KIWI Framework - From Smart Hospitals to Smarter Hospitals:

Case Study on the Future Hospital of Madeira

Pedro Gomes

Dissertation written under the supervision of Professor Henrique Martins.

Dissertation submitted in partial fulfilment of requirements for the MSc in Management with Specialization in Strategy, at the Universidade Católica Portuguesa, 30th December 2023.

Abstract

Faced with evolving healthcare complexity, costs and clients' expectations, future hospital management must find ways to use digital technology appropriately and be smarter. Four pivotal elements: Knowledge, Intelligence, Wisdom, and Interoperability (KIWI) must be well balanced. This qualitative case study uses the conceptual underpinnings of the KIWI framework for hospital maturity, in an attempt to see how it can better serve organizations to evolve from the traditional Smart Hospital models.

The study centres on the developmental plans of the forthcoming Hospital Central e Universitário da Madeira (HCUM) planned to be a new digitally advanced facility. It aims to offer a nuanced analysis beyond conventional Smart Hospital paradigms and identify action lines to address key challenges.

Given that this project is slated for completion in five years, the primary emphasis has been on interviewing individuals who possess the highest understanding and expertise in this field, along with those holding the highest positions of responsibility. In-depth interviews, including one with the person introducing the KIWI concept to Madeira, ensure a high level of accuracy in capturing overarching plans.

Findings underscore the KIWI framework as useful way to consider the future paradigm of health organizations. HCUM emerges as a proactive participant in this transformative shift, aspiring not only to embrace the KIWI model but also to serve as an exemplary institution. Despite challenges, this research offers valuable insights, contributing to the realization of the hospital's vision as a pioneering institution.

Title: KIWI Framework – From Smart Hospitals to Smarter Hospitals: Case Report on the Future Hospital in Madeira

Author: Pedro Afonso Luís Ascensão Gomes

Keywords: Health; KIWI hospital; smart hospital; Hospital Central e Universitário da Madeira; future; management; digital health

Resumo

Perante a evolução da complexidade, custos e expetativas dos clientes na área da saúde, a gestão hospitalar futura deverá utilizar a tecnologia digital de forma apropriada e mais inteligente. Quatro elementos cruciais - Conhecimento, Inteligência, Sabedoria e Interoperabilidade (KIWI) - devem ser equilibrados de forma adequada. Este estudo de caso qualitativo utiliza os fundamentos conceptuais do enquadramento KIWI para a maturidade hospitalar, numa tentativa de perceber como este pode servir melhor as organizações na transição dos modelos tradicionais de Hospitais Inteligentes.

O estudo centra-se nos planos de desenvolvimento do futuro Hospital Central e Universitário da Madeira (HCUM), planeado para ser uma instalação digitalmente avançada. Pretende oferecer uma análise detalhada para lá dos paradigmas convencionais de Hospitais Inteligentes e identificar linhas de ação para enfrentar desafios-chave.

Com a conclusão da obra prevista para 2028, a ênfase principal foi colocada em entrevistar indivíduos com o maior entendimento e experiência nesta área, e que ocupam as posições de maior responsabilidade neste projeto. Entrevistas aprofundadas, incluindo uma com a pessoa que introduziu o conceito KIWI na Madeira, asseguram um elevado nível de precisão na compreensão dos planos globais.

Os resultados destacam o modelo KIWI como uma ferramenta inequívoca a considerar no paradigma futuro nas organizações de saúde. O HCUM emerge como um participante proativo nesta mudança transformadora, aspirando não apenas a adotar o modelo KIWI, mas também a servir como uma instituição exemplar. Apesar dos desafios, esta pesquisa oferece perceções fiáveis, contribuindo para a concretização da visão do hospital como uma instituição pioneira.

Título: KIWI Framework – De Hospitais Inteligentes a Hospitais ainda mais Inteligentes: Estudo de Caso no Futuro Hospital da Madeira.

Autor: Pedro Afonso Luís Ascensão Gomes

Palavras-chave: Saúde; hospitais KIWI; Hospital Central e Universitário da Madeira; futuro; gestão; saúde digital

Acknowledgements

First of all, I would like to express my deepest gratitude to my parents. Thank you for all the time and support throughout this journey and for inspiring me to be the best version of myself every day. I am eternally thankful for the countless sacrifices and enduring love that have shaped me into the person I am today.

I owe a profound debt of gratitude to Professor Henrique Martins, whose support and provision of incredible opportunities have left an indelible mark on my academic and personal growth. Professor Martins is not only an invaluable mentor but also a beacon of inspiration who ignited my passion for the field of health management.

To Dr. Herberto Jesus and Dr. José Julio Nobrega, I express my sincere appreciation for their kindness and invaluable contribution to my thesis. Their expertise and guidance have played a pivotal role in shaping the trajectory of my research. Without their dedicated involvement, this thesis would not reach its fruition and for that I am immensely grateful.

To my cherished family and friends, I extend heartfelt thanks for your support and for standing by me since day one. Your presence in my life is a source of immense gratitude, and I am truly thankful for the strength and joy you bring.

Table of Contents

1. Introduction

Digital Transformation, mentioned by many as the Fourth Industrial Revolution is revolutionizing all areas of society (Y.Zhong, T.Newman, Q.Huang, & Lan, 2016).Therefore, the landscape of healthcare has been undergoing a profound transformation driven by the relentless march of digital technology. This digital health transformation represents a pivotal shift in the way healthcare is delivered, managed, and experienced. The urgency for such a transformation is underscored by the pressing challenges that health institutions face today.

From hospitals to primary to care providers struggle with various problems such as, aging population, escalating health care costs, disparities in healthcare access, fragmented health care systems, data management challenges, preventable medical errors, and shortage of healthcare professionals (Koebe & Bohnet-Joschko, 2023). These challenges emphasize the growing need for a major shift in the healthcare paradigm. The integration of technology and the digitalization process offer promising solutions to address some of these issues. By harnessing the power of digital technologies, healthcare institutions can enhance their ability to provide more cost-effective, efficient, and patient-centred data (Senbekov, et al., 2020; (Kwon, et al., Review of Smart Hospital Services in Real Healthcare Environments, 2022).

Smart Hospitals, defined as: "*healthcare institutions which enhance the patient treatment process through IoT, optimize asset management via an Information and Communication Technology environment integrated with internal assets, and employ business automation processes*" (ENISA, 2016) are presently a growing trend worldwide. They represent a proactive approach in ensuring that hospitals are not only contemporary and capable of addressing todays needs but also resilient to future needs by adopting and adjusting to technological shifts. However, the conventional concepts associated with Smart Hospitals exhibit notable weaknesses. They fall short in addressing critical inquiries pertaining to artificial intelligence, the prudent utilization of technologies, and the intricate dynamics of collaborative human efforts. Specifically, there is a lack of focus on aspects such as interoperability and cooperability, hindering the seamless coordination among various components of healthcare systems. Moreover, these concepts overlook essential considerations regarding the retention of technologically advanced knowledge within the medical workforce.

Given these considerations, adopting a more comprehensive approach becomes imperative. This broader perspective exists and has been referred as the KIWI framework – a theoretical

construct that shapes the seamless integration of the four elements (Knowledge, Intelligence, Wisdom and Interoperability) into all facets of hospital organization (Martins, KIWI Hospitals: "Future-Looking" Principles for a Hospital Maturity Model, 2021).

Inaugurated in 1973, the current Madeira hospital, Hospital Dr. Nélio Mendonça, is in need of a transformation due to its aging infrastructure, aiming to better meet the demands of the population. Set to be completed in 2028, the Hospital Central e Universitário da Madeira (HCUM) is positioned to replace the current hospital. This new facility will be a comprehensive multi-facility complex, featuring six above-ground floors and one below-ground floor, covering a gross building area of 172,100 square meters (compared to the 54,090 square meters of Hospital Dr. Nélio Mendonça) on a site spanning 37,750 square meters.

The HCUM is distinguished by its inclusive healthcare services, encompassing outpatient consultations, inpatient care with 607 beds, specialized medical units, surgical facilities, radiology services, and laboratories. Additionally, the hospital will provide amenities such as a heliport, ample parking spaces (1,160, with 832 covered), and extensive administrative areas. This facility is designed to serve the entire Região Autónoma da Madeira (Madeira, 2023), marking a significant advancement from the existing hospital.

Considering the opportunity presented by the establishment of a new hospital in Madeira, currently on planning stages, this presents as an extraordinary opportunity to product a case study that can help address the research questions at hand.

The three research questions outlined are:

1) Firstly, evaluate the feasibility of applying the KIWI framework to a concrete example.
2) Secondly, to investigate whether the model offers explanatory power beyond the more traditional concepts associated with Smart Hospitals both for innovation management guidance and on a theoretical level.
3) Thirdly, departing from its application to the HCUM, determine whether it is possible to expand and improve the model and extract some useful recommendations to the future hospital management.

The primary focus will be on scrutinizing the planning of the new hospital, with a particular emphasis on assessing whether the hospital administrators align with the dimensions proposed

by the KIWI framework. After understanding the plans and the degree of knowledge that the HCUM has on digital health, the final objective is to propose action lines that contribute to the project. This thesis is outlined as follows: In Chapter 2, we present the background where we explore the concepts from several authors expert on this area; then, in Chapter 3 the methodology of this study is explained; results, in the form of a case study are displayed in Chapter 4; next, we analyse the results and frame them into the KIWI framework on Chapter 5 and discuss them in Chapter 6 relating them with the background; afterwards, in Chapter 7, we present the recommendation to HCUM administrators; finally, in Chapter 8 and 9 we explain the limitations, propose avenues for further research and present the conclusions of this thesis.

2. Background

2.1. Healthcare

Upon analysis of the (OECD, 2023) report, it is possible to extract the six general aspects of challenges in healthcare services. Financial pressures pose a significant challenge as health systems grapple with constraints in a challenging economic climate, where competing priorities squeeze public funds allocated for health, placing a tension on the healthcare infrastructure. Post-pandemic struggles persist, as core population health indicators reveal that societies have yet to fully recover from the global health crisis. Many individuals continue to struggle with mental and physical health issues, emphasizing the lasting impact of the pandemic.

Healthcare is additionally increasingly overloaded by persons suffering from lifestyle-related health problems, with unhealthy habits and poor environments contributing to premature deaths. Smoking, harmful alcohol use, physical inactivity, and obesity emerge as root causes for numerous chronic conditions. Despite the implementation of universal health coverage in most OECD countries, barriers to access persist. The report encourages a renewed focus on primary care and prevention as a fundamental strategy to simultaneously enhance accessibility and efficiency in healthcare services.

The standard of care is advancing concerning safety and effectiveness, with an increased focus on shifting healthcare to be more patient centred. This shift aims to enhance the overall patient experience and satisfaction. Although digital health holds significant potential to transform health systems, the report notes that many countries are unprepared for this digital revolution and highlights the importance of readiness and strategic planning to fully harness the benefits of digital health technologies.

