the South African healthcare context	Maturity Model	Health platform	5	(Deale et al., 2019)
Maturity model for the application of social media in healthcare	Maturity Model	Health social media capability	5	(Jami Pour and Jafari, 2019)
Maturity model for Healthcare Cloud Security (M^2HCS)	Maturity Model	Cybersecurity in healthcare environments	4	(Akinsanya et al., 2019)
Brazilian Digital Health Index (BDHI)	Maturity Index	Digital transformation	5	(Cruz et al., 2019)
The Knowledge Management Maturity Model for Indonesian Hospital	Maturity Model	Knowledge management and strategy	8	(Kurniawan et al., 2019)
Digital Maturity Index for Healthcare (DMI-H)	Maturity Index	Digital transformation	4	(Folks, 2021)
Digital Maturity Index for Health Institutions (IMDIS)	Maturity Index	Digital transformation	4	(Costa and Marin, 2021)

Twenty-three maturity models were analyzed and six maturity indexes. The maturity index is characterized by being a code system (score, percentage, etc.) and is understood as the degree of (actual) advancement and detailing of the Maturity Model.

Regarding the number of stages, they ranged from 4 to 9 stages, and one of the methods, as it is characterized as a maturity index, only counted the score from 0 to 1400 (NHS, 2013). The other maturity indices transformed the obtained score into levels, as in a Maturity Model.

All methods are more specific, addressing a sub-area of health, the sub-areas covered differ from each other: digital transformation (5), information systems (3), medical images (2), Electronic Medical Record (EMR) (2), platforms/social media (2), patient safety (1), processes (1), strategies (1), Electronic Health Record (HER) (1), telemedicine (1), data (1), analytical capabilities (1), patient care (1), infrastructure (1), technology infrastructure (1), logistics (1), supplies (1), interoperability (1), cybersecurity (1), and knowledge management (1).

According to Table 2, all the IFs contemplated in these twenty-nine maturity models in the health area were compiled and how many times they were cited, among the studied models.

Table 2. Synthesis of the IFs mentioned in the MM healthcare

IFs MM Healthcare	Number of paper cited
Data management and analysis	9
Technological infrastructure	8
Services and applications	8
Strategic management	7
Information security	7
Management and operational structure	6
Integration and alignment	6
Competence and professional training	5
Financial management	5
Governance and organizational structure	5
Infrastructure	5
Standardization	5
Quality and time of the process and service	5
Predictive analytics and decision support	4
Human error management	4
Innovation	4
Productivity	4
Engagement with the patient	3
Supply chain management	3
Knowledge management	3
Information technology and management	3
Marketing	3
Staff and workload	3
Legal, political and ethical concerns	3
Services provision	3
Patient safety	3
Systems automation	2
Organizational culture	2
Human factors design	2
EMR/EHR	2
Monitoring and control	2
Social business	2
Ability to learn	1
Safety critical communications	1
Drug management and optimization	1
Interoperability	1
Feedback methods	1
PACS	1
Research and design	1
Redundancy	1
Sustainability	1
Transfer of care	1
Training and competence	1
Telemedicine	1
Usability	1

NOTE: Similar IFs in the two searches are highlighted in yellow.

Covid-19 Management Learnings

At the end of 2019 and in first months of 2020, every country on the planet was impacted in some way by Covid-19 and, on March 11, 2020, the World Health Organization (WHO) declared a pandemic. Most countries around the world reported significant increases in Covid-19 cases during the month of March and most countries have restricted movement and implemented social distancing rules, as well as closing public buildings, schools, shops, and other places of worship social gathering (Newbutt et al., 2020).

The pandemic caused severe damage to socioeconomic and global phenomena such as commodity prices, remittances, trade, tourism, significant job losses, and drastically lower wages (Zhao et al., 2021). In the health sector, which was one of the most affected during the pandemic, Mishra and colleagues mentions the lack of standardized models in a pandemic situation, ranging from hospitalized patient care to local resident health management in terms of monitoring, evaluation for diagnosis and medications (Mishra et al., 2021).

To develop a standardized model in a pandemic situation, it is necessary to understand what should be monitored and the lessons learned from this scenario. In this way, sixteen segments (i.e., keywords or sectors) that were cited by authors in twenty-two publications that analyzed the learning that the Covid-19 pandemic left us in relation to hospital management and the number of times they were cited were conglomerated, that is, among the twenty-two publications, how many studies cited each segment. These segments are also named "Influencing Factor" from now on. These factors are shown in the **Table 3**.