2.1.1. Healthcare problems

Table 1 highlights various challenges encountered by the healthcare sector. Embracing and leading digital transformation can enhance accessibility, efficiency and patient-centered care. Thus, by reshaping healthcare systems, countries can ensure that they progressively walk towards overcoming these problems.

Problem	**Description**
Aging Population	• The growing number of elderly populations poses challenges and pressure to long-term care, end-of-life care, and managing the associated healthcare needs.
Healthcare Workforce Shortages	• Shortage of healthcare professionals (doctors, nurses, and allied health workers) are prevalent in many regions. This impacts severely the quality and accessibility of care. • Fewer healthcare professional sees themselves continuing their professions in long-term (only 30%). • Physical and mental exhaustion due to extensive workload and bad monetary compensation are two of the main reasons for this lack of healthcare professionals. • It is also important to mention that this shortage of medical professionals, multiplies the workload of the existing workforce, which consequently results in high level of burnout.
Rising Healthcare Costs	• Ageing population means less taxes payments. • Costs of healthcare are increasingly higher, especially after the pandemic. Medical treatments, prescription drugs and insurance premiums contribute to this issue. • Higher service demands lead to higher financial pressures.

Access to Healthcare Inequalities	• Race, ethnicity, socioeconomic status, and geography disparities still persist. Ensuring equitable care by solving these disparities is a pressing concern. • People from disadvantage backgrounds have poorer health outcomes. • Despite the current efforts to solve these issues, the progress remains slow.
Preventable Medical Errors	• Preventable errors, like misdiagnoses, nosocomial infections and medications mistakes still happen and put patient safety at risk.
Data Privacy and Cybersecurity	• As healthcare becomes increasingly digitalized, protecting patient data from cyberattacks and breaches is a growing concern. Institutions need to develop a system that maintains the security and privacy of Electronic Health Records.

Table 1 – Adapted from (Hartmann, Schlegel, & Cronenberg, 2023) (Martins, KIWI Hospitals: "Future-Looking" Principles for a Hospital Maturity Model, 2021)

2.2. Digital Health Transformation

2.2.1. Smart Hospitals

By 2023, smart technology integration within hospital settings has established robust roots in many of the North American, European, East Asian, Australian, and Middle Eastern more advanced healthcare institutions. Conversely, in many other regions across the globe, the development of smart hospital initiatives is still in its nascent stage, with only a limited number of pilot projects to date (Hartmann, Schlegel, & Cronenberg, 2023).Therefore, the United States, United Kingdom, China, Japan, Germany, and South Korea have all included the incorporation of smart technologies into their healthcare agenda, demonstrating their dedication to the nationwide implementation of smart hospitals. As a result, the worldwide smart hospital market is projected to expand at a compound annual growth rate (CAGR) of 20.7%, reaching a total value of USD 153.3 billion by 2030 compared to the US$ 41 Billion in 2023 (Smart

Hospitals Market Analysis, 2023). Notably, the East Asia/Oceania region stands out as the most rapidly growing market in this sector.

2.2.1.1. Definition

A Smart Hospital integrates information and communication technologies to optimize clinical processes, management systems, and infrastructure, enhancing patient safety, care quality, cost-effectiveness, and patient-centeredness (Kwon, et al., 2022). In the dynamic landscape of healthcare, technological advancements, evolving care methodologies, and shifting patient expectations enable institutions to harness big data, building automation, and the Internet of Things. This empowerment elevates patient care standards, boosts healthcare professionals' productivity, and enhances overall facility efficiency (Anixter, 2020).

The "smart hospital" concept transcends a rigid standard, instead, it advocates for scrutinizing operations through smart technology lens. Implementing an integrated management platform facilitates resource allocation, quality analysis, and performance assessment, reducing medical costs and enabling informed decisions for hospital development (Demirkan, 2013). With a focus on open architecture interoperability, facility operators can apply emerging technologies to meet present and future challenges.

Smart hospitals aspire to establish intelligent connections between individuals, data, and technology, addressing individual needs, enhancing healthcare efficiency, and improving the overall medical service experience. Rooted in a culture of continuous innovation and improvement, these endeavours represent the future developmental direction of modern medicine (Tian, et al., 2019).

2.2.1.2. Identification of Smart Hospital Technologies

Hospitals executives need to properly define what technologies should be implemented in their facilities. By harnessing the technologies illustrated in Table 2, intelligent healthcare can significantly reduce the expenses and potential risks associated with medical procedures. It enhances the efficiency of medical resource utilization, fosters collaboration across diverse regions, propels the advancement of telemedicine and self-service healthcare, ultimately making personalized medical services widely accessible (Tian, et al., 2019).

Technologies	Description
Artificial Intelligence (AI) and Machine Learning	AI is used to analyse patient data, make predictions, and assist in clinical decision-making, while machine learning can help improve diagnostic accuracy. It also simplifies personalized treatments.
Robotics Process Automation	Robotic Process Automation has the capability to mechanize routine duties like appointment scheduling and billing, thereby liberating healthcare professionals to dedicate more of their time to patient care.
Virtual Reality	Virtual Reality (VR) and Augmented Reality (AR) technologies can be harnessed for simulating medical procedures and delivering training to healthcare personnel.
Electronic Health Records (EHR)	Electronic health records enable the seamless storage and exchange of patient information among healthcare providers for better coordination of care.
Internet of Things (IoT)	IoT devices like wearables, sensors, and smart medical equipment have the capacity to gather and transmit real-time data about patients' health and overall well-being, facilitating proactive care interventions.
Telemedicine	Telemedicine involves using telecommunication technologies for real-time or asynchronous communication between patients and providers or among healthcare professionals. It includes collecting health information remotely from medical or mobile devices to monitor patients, track behaviour, and make necessary adjustments to their healthcare.

Table 2 - (Roncarolo, Boivin, Denis, Hébert, & Lehoux, 2017); (Hartmann, Schlegel, & Cronenberg, 2023); (K.Alotaibi & Federico, 2017)

2.2.1.3. New trends emerging from Digital Transformation

Joschko and Koebe conducted a comprehensive study to identify the digital transformation trends impacting the hospital sector, screening 1334 articles and defining eight key trends based on 44 eligible studies (Koebe & Bohnet-Joschko, 2023).

- The first trend highlights a **shift in the patient's role**, with active involvement in healthcare decision-making, data utilization, and access to transparent information. This change, attributed to innovative technologies like the internet, smart devices, and mobile health applications, influences decision support, therapy integration, and patient compliance (Hult, Hansson, Gellerstedt, & Svensson, 2019; Lee, 2018; Fuller, et al., 2020; Palanica, J. Docktor, & Fossat, 2019).
- The second trend emphasizes an **integrated and connected healthcare delivery system** facilitated by technologies such as electronic health records, the Internet of Things, and electronic prescriptions. This interconnectedness enhances communication, streamlines care, and empowers patient-centred practices (Blaser, 2018; Cano, Tenyi, Vela, Miralles, & Roca, 2017; Guntuku, et al., 2020; Tian, et al., 2019).
- A third trend involves the **rise of new ecosystems**, transforming healthcare into a dynamic ecosystem through digital networking. Established providers must adapt to stay competitive, utilizing data exchange platforms and intermediaries. Key technologies include mobile health, machine learning, and predictive analytics, offering efficient and personalized healthcare delivery (Blaser, 2018; Wang & Hajli, 2017; Mitterecker, et al., 2020; Reda, Kanga, Fatima, & Azouazi, 2020; Gyrson, 2018; Mitterecker, et al., 2020).
- **Performance optimization in primary processes** is another outcome, enhancing the efficiency of clinical procedures through real-time data utilization, workload management, and tailored services. Technologies driving optimization include electronic health records, machine learning, and assistive robots, applicable to personalized treatment pathways, diagnostics, and robotics in clinical areas (Baslyman, Almoaber, Amyot, & Bouattane, 2017; Berntsen, et al., 2019; Burkoski, Yoon, Hutchinson, Solomon, & Collins, 2019; J.Dreyer & Geis, 2017; Staib, et al., 2016; Abitbol, et al., 2020; Mahendri Bhandari, et al., 2020; Daneshmand, Bilici, Bolotnikova, & Anbarjafari, 2017).

- **Augmented technological intensity** reshapes hospitals into highly digital institutions, with extensive data utilization promoting collaboration with digital service providers. Key technologies include smart devices, robotics, and cloud services, fostering external data exchange, partnerships, and expanded hardware inventory (Brink, Arenson, Grist, Lewin, & Enzmann, 2017; Desai, et al., 2019; Tian, et al., 2019; Aceto, Persico, & Pescapé, 2020; Abitbol, et al., 2020; Daneshmand, Bilici, Bolotnikova, & Anbarjafari, 2017).
- Digital transformation leads to **more personalized treatments and improved outcomes**, driven by data analytics, machine learning, and predictive medicine. Technologies apply to the evaluation of patient monitoring data, AI training, and individual therapies within hospital settings (Kelly, Campbell, Gong, & Scuffham, 2020; Burkoski, Yoon, Hutchinson, Solomon, & Collins, 2019; Farahani, Barzegari, Aliee, & Shaik, 2020; CH, K, & P, 2019; Wang & Hajli, 2017; Gyrson, 2018; Staib, et al., 2016).
- **Data-driven resource allocation** emerges as a trend, utilizing predictive models for efficient resource allocation, optimizing processes, planning, and controlling resources. Technologies include data mining, machine learning, and predictive analytics, applied to process optimization, resource planning, and predictive forecasting (Baslyman, Almoaber, Amyot, & Bouattane, 2017; Brink, Arenson, Grist, Lewin, & Enzmann, 2017; Chen, 2018; Deiters, Burmann, & Meister, 2018; Mitterecker, et al., 2020; Zolbanin, Davazdahemami, Delen, & Zadeh, 2022).
- The final trend identified is the use of **new information and communications media**, reshaping interactions among care process stakeholders. Technologies include avatars, mobile health (mHealth), and the Internet of Things (IoT), applicable to data exchange between providers and patients, enhanced patient engagement, and creating barrier-free communication channels (Aghdam, Rahmani, & Hosseinzadeh, 2021; Tian, et al., 2019; Lee, 2018; Hansson, Svensson, & Gellerstedt, 2019; Fuller, et al., 2020).

These trends collectively indicate a paradigm shift in healthcare, with patients playing a more active role, healthcare systems becoming interconnected, and technology-driven optimization enhancing efficiency and personalization. These insights are critical for hospitals aiming to navigate the evolving landscape of digital transformation.

2.2.1.4. Challenges of Smart Hospitals

The successful implementation of smart healthcare technologies encounters various challenges, which can be appropriately categorized into three distinct areas: organizational, technological, and environmental hurdles (Renukappa, Mudiyi, Abdalla, & Subbarao, 2022). However, the major challenges are social, organizational and environmental.

- **Organizational Challenges.** These challenges are encountered at the organizational level by institutions embracing smart healthcare strategies.
    - Ineffective communication and involvement
    - Insufficient planning
    - Inflexible policies and protocols
    - Workflow interruptions and decreased efficiency
    - Shifting corporate culture
    - Organizational preparedness
    - Company size and scale
    - Corporate framework
    - Inadequate managerial backing and ineffective leadership
    - Knowledge deficiencies
- **Technological Challenges.** These are challenges that impact the assimilation of new technology within an organization.
    - Interoperability problems
    - Ethical concerns and data governance
    - Security and privacy issues
    - Absence of standardized data terminology and norms
    - Poor data quality
    - Financial consideration
    - Operational and non-operational system challenges
- **Environmental Challenges.** These are challenges experienced by end users who are either directly impacted by or affected by the adoption of smart healthcare strategies.
    - Insufficient training and assistance
    - User behaviour and interaction
    - Reluctance to change
    - Limited computer proficiency

2.2.2. The need for a broader approach

Hospitals worldwide are undergoing transformative changes to address criticisms and better serve the needs of patients. From diverse initiatives, including the work of Patch Adams and rigorous "Clinical Governance" in the UK, to digital innovations like Kaiser Permanente and AI projects funded by the European Commission, and even the Toyota Production System-inspired Ng Teng Fong General Hospital in Singapore, these efforts aim to redefine the future of healthcare (Martins, Kiwi Hospitals: "Future-Looking" Prinicples for a Hospital Maturity Model, 2021).

While these endeavours are centred on shaping the future of hospitals, they present a challenge in visualizing the ideal form of hospitals. Rather than just focusing on physical aspects, such as size or medical specialties, the primary emphasis should be on the organizational culture and strategies. This encompasses aspects like Human Resources, Information Systems, Facilities, and Nursing and Doctoring processes. At its core, the "essential spirit" that distinguishes future hospitals from their predecessors is a combination of Hybrid Intelligence and Wisdom.

Hospitals are envisioned as "knowledge organizations" that rely heavily on skilled healthcare professionals. Yet, many are not structured around clinical pathways, the patient's journey through the healthcare system. They provide knowledge-intensive services and must prioritize quality, error reduction, and trust-building. Although this focus remains a challenge for most institutions, there is an increasing recognition of the importance of knowledge management within hospital settings (Alsaqqa & Optom, 2020). Knowledge management empowers organizations to strengthen their ability to gather information and knowledge, utilizing it for effective problem-solving and decision-making (Yazdani, Bayazidi, & Mafi, 2020).

In the face of a scientific explosion and personalized medicine, understanding patients and knowing how to provide effective care are evolving. Intelligence is no longer exclusive to humans, with artificial intelligence (AI) becoming an integral part of healthcare. The primary obstacle facing AI in healthcare lies not in its technological capabilities but in securing widespread integration into daily clinical practice (Davenport & Kalakota, 2019). To achieve broad adoption, AI systems must undergo regulatory approval, seamlessly integrate with Electronic Health Record (EHR) systems, adhere to standardized practices, undergo clinician training, secure funding from public or private payers, and receive continuous updates for ongoing effectiveness in the field. There is a compelling requirement to shift our perspective in

AI medical research, moving away from the prevalent notion of a competition between Human and AI. Instead, we should embrace a collaborative approach, the Human and AI hybrid model. This model holds the potential to yield superior results compared to either AI or Human Intelligence alone, truly embodying the principles of real medical practice (Bellini, Badino, Maffezzoni, Bezzi, & Bignami, 2023).

It is critical to wisely navigate the ethical complexities posed by technological advancements. Following the European Principles for Digital Health Ethics made by the French Presidency of the Council of the European Union, organizations should base digital health in humanistic values, enable individuals to manage their digital Health and data, make digital health inclusive and implement eco-responsible digital health.

The presence of multiple information systems and the necessity for interconnected healthcare organizations highlight that hospitals often function as a collection of fragmented units within a broader ecosystem of regional, national, and global public health interdependence. Efforts such as the implementation of SNOMED-CT in Europe and France are currently underway, aiming to contribute to the establishment of the European Health Data Space and fulfil national requirements (France 22, 2022).

Figure 1 - Source: Model of Connected Care by Jingshan Li and Pascale Carayon

The illustrative example presented in Figure 1, captured by Li & Carayon (2021), depicts a model of connected care, emphasizing the central role of patients within the network.

2.2.3. KIWI Hospitals

To address these challenges, the concept of KIWI hospitals has emerged, characterized by their ability to be Knowledgeable, Intelligent, Wise, and Interoperable. These elements must be embedded in all processes.

Knowledgeable hospitals increasingly rely on advanced science and technology, including genomics and research outcomes, combined with practical expertise. Clinical Decision Support tools and structured clinical pathways are integral to their operations.

Intelligent hospitals leverage AI in basic medical procedures and intelligent management of healthcare services. This means hospitals will have a new workforce which is divided between humans and robots, through artificial intelligence, enhanced intelligence and hybrid professionals.

Wisdom remains a uniquely human attribute. While it is exclusive to humans, the organization must prioritize trust and ethics at its core. The reinforcement of trust and the establishment of structures and processes for Digital Ethics are essential, given the growing potential for technical and scientific activities that could have adverse consequences.

Interoperability, often associated with IT, is essential for seamless information exchange, standards use, and harnessing the value of data. Interprofessional teams and inter-organizational Virtual Competence Centres are crucial for KIWI hospitals, giving that the majority of the problems related to low performance and errors in medicine are due to problems in communication and multiprofessionalism.

This approach has far-reaching implications for patients, healthcare professionals, and managers. Patients can expect not just improved care but also greater empowerment and understanding of their health. Healthcare professionals must focus on knowledge, including embracing unconventional medical practices and AI. Interprofessional collaboration is critical to address communication issues and improve performance.

Managers should prioritize intangible assets like culture development, reflection processes, and performance appraisal systems. The concept of "hospital-as-a-university" will reshape

healthcare, creating new services and reshaping education in healthcare. To foster a more cohesive and efficient coordination and monitoring system, it's imperative to consolidate all levels of organizational decision-making into a unified structure. This consolidation empowers managers to guarantee that every department progresses uniformly. It's essential because the presence of one significantly advanced department can impede the development of others. Therefore, synchronized progress across all departments is paramount.

The ultimate goal is to create hospitals that are not only highly functional but also alive, open, and transformational. Collaboration with patients and citizens will help hospitals evolve into places of happiness, even in challenging circumstances.

2.2.3.1. Adding to the KIWI framework

Aiming to establish KIWI hospitals, hospital executives, should carefully navigate several considerations when delineating their implementation strategy, as highlighted by (Saetren & Laumann, 2017) and (Todnem, 2005). Both papers contribute to the successful implementation of a strategy by exploring various change management theories proposed by several authors.

There is a second dimension that is not covered by the KIWI framework, which has to do with telehealth and the hospital itself (Martins, Henrique Martins and the Hospital of the Future, 2020). When we consider what lies ahead, there are two main viewpoints. The first one, a straightforward trend analysis that suggests that hospitals are merely getting bigger and adding more beds. However, a more forward-thinking approach involves scenario analysis, where we imagine a world where hospitals have no beds and walls, or where people are less inclined to visit hospitals due to the risk of infections. This imaginative approach opens up exciting possibilities for innovative technologies.

There are several technologies that could be moved to the patients' house, such as, portable ventilators, telemonitoring for cardiac patients, which is already being tried in several countries, including at Hospital Santa Maria in Portugal which as a very good one (Brito, 2021), and telemonitoring respiratory patients.

This vision goes beyond standard telehealth consultations, it embraces the concept of tele-hospital, where hospital visits are reserved for absolutely needed situations. For example, there is no need for HIV patients to go to the hospital every three months to pick up medication. Research indicates that approximately 80% of primary care dermatology consultations can be

conducted remotely when patients provide high-quality supporting images. (Jones, et al., 2022). Actually, it is claimed that from 25% up to 50% of the current things physically done in hospitals could be taken away, reducing the need for physical visits.

3. Methodology

This research adopted a two-step methodology. Firstly, it commenced with a comprehensive literature review covering the landscape of healthcare, trends in digital health transformation, smart hospital concepts, associated technologies and challenges, the KIWI hospitals and how they represent an evolution of smart hospitals. Lastly, a series of interviews were conducted with administrators and medical staff related to the HCUM. The aim was to gain valuable insights into the organization's vision, plans, perspectives, and forward-looking strategies, and how they align with the essential requirements of the KIWI framework.

Given the possibility of studying the construction of a new hospital in Madeira, and based on (Priya, 2020) and (Crowe, et al., 2011), this thesis will focus on developing a case study and a thematic analysis. “A case study is both the process of learning about the case and the product of our learning” (Stake, 1995). The choice of a case study methodology was made to provide a nuanced, in-depth exploration of the complexities surrounding the construction of a new hospital in Madeira, allowing for a comprehensive understanding of the specific context and multifaceted factors at play.

3.1. Data collection

Conducting a thorough investigation, case study research grants the researcher the flexibility to employ any method of data collection that aligns with their objectives (provided the method is both feasible and ethical). To ensure a robust, unbiased study of the phenomenon under investigation, various data collection techniques are typically utilized. These may encompass methods such as questionnaires, surveys, in-depth interviews, participant/non-participant observation, and the examination of relevant documents (Priya, 2020).

According to (Bogdan & Biklen, 1994: 51), "qualitative researchers establish strategies and procedures that allow them to take into consideration the informants' experiences from their perspective." In this line of thought, we utilized interviews as we deemed this to be the most suitable research instrument. The need for interviews is justified by the fact that they enable the collection of descriptive data capable of intuitively developing an understanding of how subjects interpret aspects of the world. Furthermore, it allows for capturing the subject's own discourse (Bogdan & Biklen, 1994).

Hence, to properly address the research questions, it was essential to create a well-structured series of interview questions. Therefore, it was developed a more in-dept series of questions that went deeper on what has to be known to understand the extent which the KIWI concept is present in the organization plans. In-depth interviewing is a qualitative research method that involves conducting thorough individual interviews with a limited number of participants to investigate into their perspectives on a specific idea, program, or situation (Boyce & Neale, 2006). Given that this method enables interviewees to offer much more detailed information than other alternative methods, it became evident that the first research question could be effectively addressed through the information collected from the interviews. The full interview guideline is available on **Appendix 1**. Each interview lasted approximately one hour.

Additionally, in our quest for comprehensive data, we consulted the HCUM website (Madeira G. R., 2023), a repository of pertinent project information. Additionally, we explored regional digital journals and local entities' websites to further augment our information pool, such as, (Diário de Notícias da Madeira, 2022; SESARAM, 2023).

3.1.1. Target Group

Health professionals in governance roles “need to be aware of how quickly AI is advancing in health, so that they are ready to lead the change required for its adoption by health system” ((Castro, 2022); (Loh, 2018)). Therefore, the target group of this research were administrators and clinical directors, who, at the time of the interview, were working in Madeira. The questions were initially formulated in English and subsequently translated into Portuguese, their primary language, for a more seamless conversation.