Table 3. Synthesis of IFs cited in Covid-19 articles

IFs Covid-19	Number of paper cited
Technology	16
Supply chain	6
Services and applications	5
Monitoring	5
Diagnosis/tests	4
Patient safety	3
Attendance	3
Communication	3
Disinfection	2
Innovation	2
Counseling and training	1
Data	1
EMR	1
Financial management	1
Medicines	1
Standardization	1

NOTE: Similar IFs in the two searches are highlighted in yellow.

Regarding Technologies, in **Table 4** was mentioned which technologies specifically the studies mentioned:

Table 4. Synthesis of technologies specified in the studies of Covid-19

Technologies (covid-19)
Machine learning (ML)
Learning management system (LMS)
Deep learning (DL)
Robot assistance
Actuators
Big data
Blockchain
Smart wearable devices
Delivery drones
Artificial intelligence
Internet of things
Augmented reality
Virtual reality
Sensors
Telemedicine
Cloud technology

NOTE: Similar IFs in the two searches are highlighted in yellow.

A comparison was made of the influencing factors in the two literature searches and those that were similar were highlighted.

RESULTS

At the end of the literature review on the seventy-one articles corresponding to maturity models in the health area, it can be analyzed that none of the twenty-nine models analyzed covers the health ecosystem, five of the twenty-nine models are focused on digital transformation, three on information system, two on medical images, EMR, platforms/social media, and only one for patient safety, processes, strategies, HER, telemedicine, data, analytical capabilities, patient care, infrastructure, technology infrastructure, logistics, supplies, interoperability, cybersecurity, and knowledge management. Only two of the models mentioned consider different weights for the IF presented (Carvalho et al., 2019b), (Costa and Marin, 2021).

The IF addressed in these models are summarized, from the highest number of citations to the lowest: Management and data analysis, Technological infrastructure, Services and applications, Strategic management, Information security, Management and operational structure, Integration and alignment, Competence and professional training, Financial management, Governance and organizational structure, Infrastructure, Standardization, Quality and time of the process and service, Predictive analysis and decision support, Management of human failure, Innovation, Productivity, Involvement patient care, Supply chain management, Knowledge management, Information technology and management, Marketing, People and workload, Legal, political and ethical concerns, Service delivery, Patient safety, Systems automation, Organizational culture, Human Factors Design, EMR/HER, Monitoring and Control, Social Business, Learning Ability ender, Safety Critical Communications, Medication Management and Optimization, Interoperability, Feedback Methods, PACS, Research and Design, Redundancy, Sustainability, Care Transfer, Training and Competence, Telemedicine and Usability.

There is a great emphasis on data management and analysis, technological infrastructure and services and applications. However, in a sector where the focus should be patient care, the organization's safety culture, and quality of care, we have only few citations: Quality and process time (5), Human error management (4), Engagement with the patient (3), Patient safety (3), Human factors design (2), Safety critical communications (1). In addition, none of the models considered any IF in endemic/pandemic control situations.

If we analyze the most cited IF in the twenty-two articles corresponding to the lessons learned in managing hospital systems in a post-Covid-19 scenario, the following stand out: Supply chain, Services and applications, Monitoring, Diagnosis/tests, Patient safety, Care, Communication, Disinfection, Innovation, Counseling and Training, Data, Electronic Medical Record (EMR), Financial Management, Medicines, Standardization and; Technologies such as: Machine Learning (ML), Online Learning (LMS), Deep Learning (DL), Robot Assistance, Actuators, Big Data, Blockchain, Smart Wearable Devices, Delivery Drones, Artificial Intelligence, Internet of Things, Augmented Reality, Virtual Reality, Sensors, Telemedicine, Cloud technology.

When compared the IF chosen in the health Maturity Models with the IF highlighted as important to be evaluated in a pandemic scenario, we realize that the main difference is exactly in the specific characteristics of a pandemic such as: Diagnoses, Tests, Disinfection, but, in addition, the great difference focuses on the technologies involved in the healthcare industry, technologies such as Machine Learning (ML), Online Learning (LMS), Deep Learning (DL), Robot Assistance, Actuators, Big Data, Blockchain, Smart Wearables, Delivery Drones, Artificial Intelligence, Internet of Things, Augmented Reality , Virtual reality, Sensors and Cloud Technology.