Firstly, we interviewed the president of SESARAM, which is the healthcare services organization of the Região Autónoma da Madeira. His extensive professional roles have been closely connected with the management of healthcare services in Madeira for several years, and he assumed the position of president in 2023. Therefore, he possesses a profound understanding of the current management model and its limitations, and he is keenly aware of the necessary changes required to achieve an enhanced delivery of care on HCUM.

Secondly, to provide an on-field perspective, we conducted an interview with the clinical director of intensive care. His extensive professional experience and deep knowledge of daily clinical practices provide us with a precise insight into the day-to-day operations of the current

hospital in Madeira, including its limitations. Similar to the previous interviewee, he also has a full awareness of the necessary changes to achieve an improved delivery of healthcare.

Based on the information gathered in these interviews, we were able to paint an accurate picture of the intentions of those in charge of the plans for the new hospital and the future of healthcare in the Região Autónoma da Madeira.

3.2. Data Analysis

The formulation and exploration of the second and third research questions depended on a comprehensive analysis of interview responses and insights derived from an extensive literature review. This approach facilitated our comprehension of how the KIWI framework constitutes an evolution beyond traditional Smart Hospitals concepts. Furthermore, it provided an opportunity to extend and refine certain aspects within the framework, namely the knowledge and intelligence domains. Subsequently, recommendations were proffered to HCUM administrators.

Analysing the data and examining the results is essential to achieving the objective of this dissertation. Given the limited sample size, consisting solely of top managers, a comprehensive analysis involved reviewing responses to each question and assessing their alignment with the existing literature (Castro, 2022; Harrell & Bradley, 2009).

4. Results

Following a comprehensive interview designed to assess the perspectives of hospital administrators on the KIWI framework, the gathered responses are as follows:

The initial focus of inquiries centred on gathering insights into the plans for clinical decision tools at Madeira hospital. Currently utilizing "Átrio," an Electronic Health Record distinct from other national programs, the tool provides a comprehensive overview of a patient's journey across various health centres. Future perspectives include integrating artificial intelligence into clinical decision tools, with administrators assessing AI algorithms for implementation in various medical domains. The hospital aims to proactively engage with futuristic technology, seeking solutions relevant five years from now.

A visionary initiative involves incorporating biosensors in the entrance hall, assessing vital parameters upon patient arrival for real-time health insights. The ideal scenario envisions technology seamlessly providing necessary information, minimizing patient interaction, and enhancing the overall patient experience. Drawing parallels with aviation, where autopilot aids in complex decision-making, a similar synergy is envisioned in medicine.

The administrators anticipate advanced stages of robotization, recognizing its benefits in reducing errors and infection rates in robotic surgery. Future visions focus on leveraging robotization in specific, complex scenarios like intricate vascular access. The hospital has committed substantial funds for a surgical robot, recognizing robotization as pivotal for its advancement.

HCUM is committed to healthcare progress, investing in cutting-edge equipment, including advanced imaging and nuclear medicine, with a primary focus on oncology. Despite potential funding from European projects and the PRR, the regional health system relies on the regional budget. To cultivate self-sustainability, emphasis is on creating start-ups and investigation projects, a pivotal strategy for transformative goals.

The integration of robotization is crucial for the hospital's advancement, promising precision in disease diagnosis, pharmaceutical selection, and surgical intricacies. In their visionary healthcare approach, the hospital prioritizes the patient, embracing a modular hospital philosophy to optimize patient flow and tailor approaches to individual needs. In this patient-centric paradigm, the modular hospital concept ensures dynamic patient movement based on

evolving needs. The hospital aims to expand this patient-focused structure to the Macaronesia region, encompassing Madeira, Açores, Cabo Verde, and Canarias.

The primary goal is to instil happiness and well-being in healthcare settings by designing aesthetically pleasing hospitals surrounded by nature, shifting the traditional association of hospitals with diseases and death. Individualized bedrooms accommodating a maximum of two patients enhance the patient experience, emphasizing reduced hospital stays. Hospitals primarily cater to severe medical conditions, ensuring individuals with chronic or terminal illnesses that demand highly specialized care receive necessary hospitalization. The strategy aims to shift a significant portion of medical treatments to outpatient care, encouraging home management when feasible.

As highlighted earlier, there are strategic plans to integrate artificial intelligence into various medical procedures, with a particular focus on pathologic anatomy, radiology, genomic analysis, and imaging. The administrators are not limiting the potential application of AI to these areas, keeping their minds open to extending its implementation across other domains within the healthcare system.

Looking ahead, the future perspective is to embrace AI comprehensively, aiming to incorporate it into every feasible aspect of healthcare operations. The overarching objective is to harness AI's capabilities to reduce errors while ensuring a harmonious balance with the human touch. The integration of artificial intelligence is pivotal for HCUM healthcare management, aiming to enhance efficiency and reduce waste. Beyond clinical applications, AI extends to functions such as stock management and waiting list optimization. Successful implementation hinges on skilled professionals, like data scientists, guiding the system dynamically.

Investment in education stands as a cornerstone of Madeira's development, with a profound focus on professional training. Recognizing education's role in fostering accountability and empowerment, the hospital values continuous learning. The hospital prioritizes cultivating motivated, pleased professionals, understanding that a happy workforce is key to optimal healthcare delivery.

Over the years, strategic investments in emergency and trauma medicine, hosting European courses with European instructors in Madeira, have been made. The MRMI program (Medical Response to Major Incidents), originating in Sweden, stands out as a three-day course equipping professionals with catastrophe response skills. This investment extends to intensive care, where

Madeira has honed expertise, sharing knowledge through training programs not only in Europe but also in Brazil.

Aligned with progressive developments, the hospital recognizes the importance of artificial intelligence in healthcare. Instead of training all professionals as AI experts, the focus is on providing tools complementing their skills, aiding in interpreting AI-generated insights. The goal is seamless AI integration, with every professional possessing basic educational training to grasp concepts and potential benefits.

Facing resistance to AI adoption, the hospital rejects authoritarian leadership, favouring a democratic and less autocratic management approach. Continuous education serves as an antidote to resistance, ensuring professionals skilfully handle evolving technologies. Senior management is already undergoing training to shift mindsets.

The clinical training centre at the Hospital of Madeira attests to their commitment to professional development, ranging from basic procedures to mastering complex skills. The primary objective is nurturing a workforce of passionate professionals dedicated to their roles and patients' well-being.

In the healthcare domain, trust is fundamental in patient-professional relationships, grounded in safeguarding patient information confidentiality. As the hospital transitions to digital processes, there is a meticulous focus on preventing leaks. Defence tools, including double certification, play a crucial role in tracking access and ensuring authorization. Future solutions may involve patients owning their data and selectively granting access when engaging with healthcare entities.

Post-cyberattacks, massive data protection initiatives are underway, ensuring that all users of informatic tools understand and adhere to ethical standards and data protection regulations. Patients gain authority over data sharing, emphasizing conscious and well-informed authorization. Stringent measures post-cyberattacks, including double certification, limit access to health professionals directly involved in patient care. Interactions are meticulously recorded to fortify security. Patient data transfer hinges on authorization, challenging the belief that hospitals own data. The ideal envisions patients, entering healthcare, consciously authorizing data use for studies or other purposes.

The current hospital utilizes the Atrio system, consolidating patient data across all public hospital units in Madeira, excluding private ones. The goal is to enhance this system, ensuring a more seamless and rapid process with a focus on security. However, the imperative consideration is security, and measures are in place to ensure that access to Atrio is restricted to armoured computers, preventing external parties from using regular computers and accessing external platforms like Gmail.

A key objective is the comprehensive integration of all patient-related information, combining public and private healthcare records into a unified database. Although a cyberattack temporarily halted progress, plans to merge data from the private sector's nine different programs with the public hospital's system persist. Despite the setback, there's a strategic intent to initiate this integration, potentially starting with separate departments, as planned in pediatrics.

Looking forward, the future objective is to incorporate artificial intelligence into managing this integrated data system. Recognizing human fallibility, AI introduces an additional layer of information analysis and decision-making capabilities, promising enhanced insights and efficiency in handling patient records and medical data.

Multi-professional teams, aligning with the overarching vision centred on patient well-being, are already in existence. Emphasis is on cultivating balanced teams, recognizing that teams with more than four or five individuals may prove less effective. An innovative consortium is emerging, uniting Madeira, Cabo Verde, Açores, and the Canary Islands. This collaborative effort envisions positioning Madeira as a hub for specialized medical treatments, fostering a sense of shared interests within Macaronesia. The region, synonymous with happiness and well-being, embodies the philosophy guiding this transformative initiative.

Building on the current hospital's exceptional Clinical Training Centre, renowned nationally for training professionals from various parts of the country, this flagship institution will continue in the new hospital. With a solid foundation in place, the hospital is already receiving invitations from global organizations. The ultimate goal is to foster a sense of shared interests within Macaronesia, uniting these regions and facilitating the seamless exchange of data.

While telehealth connects the hospital with institutions in the region, the aspiration extends to widespread data sharing. The objective is to create an environment where data, knowledge, and education are shared not only within these regions but also beyond. Madeira, with its stability

and favourable conditions, aims to become a knowledge management hub, yet this endeavour requires the establishment of a robust virtual environment that fosters knowledge flows and data exchange for enhanced collective outcomes.

However, addressing the managerial complexity within hospitals and the broader healthcare system is crucial for effective collaboration and streamlined management across the participating regions. This visionary pursuit seeks to harmonize diverse regions for mutual advancement in medical expertise and patient care.

In the dynamic landscape of diverse health organizations, the primary challenge for KIWI hospitals surpasses acquiring specialized equipment; it involves transforming mentalities. The paramount goal is instilling a KIWI philosophy, rooted in a fundamental mindset shift. The focus is clear: every health worker prioritizing patient happiness, advocating for an open structure, recognizing the hospital's transversal role in society. The challenge lies in transforming each worker's mindset, emphasizing broader societal impact. The task is challenging but achievable, with a committed five-year plan to reshape individual philosophies.

In the viewpoint of hospital administrators, the KIWI mentality transcends physical space, residing in the people working there. Beyond KIWI hospitals, the goal is fostering a KIWI region, making Madeira a harmonious ecosystem where everyone is interconnected with wisdom. This approach aims to revolutionize the hospital setting and extend the KIWI philosophy throughout the region, encapsulating a collective commitment to holistic wisdom and integrated intelligence.

5. Analysis of Results

Examining the data entails revisiting the interview transcripts to discern emerging themes within the respondents' answers. Utilizing predefined topics and questions serves as an organizational framework for the analysis, essentially synthesizing the responses to the proposed questions (Guion, Diehl, & McDonald). The objective of this section is to contextualize the results obtained in the interviews within the four KIWI dimensions, in order to ascertain the feasibility of integrating this model into the plans of HCUM. To achieve a more complete analysis, an initial segment was conducted to synthesize the interview results, providing insights into the perspective of hospital administrators.

5.1.1. Vision for the hospital and for Região Autónoma da Madeira

In their pursuit of progress, the team envisions not just a KIWI hospital but dreams of cultivating a KIWI region, weaving the entire island into a fabric of shared data, knowledge, and education. The essential of this effort lies in fostering a close partnership between private and public health sectors, a collaboration vital for connecting our healthcare network comprehensively.

The vision goes beyond the norm in healthcare. The aim is to create a hospital that goes beyond the usual associations of sickness and fear, embracing a holistic perspective that nurtures happiness and well-being. The goal is to change the way people perceive healthcare facilities by introducing green and leisure spaces within the hospital.

In terms of design, the vision comes to life in an infrastructure that mirrors the comfort of a patient's home. Each room is designed to be almost private, accommodating a maximum of two patients. This intentional design aims to enhance the patient experience and reduce conditions like delirium during their stay.

At the core of this transformative approach is putting the patient first. This marks a shift from the usual approach of building hospitals around the needs of healthcare professionals. The hospital will adopt a modular hospital philosophy, focusing on optimizing the patient flow within the facility, ensuring efficiency and personalized care.

Leveraging the stability, security, and favourable climate conditions of Madeira, the region is poised to become a hub for managing knowledge, using these strengths to drive advancements in healthcare and beyond. Yet, their most significant challenge lies not in building a KIWI hospital but in fostering a KIWI mindset. Over the next five years, the team is dedicated to gradually transforming everyone's mentality to embrace the spirit of KIWI.

In conclusion, the vision of the hospital administrators is aligned with the principles of KIWI, reflecting their commitment to a progressive, interconnected, and patient-centric healthcare ecosystem in Madeira.

5.1.2. Hospital typology

In the realm of hospital typology, it's clear that healthcare administrators aim to create a KIWI-centric medical facility staffed by health professionals aligned with KIWI principles. In

summarizing and interpreting the discoveries, responses were systematically categorized into four distinct groups, according to the domains outlined by the KIWI concept (Martins, Kiwi Hospitals: "Future-Looking" Prinicples for a Hospital Maturity Model, 2021).

5.1.2.1. Will it be a Knowledge Hospital?

The interview responses have clearly highlighted the essential elements required to shape the envisioned knowledge hospital. It is evident that the institution is poised to integrate cutting-edge science and technology, underscoring a robust commitment to advancing knowledge within its precincts. The patient-centric philosophy is notably emblematic of their approach, characterised by a modular facility concept that tailors healthcare to the unique needs of each individual. This departure from the traditional model, which built hospitals around the preferences of healthcare professionals, signifies a progressive shift toward personalized and inclusive care.

Furthermore, the hospital's foresight extends to empowering its health professionals by providing them with state-of-the-art clinical decision support tools. This strategic vision aligns with the overarching goal of fostering an environment where medical practitioners can make informed and precise decisions, ultimately enhancing the quality of patient care. The incorporation of these components reflects a deliberate and comprehensive strategy to establish a knowledge hospital that stands at the forefront of scientific innovation, patient-centred care, and professional empowerment.

5.1.2.2. Will it be an Intelligent Hospital?

Within the realm of intelligence, a clear objective emerges: the comprehensive integration of AI across diverse facets of the hospital's operations. The strategic vision encompasses the infusion of AI into medical procedures, with certainty in pathologic anatomy, genomics analysis, radiology, and imaging. Notably, the hospital administrators express a forward-thinking approach, remaining receptive to extending AI integration into other operational domains.

In the HCUM, AI assumes a pivotal role, strategically aimed at eradicating inefficiencies and curbing wasteful practices. The hospital recognizes AI's indispensable contribution to waste detection and mitigation, streamlining intricate processes, and advancing decision-making. The integration of AI is not confined to specific areas, rather, it extends to functions like stock

management and waiting list optimization, underscoring a commitment to infuse intelligence into diverse operational facets.

Acknowledging the transformative potential of AI in smart health system management, the hospital is resolute in its commitment to invest in these cutting-edge technologies. They perceive AI not as an isolated remedy but as an integrated force shaping various dimensions of healthcare operations. However, the efficacy of AI implementation hinges on the expertise and guidance provided by skilled professionals, particularly data scientists who serve as the architects behind the system. Thus, AI is viewed as a dynamic collaborator, guided by human intelligence, working synergistically to optimize the intelligent management of the health system.

5.1.2.3. Will it be a Wise Hospital?

In the realm of Wisdom, recent cybersecurity challenges have driven a heightened commitment to fortifying security measures within the hospital's framework. A proactive stance is evident through the implementation of robust and continuous data protection measures, with defence tools such as double certification taking centre stage. These tools are strategically positioned to play a pivotal role in meticulously tracking and monitoring access to sensitive information, ensuring that only authorized individuals can retrieve pertinent data.

Recognizing the inherent risks associated with unrestricted access, the hospital is contemplating a paradigm shift by considering a future solution where patients take ownership of their data. This innovative approach entails patients selectively granting access to their information when engaging with healthcare entities, whether public or private. This re-evaluation challenges the conventional notion that hospitals exclusively own patient data and underscores a commitment to empowering individuals with control over their personal health information.

Moreover, the hospital is implementing protocols aimed at restricting access to patient information exclusively to health professionals and specialties directly involved in the patient's care. This targeted approach not only enhances the safety of the organization but also aligns with the philosophy of ensuring that sensitive data is accessible only to those who play a direct role in patient well-being. The meticulous recording of every interaction within the platform adds an additional layer of security, fostering a culture of accountability and transparency within the healthcare ecosystem.

Together with these measures, it is evident that hospital administrators harbour a strategic focus on reinforcing the trust of their patients in the organization. This commitment is underscored by a conscious emphasis on digital ethics, recognizing the importance of responsible and ethical handling of patient data. By prioritizing trustworthiness and ethical considerations, the hospital aims to cultivate a secure and reliable healthcare environment that places patient well-being at the forefront of its digital practices.

5.1.2.4. Will it be an Interoperable Hospital?

Upon delving into the final domain, a comprehensive understanding of the current hospital's operational landscape revealed its reliance on the Atrio system. This system effectively integrates patient data across all public health units in Madeira, with the exception of private facilities. The strategic vision entails a significant advancement of this system, aspiring to evolve towards a more streamlined and nearly instantaneous process. At the forefront of this vision is the ambitious goal of achieving comprehensive integration, harmonizing all patient-related information, including records from both public and private healthcare sectors, within a unified and interconnected database.

Despite facing a temporary setback due to the recent cyberattack, there remains a resolute strategic intent to initiate and progress with this integration. The initial steps may involve the phased integration of separate departments, mirroring the successful implementation observed in the pediatrics department.

An innovative consortium is taking shape, forming a collaborative network that extends beyond the confines of Madeira to include Cabo Verde, Açores, and the Canary Islands (Macaronesia), collectively representing approximately 3 million citizens. This visionary initiative aims to establish an environment where data, knowledge, and educational resources can be shared not only within these regions but also on a broader scale. The overarching objective is to cultivate growth through collaborative efforts, fostering an interoperable healthcare ecosystem that transcends geographical boundaries and facilitates the seamless exchange of information for the benefit of patients and healthcare providers alike.

6. Discussion

6.1. The path for future hospitals

The objective of this section is to engage in a comprehensive discussion, drawing insights from both the literature review and interviews conducted with HCUM administrators. The focus is on their perspectives and visions pertaining to HCUM and healthcare in Madeira, with particular emphasis on KIWI hospitals. To enhance clarity and coherence, the discussion will be categorized into seven distinct sections: KIWI Hospitals, Hybrid Intelligence, Security, and Integrated and Interconnected Healthcare Services, Infrastructure, Challenging Mentalities and Paradigm Change. All these categories address aspects that are not encompassed in traditional smart hospital models, thereby underscoring the significance of examining this more comprehensive framework.

6.1.1. KIWI hospitals

While numerous commendable initiatives are dedicated to advancing the future of hospitals, there lacks a definitive roadmap for organizations to navigate (Martins, KIWI Hospitals: “Future-Looking” Principles for a Hospital Maturity Model, 2021). Although these efforts are pivotal in shaping the trajectory of hospitals, they introduce a challenge in envisioning the ideal form of healthcare institutions. Instead of fixating solely on physical attributes such as size or medical specialties, the paramount focus should be on organizational culture and strategic frameworks. Consequently, KIWI hospitals signify an evolution beyond the conventional notion of smart hospitals. Upon scrutinizing the interviews, a cohesive resonance emerged, indicating a consensus among the literature, and HCUM administrators alike that the path forward involves embracing KIWI hospitals and cultivating KIWI-oriented individuals.

The majority of challenges faced by hospitals are social, organizational, and environmental. The KIWI model, emphasizing the need to address and value these dimensions of technological change, assists organizations in perceiving these challenges not as obstacles but rather as complementary dimensions of a digitally transformed institution.

6.1.2. Hybrid Intelligence

As articulated by Martins in "Kiwi Hospitals: 'Future-Looking' Principles for a Hospital Maturity Model" (2021), the distinguishing factor between future and present hospitals lies in

the concept of Hybrid Intelligence. Aligned with this perspective, HCUM administrators are committed to an extensive integration of artificial intelligence in every feasible aspect to optimize processes, echoing the strategic approach advocated by Koebe and Bohnet-Joschko (2023). Within the framework of KIWI principles, HCUM emphasizes the certain implementation of AI in key domains like pathologic anatomy, imaging, radiology, and genomics analysis. For widespread adoption, AI systems must obtain regulatory approval, seamlessly integrate with EHR systems, adhere to standardized practices, undergo clinician training, secure funding, and receive continuous updates for ongoing effectiveness (Davenport & Kalakota, 2019).

HCUM's strategic direction converges with the insights of Gordon, Perlman, and Shukla (2017), emphasizing a long-term perspective. The planning team underscores the importance of ensuring project scope accommodates cost-effective additions, modifications, or replacements of technology. This underscores HCUM's commitment to adaptability and scalability during implementation, acknowledging the paramount significance of these considerations in the integration of advanced technologies.

6.1.3. Security

As emphasized by Renukappa, Mudiyi, Abdalla, and Subbarao (2022), one of the challenges posed by emerging technologies is the prevalence of security threats. Wisdom, an attribute exclusive to humans, underscores the critical importance of reinforcing trust and digital ethics in this context (Martins, Kiwi Hospitals: "Future-Looking" Prinicples for a Hospital Maturity Model, 2021). Executives must discern that cybersecurity is equally pivotal to digital implementation and allocate resources, accordingly, as highlighted by Koebe and Bohnet-Joschko (2023). This imperative is accordingly acknowledged in the plans of HCUM.

In response to a cyberattack at the current hospital in Madeira, HCUM is actively exploring measures to fortify security, trust, and ethical considerations to address the escalating concerns of digital threats. Explorations include empowering patients to own their information, allowing selective access when interacting with healthcare institutions, whether private or public. The deployment of double certification and authorization by patients, integration of armoured computers, and the meticulous restriction and documentation of every individual accessing patients' information are among the mechanisms currently under scrutiny.