These technologies, called ICTs (Information and Communication Technologies) promote the digitization and interconnectivity of processes, products, services and people (Koh et al., 2019). Its application in healthcare gave rise to the term Healthcare 4.0 (H4.0) (Thuemmler and Bai, 2017). The concept of H4.0 is a continuous but disruptive process of transforming the entire health value chain, from the production of medicines and medical equipment, hospital and non-hospital care, health logistics, healthy living environment, financial systems and social (Pang et al., 2018) as well as assisting in the implementation of different public health interventions, such as disease surveillance, outbreak response, and health systems management (World Health Organization, 2021). Its objective is to provide high-quality health services more efficiently and to decrease costs and resource utilization (Al-Jaroodi et al., 2020).

Use technology to transform the healthcare system is an important strategy in the current pandemic situation (Mishra et al., 2021). According to data from the State of Digital Health report, from the US market intelligence platform CB Insights, global investment in digital health reached a record in 2021, reaching the mark of US$ 57.2 billion, an increase of 79% compared to the previous year. In 2020, global investments in this area totaled US$ 32 billion (Folha Vitória, 2022).

However, significant challenges remain regarding how the technology is deployed, monitored, and managed in practice (Newbutt et al., 2020). Barriers to a digital transformation in healthcare are often not technological. Harold F. Wolf, President and CEO of the Healthcare Information and Management Systems Society (HIMSS), a global not-for-profit organization, considers a shift in culture to be the biggest hurdle in the industry's digital transformation. Similarly, the business consulting firm McKinsey found that the three barriers to tackling the digital age most mentioned by leaders in the pharmaceutical and medical technology industry were culture and mindset, organizational structure, and governance (Jones et al., 2019).

When we talk about the adoption of technologies in health, we cannot forget to think about patient safety, which is a particular challenge, with more than two decades of research and safety initiatives to define the problem, both nationally and globally. If there is a technological transition in health systems with undisciplined and chaotic processes (Gonçalves et al., 2011; Gonçalves and Rocha, 2012) we will have a greater probability of medical error and uncertainties in patient safety. Patient safety was mentioned in only 3 analyzed maturity models, however, due to its importance for a healthcare organization, the authors emphasize the need to debate and include it more in management tools.

Justifying the need to invest in patient safety, some worrying data are shown: medical error has become the third leading cause of death in North America, behind heart disease and cancer (CDC/National Center for Health Statistics, 2022; Makary and Daniel, 2016); avoidable errors are responsible for approximately 50,000 deaths per year (Naveh et al., 2005); the Institute of Medicine report also estimated that 44,000 to 98,000 people die each year in US hospitals from potentially preventable adverse events; the Canadian Adverse Events Study revealed that patients were harmed by adverse events at a rate of 7.5% of hospitalizations,8 with 36.9% of these events considered highly preventable; Makary and colleagues (Makary and Daniel, 2016) estimates that 251,454 people suffer preventable deaths each year in the US, that translates to 688 daily deaths in the US health care system, to put that number in perspective, that's equivalent to two jumbo jet plane crashes every day (Snowdon, 2022). Added to that, Brborovic and colleagues (Brborović et al., 2022) revealed that, during the Covid-19 pandemic, several patient safety issues were identified.

Some factors that contribute to human error were highlighted by Snowdon (Snowdon, 2022): EMRs are not enough, there is very little "line of sight" or "transparency" in most health systems. Reporting of adverse events is inadequate, i.e., evidence of the prevalence or root cause of adverse events in clinical settings such as primary care, long-term care, or home-based care is lacking, therefore, provider teams or health system leaders have limited ability to prevent events when they are not measured, reported or shared from one clinical setting to another, in addition to distrusting the methodology of reviewing medical records to determine the nature and prevalence of adverse events. Lack of reporting standardization also contributes to failure, as there are few opportunities to learn from mistakes or adverse events within systems or organizations. The lack of data analysis, to identify risks or link data to results to allow for traceability. And lastly, adverse events that simply should never happen in healthcare, like giving the wrong medication that results in permanent damage or death.

Furthermore, a special importance for the supply chain is highlighted and mentioned in six articles on health management learning. The procurement and supply of crucial health products in the early stages of the Covid-19 emergency was chaotic (Harland et al., 2021). Policy makers have been working hard to mobilize the movement of essential goods and services given their importance in containing the pandemic. It signifies the importance of establishing and maintaining logistics and supply chain management (LSCM) operations, both during containment and beyond (Illahi and Mir, 2021). More granular data suggests that N95 respirators and disposable face masks accounted for the largest share of imports in July-October 2020 (35% and 25%, respectively), followed by non-disposable face masks (16%). After the initial surge, data shows that imports of face masks have stabilized at around $ 350-450 million per month throughout 2021, slightly above pre-crisis levels. The data also point to a diversification of suppliers. While China accounted for about 94% of the value of disposable masks imported by the United States in July 2020, the origin of disposable masks has diversified with the emergence of new suppliers: Mexico, Korea and other countries accounted for 11%, 5% and 4 %, respectively, of US face mask imports in November 2021. Analysis confirms that global trade and supply chains have played a key role in helping countries gain access to products (OECD, 2022).

Therefore, to obtain a greater probability of success and improvement in the management of health systems, using the lessons learned in dealing with the Covid-19 pandemic, it can be assumed that organizations should invest in improvements in the supply chain, services and applications, monitoring and, mainly, technologies in order to pave the way for H4.0. In addition, issues that affect patient safety and care should be prioritized. However, to make these improvements possible, it is essential that all processes are organized, monitored, standardized, documented and evaluated. For that, it is suggested the use of management tools that will help in this process, such as, Maturity Models. With the use of this tool, healthcare organizations will be able to accelerate their digitization process, assess a specific aspect of digital maturity and specific sectors, and be guided towards the best strategic decisions.

Below is presented **Figure 3**, in which the IFs of the two sets and their common intersection in the Venn Diagram were gathered. In this way, it facilitates the interpretation of the Ifs that are missing from the MM in the health area, as learned during Covid-19.