Moreover, it can be asserted that HCUM aligns with the initial two European Principles for Digital Health Ethics introduced by the French Presidency of the Council of the European Union. These principles advocate for digital health grounded in humanistic values and empower individuals to oversee their digital health and data. Regarding the other two principles no mentions was made, therefore, assuming they are currently not in the plans, it is suggested that the administrators explore strategies to make digital health inclusive and implement eco-responsible digital health, as stated below:

Inclusive Digital Health

- Digital health services must be available to everyone, including individuals with disabilities or limited literacy levels
- Digital health services should be user-friendly and straightforward
- Individuals are provided with training in digital health
- Digital health services offer human communication support as needed

Implementing Eco-Responsible Digital Health

- Identifying and quantifying the environmental impacts of Digital Health
- Development of Digital Health services adheres to eco-design best practices.
- Ensuring the re-use and recycling of Digital Health equipment
- Digital Health stakeholders need to be dedicated to minimizing their ecological footprint

6.1.4. Integrated and Interconnected Healthcare Services

The bedrock of effective healthcare operations is data, a notion underscored by Gordon, Perlman, and Shukla (2017). Establishing a robust, organization-wide data infrastructure is imperative, as elucidated by Martins in "Kiwi Hospitals: 'Future-Looking' Principles for a Hospital Maturity Model" (2021). This aligns seamlessly with the identified trends of Digital Health Transformation, where an integrated and connected healthcare delivery system thrives on interoperability, ensuring seamless information exchange, standardized use, and optimal data utilization (Koebe & Bohnet-Joschko, 2023). Li and Carayon (2021) effectively illustrate the ideal structure of a connected care model.

HCUM is dedicated to consolidating the private and public sectors into a unified platform in the future. Additionally, HCUM administrators are proactively orchestrating the creation of a

consortium that links the Macaronesia region. This endeavour not only promotes connectivity within the local region but also aspires to extend its impact beyond regional boundaries, facilitating the exchange of data, knowledge, and education. The overarching vision is to foster growth through collaborative initiatives, reflecting once more the principles embedded in the KIWI framework embraced by HCUM administrators.

6.1.5. Infrastructure

As highlighted in the Cruzamento Podcast, an additional facet not encompassed by the KIWI framework revolves around telehealth and the hospital's evolving role (Martins, Henrique Martins and the Hospital of the Future, 2020). This perspective transcends conventional telehealth consultations, embracing the concept of a tele-hospital, where physical hospital visits are reserved for absolutely essential situations. The hospital is envisaged to cater to highly specialized and technological scenarios, such as intricate surgeries, cardiac emergencies, and severe pneumonias. Significantly, day hospitals and ambulatory care assume pivotal roles, providing viable alternatives to traditional overnight hospital stays.

The preference is aligned with facilitating consultations at the patient's residence through teleconsultation, allowing for prompt treatment while enabling patients to return home expeditiously. In instances where hospitalization proves indispensable, the overarching focus remains on creating an environment that fosters both well-being and patient satisfaction. Notably, this vision resonates with the perspective articulated by HCUM administrators, who echoed consonant sentiments when delineating their vision for the future of hospitals.

6.1.6. Challenging mentalities

Another pivotal observation derived from synthesizing the literature review and analysing interview responses is that implementing a KIWI hospital necessitates a concurrent shift in mentalities to adopt the KIWI mindset. As noted by (Saetren & Laumann, 2017), Oreg (2006) states that resistance to change comprises personality and contextual factors. Personality factors pertain to an individual’s disposition towards change and their internal inclinations, while contextual factors encompass variables, such as, power and prestige, job security and trust in management.

Merely possessing financial resources and visionary goals is insufficient, success hinges on the parallel transformation of attitudes. Hospitals aspiring to establish KIWI institutions ought to

concentrate on strategic awareness campaigns aimed at reshaping prevailing mindsets, aligning with the imperative underscored by (Gordon, Perlman, & Shukla, 2017). Therefore, KIWI implementation strategies need to integrate effective communication measures to adequately address and prepare for these issues, as mentioned by the change management theories outlined in (Todnem, 2005).

6.1.7. Paradigm change

The traditional notion of hospitals as closed organizations associated with diseases, sadness, and mortality has been transcended. Present-day health institutions are compelled to redefine this paradigm and evolve into open and interconnected entities within society spaces characterized by joyfulness and vitality even in the most challenging circumstances (Martins, Kiwi Hospitals: "Future-Looking" Prinicples for a Hospital Maturity Model, 2021), it becomes evident that this transformation aligns with the overarching goals of HCUM. Initiatives such as individualized and personalized rooms serve as strategic interventions to combat challenges inherent to in-patient stays, including issues like delirium. This proactive approach contributes to enhanced personalization of treatments and improved outcomes, echoing the insights from Koebe and Bohnet-Joschko (2023).

A paradigm shift is further underscored by a patient-centred focus, challenging the historical construction of hospitals centred around the needs of healthcare professionals. HCUM is spearheading a modular hospital philosophy, emphasizing the optimization of patient flow within the facility. By tailoring approaches to individual needs, the hospital introduces adaptable scenarios, departing from conventional practices. Pioneering expansive zones lacking rigid specialty definitions, HCUM will enable patients to navigate seamlessly based on their distinct requirements within a flexible structure. The heart of achieving optimal outcomes lies in adopting a comprehensive and holistic perspective when evaluating patient needs, a philosophy driving transformative changes in the healthcare landscape.

As indicated by Todnem (2005), the Kanter et al.'s Ten Commandments for Executing Change, Kotter's Eight-Stage Process for Successful Organizational Transformation, and Luecke's Seven Steps all underscore the importance of hospital administrators establishing a vision and a shared direction to effectively achieve transformative change.

6.2. Expanding the model

Owing to space constraints, this section will exclusively delve into concepts pertaining to the Knowledge and Intelligence domains. To achieve this, we will explore aspects that have not been previously explored in studies on the KIWI framework.

6.2.1. Closer look into the Knowledge Hospitals

A knowledge hospital is operationally defined as one that integrates a knowledge management unit into its governance structure. This integration aims to empower the organization to enhance its capability to gather information and knowledge, utilizing them for effective problem-solving and decision-making (Yazdani, Bayazidi, & Mafi, 2020). This unit is specifically designed to facilitate a continuous learning cycle, ensuring the seamless transfer of both implicit and explicit knowledge. The overarching goal is to cultivate improved strategies for the future.

"Implicit learning is characterized as an unconscious process in which implicit knowledge is acquired without the conscious intent to learn something while explicit learning is assumed only if a person uses active and conscious strategies to detect rules or features of a task" (Herbig & Bussing, 2003).

In a hospital environment, both explicit and implicit knowledge play crucial roles. Explicit knowledge ensures standardized procedures and guidelines are followed, contributing to efficiency and consistency. On the meantime, implicit knowledge, rooted in the experience of healthcare professionals, allows for adaptability in complex and unpredictable situations.

6.2.1.1. Explicit Knowledge:

Starting Point: Explicit knowledge refers to knowledge that is easily codified, documented, and transferable. It is knowledge that can be articulated, written down, and shared in a formalized manner. (Nickols, 2019)

Knowledge Transfer: In the context of hospitals, explicit knowledge may involve information that is formally documented in procedures, guidelines, manuals, or protocols. This knowledge is usually structured and can be easily communicated to others through training sessions, written materials, or other formal channels.

6.2.1.2. Implicit Knowledge:

Acquired Knowledge: Implicit knowledge, on the other hand, is more experiential and less formalized. It is knowledge that is often gained through hands-on experience, observation, and practice. This type of knowledge may not be easily expressed in words or documented in a straightforward manner. (Nickols, 2019)

Continuous Learning and Improvement: Implicit knowledge in a hospital setting may include the intuitive understanding of complex patient interactions, the ability to navigate dynamic and unpredictable situations, and the tacit knowledge that comes with experience. Continuous learning and improvement in this context involve healthcare professionals refining their skills, adapting to new situations, and incorporating insights gained from their experiences into their practice.

The interaction between explicit and implicit knowledge within a hospital setting is dynamic and crucial for effective healthcare delivery and continuous improvement.

6.2.1.3. Interplay of Explicit and Implicit Knowledge:

Collaborative Decision-Making: Healthcare professionals often need to blend explicit knowledge (such as established medical protocols and guidelines) with implicit knowledge (based on their experience and judgment) when making decisions (Luchins, 2012). The collaboration between the two types of knowledge ensures that decisions are not only evidence-based but also consider the nuances of individual patient cases.

Training and Skill Development: Explicit knowledge is often the foundation of formal training programs, providing healthcare professionals with a structured understanding of medical principles. However, true expertise is developed through the application of this explicit knowledge in real-world scenarios, leading to the accumulation of implicit knowledge. The interplay between training and hands-on experience is essential for comprehensive skill development.

Contribution to Healthcare Delivery

Efficiency and Consistency: Explicit knowledge, in the form of standardized procedures and protocols, contributes to the efficiency and consistency of healthcare delivery. It ensures that

best practices are followed consistently, reducing the likelihood of errors, and improving patient outcomes.

Adaptability and Patient-Centred Care: Implicit knowledge enables healthcare professionals to adapt to the unique and often unpredictable aspects of patient care. The ability to draw on experiential insights allows for more personalized and patient-centred approaches, acknowledging that each patient may require an individualized strategy beyond standardized protocols.

Continuous Improvement

Learning from Experience: Implicit knowledge is a product of continuous learning from practical experiences. The insights gained from handling diverse cases and situations contribute to a culture of continuous improvement. Healthcare professionals can reflect on their experiences, identify areas for enhancement, and implement changes to refine their practices.

Feedback Loops: A balanced integration of explicit and implicit knowledge promotes effective feedback loops within a healthcare system. Feedback from frontline healthcare providers, informed by implicit knowledge, can be used to refine and update explicit knowledge in the form of guidelines and protocols, creating a continuous cycle of improvement.

In summary, the effective interplay and balance between explicit and implicit knowledge in a hospital setting foster a holistic approach to healthcare delivery. Explicit knowledge provides a solid foundation and standardization, while implicit knowledge allows for adaptability, individualization, and ongoing improvement. Recognizing and leveraging both types of knowledge is essential for healthcare systems aiming to deliver high-quality care in a continually evolving environment.

6.2.1.4. Knowledge Hospitals and Knowledge Management:

Knowledge hospitals are institutions that prioritize the effective management of information and expertise to enhance their overall performance and outcomes. This involves the utilization of knowledge management tools, which can include specialized software and process boards. These tools are employed to organize, share, and leverage both explicit and implicit knowledge within the hospital (Wickramasinghe, 2012).

Knowledge Management Unit:

The knowledge management unit is a dedicated team within the hospital structure responsible for overseeing the lifecycle of knowledge. The functions are the following:

Acquisition: Involves gathering relevant information and expertise from various sources, both internal and external.