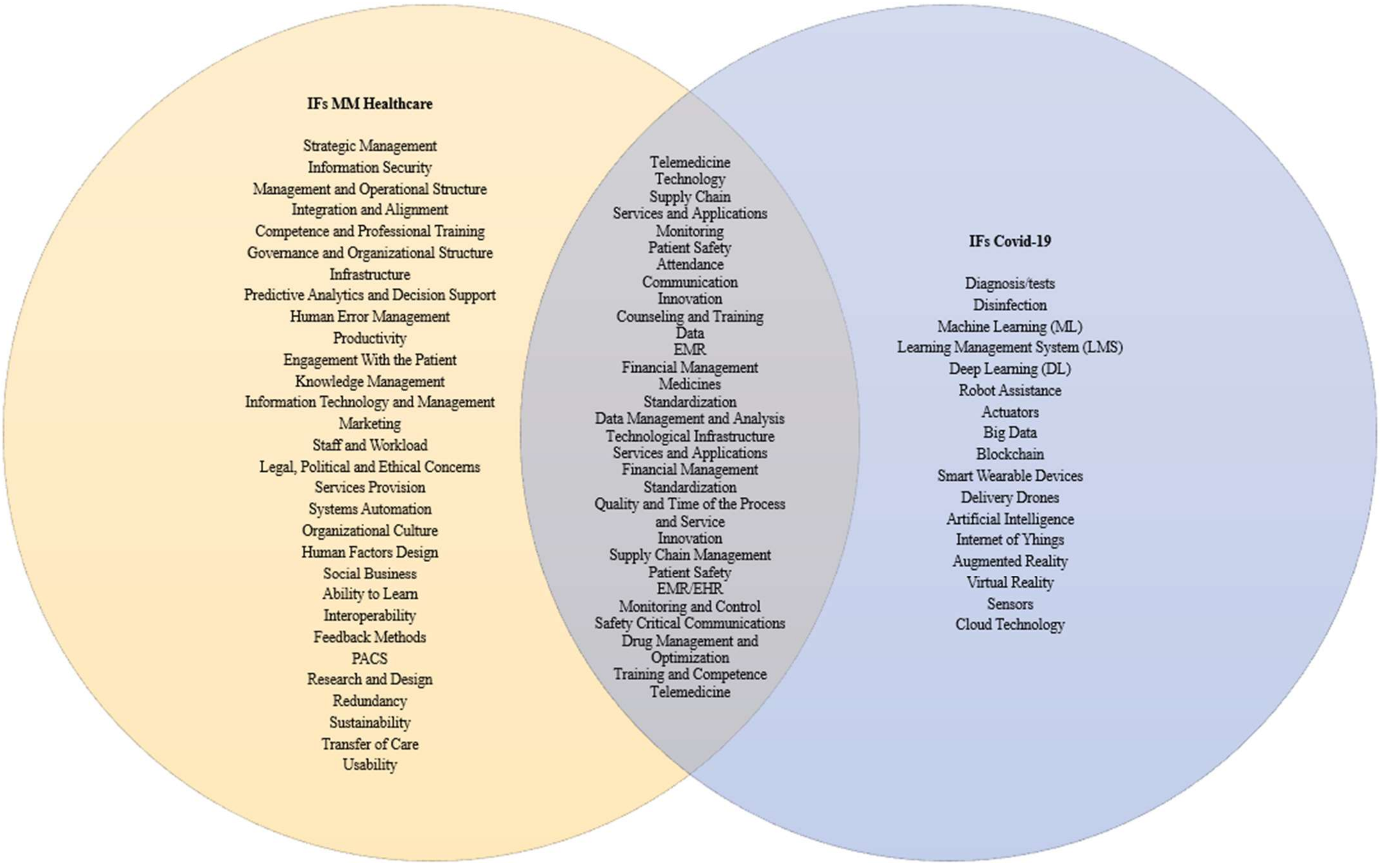

Figure 3. Venn Diagram IFs MMs and IFs Covid-19

CONCLUSION

Maturity Models in different sectors aims to support organizations to identify their current situation in the technology adoption process, and many fail to connect with the next step, which would be the development of action plans. It has already been proven by authors that the process of digital transformation in health must be guided by assessment methods and Maturity Models. When we can measure and assess the maturity of health systems, we will be able to have better control and direction for hospitals management to better invest in resources, technologies and better manage people.

Thus, twenty-nine methods of assessing maturity in health were analyzed. In this literature review, it was possible to observe the different subareas for which maturity models were developed to enhance the measurement of these dimensions and, consequently, their maturity. The Maturity Models studied in the literature, in the health area, are specific to subareas of some sectors, most of them are focused on digital transformation. There is a lack of Maturity Models that consider the health system as a whole and evaluate it broadly, with a global vision, which would be extremely important for better management of health organizations. In addition, there is a lack of maturity models that focus on patient well-being and safety, which should be the main concern of a sector that deals directly with this point. In addition, most MMs consider all FIs to be of equal importance when evaluating the defined process and, as is known, it is important to define their differences and importance for a more accurate evaluation.

With the Covid-19 pandemic, it is possible to highlight the difficulty that all health systems faced, such as the lack and reallocation of health professionals, lack of equipment, lack of safety materials, logistical difficulties in relocating equipment and materials, standardized models to aid management, agility in the process of developing effective drugs for the disease, development of technologies to track the disease and prevent its spread, ineffective culture about technologies, patient safety, mental health of health workers and of the general population. Finally, we pointed that global health systems were not prepared, i.e., they were not well ready to deal with the adversities that occurred during the pandemic. To prove this fact, the literature review carried out, in twenty-two articles, that had as their main theme the lessons learned about management of hospital systems during the Covid-19 pandemic.

Crossing these two lines of investigation, we can conclude that, in order to better prepare, adapt and make health systems more resilient, it is fundamental that the Maturity Models that will be developed after Covid-19 take into account these aspects that were mapped in the revision of the a presented literature of lessons learned in hospital management, and that no Maturity Model, so far, has contemplated. In this way, we suggest that future Maturity Models consider mapping the agility of disease diagnosis, examination scale, hospital disinfection process and technological infrastructure, with a focus on ICTs, capable of promoting digitization and interconnectivity of processes, products, services and people , such as ML, LMS, DL, Robot Assistance, Actuators, Big Data, Blockchain, Smart Wearables, Delivery Drones, Artificial Intelligence, Internet of Things, Augmented Reality, virtual reality, sensors and cloud technology.

Allied to this, although some MMs already address these issues, it is indicated that the authors consider expanding their focus on supply chain, services and applications, monitoring and, mainly, on patient safety and care, given the importance that these IFs demonstrated in coping with the pandemic.

For future literature reviews and research on Maturity Models in the health area, a deeper study on the needs observed during Covid-19, its subareas and IF that should be highlighted is recommended. In addition, field research in hospitals is recommended because this work, in fact, only collected data from the literature that we have today.

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