Retention: Focuses on preserving valuable knowledge within the organization, ensuring it is accessible when needed.

Production: Involves the creation of new knowledge through processes like research, collaboration, and innovation.

Creating Situations for Implicit Knowledge Generation

Hospitals need to foster environments and situations that naturally lead to the generation of implicit knowledge to nurture clinical competencies of the participants while enhancing their clinical reasoning and reflective-thinking abilities (Onda, 2012). This could involve hands-on training, real-world simulations, and opportunities for professionals to share and reflect on their experiences.

To outline, a knowledge hospital implements knowledge management tools, facilitated by a dedicated knowledge management unit. This unit is responsible for acquiring, retaining, and producing knowledge. The organization actively promotes the creation of explicit knowledge through formalized processes and documents while also creating conducive situations for the generation of implicit knowledge through practical experiences and collaborative learning.

6.2.2. Closer look into the Intelligent Hospitals

A medical institution equipped with a streamlined recruitment process for acquiring intelligent personnel proficient in the development, procurement, and utilization of artificial intelligence. The institution boasts a council dedicated to deliberating on software data, contributing to informed organizational decision-making.

6.2.2.1. Human Intelligence:

Components

Classical/IQ Intelligence: The traditional cognitive abilities measured by intelligence quotient (IQ) tests, encompassing problem-solving, reasoning, and logical thinking.

Emotional Intelligence: The capacity to recognize, understand, manage, and effectively use one's own emotions and those of others for better interpersonal relationships.

Social Intelligence: The ability to navigate social situations, understand social cues, and build effective relationships with others.

Human Intelligence, with its diverse components, forms the cognitive and emotional foundation of individuals. It influences how individuals process information, interact with others, and contribute to collaborative environments.

Human Resources

Functions:

Selection: The process of identifying and evaluating candidates to fill specific roles within an organization.

Hiring: The formal recruitment and onboarding of selected individuals, ensuring a match between their skills and the organization's needs.

Human Resources serves as the bridge between an organization's needs and the pool of available talent. The selection and hiring processes are critical in bringing individuals with diverse skills and experiences into the organizational fold.

Integration of Intelligent Humans and Communities of Practice (CoPs)

Intelligent Humans: Individuals selected based on their cognitive, emotional, and social intelligence, contributing to the overall intellectual capital of the organization.

Communities of Practice (CoPs): Informal groups within the organization where individuals with shared interests, skills, and expertise collaborate and learn from one another.

Synergy: The integration of intelligent humans into the organization, coupled with the establishment of Communities of Practice, creates a synergistic environment. Intelligent individuals bring diverse perspectives and expertise, while CoPs foster knowledge sharing, collaboration, and continuous learning.

To recapitulate, Human Intelligence, comprising classical/IQ intelligence, emotional intelligence, and social intelligence, lays the foundation for the capabilities of individuals. Human Resources functions as the mechanism for selecting and hiring individuals, ensuring a strategic alignment between the organization's needs and the skills of the workforce. The integration of intelligent humans and the establishment of Communities of Practice further enhance the collective intelligence.

6.2.2.2. Artificial Intelligence:

Components

Technologies: The tools and systems that emulate intelligent behaviour, such as machine learning algorithms, natural language processing, and computer vision.

Databases: The structured repositories of data that AI systems use to learn, analyse patterns, and make informed decisions.

Liability: The ethical and legal considerations surrounding the responsible use of AI, including issues related to accountability and transparency.

Integration in Departments

Purchasing Department: Involves the selection and acquisition of AI technologies, considering factors like cost, functionality, and ethical implications.

IT Department: Manages the implementation, maintenance, and security of AI systems within the organization.

Research and Development: Engages in creating and innovating AI solutions to address specific healthcare challenges.

Integration into Clinical and Nursing Directions

Clinical Direction: Utilizing AI to enhance diagnostic capabilities, treatment planning, and personalized medicine. It involves integrating AI technologies into medical decision-making processes, optimizing patient care and outcomes.

Nursing Direction: Implementing AI to streamline administrative tasks, optimize resource allocation, and improve patient care through data-driven insights. AI can also assist in monitoring patient health and providing timely interventions.

IT Integration and Uptake

Seeking IT Integration: Ensuring that IT systems are seamlessly integrated into the healthcare infrastructure, allowing for efficient data flow and communication.

Using IT in Clinical and Nursing Practices: Enabling healthcare professionals to leverage AI tools in their daily activities, enhancing efficiency, accuracy, and the overall quality of patient care.

In conclusion, the integration of artificial intelligence into a healthcare organization involves selecting, acquiring, and developing AI technologies with considerations for ethics and liability. This integration spans across key departments, including Purchasing, IT, and Research and Development. The subsequent use of AI in clinical and nursing directions enhances medical decision-making, patient care, and overall operational efficiency within the healthcare settings.

6.2.2.3. Hybrid Intelligence

As said previously, in AI medical research, it's crucial to shift from perceiving Human and AI as competitors to embracing collaboration through the Human and AI hybrid model. This approach promises superior results, transcending the limitations of AI or Human Intelligence alone and aligning with real medical practice principles (Bellini, Badino, Maffezzoni, Bezzi, & Bignami, 2023).

Hybrid Intelligence at the Process Level

Definition: Hybrid Intelligence at the process level involves the synergistic collaboration between human and AI to optimize and improve specific operational processes.

Integration of Human and AI Capabilities: It encompasses the combined strengths of human decision-making, creativity, and adaptability with the computational power, data processing, and pattern recognition capabilities of AI. In a healthcare setting, for example, this could involve the use of AI algorithms to assist medical professionals in diagnostic processes, with human experts interpreting results and making final decisions ((Jussupow, Spohrer, Heinzl, & Gawlitza, 2021).

Hybrid Intelligence at the Organizational Level

Definition: At the organizational level, Hybrid Intelligence refers to the strategic integration of human and AI capabilities across various functions, departments, and decision-making levels within an organization (Zheng, et al., 2017). It aims to optimize workflows, enhance productivity, and drive innovation by leveraging the strengths of both human and AI resources. The organization learns from the collective intelligence of humans and AI, adapting to dynamic environments and continuously improving processes.

Benefits

Complementary Strengths: Hybrid Intelligence capitalizes on the complementary strengths of humans and AI, fostering a collaborative environment where each contributes what it does best (Ebel, Sollner, Leimeister, Crownston, & Vreede, 2021).

Efficiency and Innovation: At the process level, Hybrid Intelligence can lead to more efficient and accurate outcomes, while at the organizational level, it can drive innovation by combining creative human thinking with the analytical capabilities of AI.

Adaptability: Hybrid Intelligence allows organizations to adapt to changing circumstances, make data-driven decisions, and navigate complex challenges by drawing on the collective intelligence of both human and artificial elements.

To summarize, Hybrid Intelligence operates at both the process and organizational levels, emphasizing collaboration between human and AI capabilities. At the process level, it enhances specific operational workflows, while at the organizational level, it strategically integrates human and AI resources to optimize overall performance, foster innovation, and adapt to dynamic environments.

7. Recommendations

In the pursuit of outlining action lines for the future hospital, this research sought to uncover challenges that HCUM is likely to encounter in the coming years, thereby paving the way for proactive strategies. Following a meticulous analysis of administrator responses, several pivotal challenges have come to the forefront, each demanding strategic attention, and innovative solutions. This comprehensive assessment was facilitated by valuable insights from our literature review.

7.1. Shifting Mentalities

A paramount challenge emerges in the imperative need to instigate a mindset shift among hospital staff, which is the adoption of a KIWI mindset. Recognizing that the successful implementation of new technologies hinges on the alignment of individuals with this innovative culture, crafting strategic initiatives aimed at gradually cultivating this mindset over the next five years is deemed crucial. As said by (Gordon, Perlman, & Shukla, 2017), the creation of a cultural shift towards embracing technological advancements is pivotal for the hospital's success in the evolving healthcare landscape.

1. **Training and Awareness Programs:** Implement comprehensive training programs to educate hospital staff about the benefits and nuances of KIWI technologies. Create awareness campaigns to instil the significance of a KIWI mindset in everyday practices.
2. **Leadership Support:** Garner support from leadership to champion the cultural shift. Leaders can serve as role models, showcasing the adoption of KIWI principles in decision-making and daily operations.
3. **Incentive Structures:** Introduce incentive structures that reward and recognize individuals embracing the KIWI mindset. This can include performance bonuses, acknowledgment programs, and career advancement opportunities.

7.2. Talent Acquisition

Attracting and retaining qualified personnel, particularly data scientists and managers, poses a formidable challenge due to comparatively low salaries in Portugal. To counteract the emigration of highly qualified professionals seeking better compensation, the hospital should explore options to competitively remunerate these experts. Strategically studying and

implementing measures to enhance remuneration could prove instrumental in building a skilled and committed workforce.

1. **Salary Review and Adjustments:** Conduct a thorough review of salary structures, benchmarking them against industry standards. Consider adjusting remuneration packages for critical roles such as data scientists and managers to make them competitive.
2. **Professional Development Opportunities:** Emphasize the provision of continuous learning and development opportunities. Offering avenues for skill enhancement can make the hospital an attractive workplace for professionals seeking career growth.
3. **Partnerships with Educational Institutions:** Forge partnerships with universities and educational institutions to establish pipelines for fresh talent. Collaborative programs can incentivize students to pursue careers within the hospital

7.3. Integration of Private and Public Sectors

Unifying the private and public healthcare sectors emerges as a critical challenge and opportunity. Despite setbacks from the recent cyberattack, there is a persistent need to foster collaboration between the two sectors. The hospital should persist in its efforts to explore integration possibilities, assessing the unique challenges faced by each sector and identifying optimal solutions to establish a unified platform. Such integration promises substantial benefits for patients and healthcare at large, creating a seamless and comprehensive healthcare delivery system.

1. **Stakeholder Collaboration:** Facilitate dialogues and collaborative workshops involving key stakeholders from both private and public sectors. Encourage open discussions to understand concerns and find common ground for integration.
2. **Pilot Programs:** Initiate small-scale integration pilot programs to test feasibility and identify challenges. Learning from these pilots can inform the development of a comprehensive integration strategy.
3. **Legal and Regulatory Assessment:** Conduct a thorough analysis of legal and regulatory frameworks governing healthcare integration. Identify potential hurdles and work collaboratively with policymakers to address them.

7.4. Managerial Complexity

Addressing the inherent managerial complexity within hospitals and the broader healthcare systems of the Macaronesia regions stands as another pivotal challenge. Effectively managing this complexity is integral to harnessing the full potential of the consortium, ensuring cohesive collaboration, and streamlining management practices across diverse regions. Strategic initiatives aimed at simplifying managerial processes and fostering a harmonized approach are paramount for realizing the collective benefits envisioned by the consortium.

1. **Strategic Planning:** Develop a comprehensive strategic plan that outlines clear objectives, roles, and responsibilities across the consortium. Ensure that each region's unique characteristics are considered in the planning process.
2. **Technology Solutions:** Explore the implementation of advanced healthcare management technologies to streamline processes. This could include integrated information systems, project management tools, and communication platforms.
3. **Capacity Building:** Invest in leadership and managerial training programs to enhance the capabilities of individuals overseeing complex healthcare systems. Empower managers with the skills needed to navigate diverse regional contexts.

In charting the course for action, these identified challenges provide a roadmap for the hospital to formulate targeted strategies, fostering a resilient and forward-thinking healthcare environment.

8. Limitations and Further Research

While the inclusion of more interviews could have enriched insights and data, it's imperative to underscore that the primary objective of a qualitative study is not to achieve statistical significance, quantifiability, or generalizability. Rather, the focus is on delving into the experiences, perceptions, and behaviours of the participants and understanding the meanings associated with their narratives (Castro, 2022).

The limited awareness of the KIWI framework in Madeira posed a challenge in selecting suitable interviewees, necessitating a deliberate focus on in-depth interviews to extract maximal information from each engagement. Another noteworthy challenge stemmed from my non-expertise in the healthcare sector, despite my keen interest. With a management background rather than a medical one, I found myself delving into the nuances of healthcare operations and terminologies.

For future research, replicating this study could unveil the realization of conceptual ideas and how HCUM administrators navigated the numerous challenges encountered. Investigating the specific areas of AI implementation within the hospital and assessing whether the institution becomes specialized for certain situations while offering ambulatory or at-home services for others are intriguing avenues. As HCUM emerges as a potential pioneer of a KIWI hospital, subsequent endeavours might involve evaluating its transformation and elucidating the processes employed, providing valuable recommendations for other healthcare institutions. Future research could also delve into the dynamics of unifying the private and public sectors into a cohesive platform. Furthermore, exploring the mindset shifts among health professionals and evaluating their acceptance of the KIWI concept would be insightful for understanding the broader impact of such innovations in healthcare practices.

9. Conclusion

The primary objective of this research was to delve into how KIWI hospitals signify an evolution in the realm of smart hospitals and subsequently scrutinize their alignment with the imminent plans of HCUM, slated for completion in five years. The key findings and conclusions are as follows:

- KIWI hospitals illuminate the path for healthcare institutions, advocating the seamless integration of Knowledge, Intelligence, Wisdom, and Interoperability into their operational framework.
- The visionary plans of HCUM administrators extend beyond the new hospital, encompassing the entire Região Autónoma da Madeira with an embrace of KIWI concepts. However, the pivotal challenge lies in fostering a shift towards a KIWI mentality among stakeholders.
- Thorough analysis of interview responses substantiates that the forthcoming hospital's typology is distinctly KIWI, with meticulous consideration given to incorporating Knowledge, Intelligence, Wisdom, and Interoperability elements.
- Overcoming challenges such as mindset transformation, attracting and retaining skilled professionals, forging unity between the private and public sectors, and addressing managerial complexities within the Macaronesia region emerges as imperative for HCUM in the next five years.

Clearly, given the recent emergence of KIWI hospitals, there remains considerable scope for further exploration of these concepts. This pioneering study stands as an initial endeavour to highlight the significance of these principles in shaping the future landscape of healthcare organizations, with a specific emphasis on healthcare services in Madeira.

10. Bibliography

Koebe, P., & Bohnet-Joschko, S. (2023, April 21). The Impact of Digital Transformation on Inpatient Care: Mixed Methods Study. *JMIR Publications, 9*.

Lerzynski, G. (2021, March 14). Opening the Door for Digital Transformation in Hospitals Management's Point of View. *Future of Business and Finance. Digitalization in Healthcare*, 17-28.

Martins, H. (2021). Kiwi Hospitals: "Future-Looking" Prinicples for a Hospital Maturity Model. *International Jounral of Digital Health*.

Martins, H. (2020). Os Hospitais KIWI. *Plataforma* .

Hult, H. V., Hansson, A., Gellerstedt, M., & Svensson, L. (2019). Flipped Healthcare for better or worse. *Sage Journals* .

Fuller, T. E., Pong, D. D., Piniella, N., Pardo, M., Bessa, N., Yoon, C., . . . Dajal, A. K. (2020, April 28). Interactive Digital Health Tools to Engage Patients and Caregivers in Discharge Preparation: Implementation Study. *National Library of Medicine*.

Palanica, A., J.Docktor, M., & Fossat, Y. (2019, March 25). Using mobile virtual reality to enhance medical comprehension and satisfaction in patients and their families. *Perspectives on Medical Education, 8*(123-127).

Blaser, J. (2018, June). Challenges of Digital Medicine. *PubMed*, 712-716.

Cano, I., Tenyi, A., Vela, E., Miralles, F., & Roca, J. (2017, June). Perspectives on Big Data applications of health information. *Current Opinion in Systems Biology, 3*, 36-42.

Guntuku, S. C., Schartwz, H., Kashyap, A., S.Gaulton, J., C.Stokes, D., A.Asch, D., . . . M.Merchant, R. (2020, July). Variability in Language used on Social Media prior to Hospital Visits. *Scientific Reports*.

Tian, S., Yang, W., Grange, J. M., Wang, P., Huang, W., & Ye, Z. (2019, September). Smart healthcare: making medical care more intelligent. *Global Health Journal , 3*(3), 62-65.

Wang, Y., & Hajli, N. (2017, January). Exploring the path to big data analytics success in healthcare. *Journal of Business Research, 70*, 287-299.

Mitterecker, A., Hofmann, A., Trentino, K. M., Lloyd, A., Leahy, M. F., Schwarzbauer, K., . . . Meier, J. (2020, June 28). Machine learning-based prediction of transfusion. *PubMed*.

Reda, M., Kanga, D. B., Fatima, T., & Azouazi, M. (2020). Blockchain in health supply chain management: State of art challenges and opportunities. *Procedia Computer Scince, 175*, 706-709.

Gyrson, O. (2018, June 1). Who will kick off the digital transformation of health? *Europe PMC, 34*(6-7), 587-589.

Baslyman, M., Almoaber, B., Amyot, D., & Bouattane, E. M. (2017). Using Goals and Indicators for Activity-based Process Integration in Healthcare. *Procedia Computer Science, 113*, 318-325.

Berntsen, G., Strisland, F., Malm-Nicolaisen, K., Smaradottir, B., Fensli, R., & Rohne, M. (2019, April 22). The Evidence Base for an Ideal Care Pathway for Frail Multimorbid Elderly: Combined Scoping and Systematic Intervention Review. *JMIR Publications, 21*.

Burkoski, V., Yoon, J., Hutchinson, D., Solomon, S., & Collins, B. E. (2019, May). Experiences of Nurses Working in a Fully Digital Hospital: A Phenomenological Study. *Nursing Leadership, 32*, 73-85.

J.Dreyer, K., & Geis, J. (2017, November 20). When Machines Think: Radiology's Next Frontier. *Radiology, 285*(3).

Staib, A., Sullivan, C., Jones, M., Griffin, B., Bell, A., & Scott, I. (2016, September 4). The ED-inpatient dashboard: Uniting emergency and inpatient clinicians to improve the efficiency and quality of care for patients requiring emergency admission to hospital. *Emergency Medicine Australasia, 29*(3), 363-366.

Abitbol, J., Munir, A., How, J., Lau, S., Salvador, S., Kogan, L., . . . Gotlieb, W. H. (2020, June). The shifting trends towards a robotically-assisted surgical interface: Clinical and financial implications. *Health Policy and Technology, 9*(2), 157-165.

Mahendri Bhandari, d., Mahendra, Zeffiro, Trevor, Reddiboina, & Madhu. (2020, January). Artificial intelligence and robotic surgery current perspective and future directions. *Current Opinion in Urology, 30*(1), 48-54.

Daneshmand, M., Bilici, O., Bolotnikova, A., & Anbarjafari, G. (2017, September). Medical robots with potential applications in participatory and opportunistic remote sensing: A review. *Robotics and Auntonomous Sytems, 95*, 160-180.

Y.Zhong, R., T.Newman, S., Q.Huang, G., & Lan, S. (2016, November). Big Data for supply chain management in the service and manufacturing sectors: Challenges, Opportunities, and future perspectives. *Computers & industrial Engineering, 101*, 572-591.

Lee, D. (2018, December). Strategies for technology-driven service encounters for patient experience satisfaction in hospitals. *Technological Forecasting and Social Change, 137*, 118-127.

Brink, J. A., Arenson, R. L., Grist, T. M., Lewin, J. S., & Enzmann, D. (2017, March 9). Bits and bytes: the future of radiology lies in informatics and information technology. *European Radiology, 27*, 3647-3651.

Desai, A. N., Kraemer, M. U., Bhatia, S., Cori, A., Nouvellet, P., Herringer, M., . . . Lassmann, B. (2019, August 29). Real-time Epidemic Forecasting: Challenges and Opportunities. *Health Security, 17*(4).

Aceto, G., Persico, V., & Pescapé, A. (2020, June 18). Industry 4.0 and Health: Internet of Things, Big Data, and Cloud Computing for Healthcare 4.0. *Journal of Industrial Information Integration*.

Kelly, J. T., Campbell, K. L., Gong, E., & Scuffham, P. (2020, November 10). The Internet of Things: Impact and Implications for Health Care Delivery. *JMIR Publications, 22*(11).

Farahani, B., Barzegari, M., Aliee, F. S., & Shaik, K. A. (2020, February). Towards collaborative intelligent IoT eHealth: From device to fog, and cloud. *Microprocessor and Mycrosystems , 72*.

CH, F., K, C., & P, Z. (2019, January 1). The current situation and prospects of the application of intelligent diagnosis and treatment technology in the general surgery. *Chinese Journal of Surgery, 51*(1), 1-5.

Chen, P.-T. (2018, May). Medical big data applications: Intertwined effects and effective resource allocation strategies identified through IRA-NRM analysis. *Techonological Forecasting and Social Change, 130*, 150-164.

Deiters, W., Burmann, A., & Meister, S. (2018, September). Strategies for digitalizing the hospital of the future. *Urologe A., 57*(9), 1031-1039.

Zolbanin, H. M., Davazdahemami, B., Delen, D., & Zadeh, A. H. (2022, July). Data analytics for the sustainable use of resources in hospitals: Predicting the length of stay for patients with chronic diseases. *Information and Management, 59*(5).

Aghdam, Z. N., Rahmani, A. M., & Hosseinzadeh, M. (2021, February). The Role of the Internet of Things in Healthcare: Future Trends and Challenges Author links open overlay panel. *Computer Methods of the Internet of Things in Healthcare: Future Trends and Challenges, 199*.

Hansson, A., Svensson, L., & Gellerstedt, M. (2019, September). Flipped healthcare for better or worse. *Journal of Health Informatics, 25*(3), 587-597.

Renukappa, S., Mudiyi, P., Abdalla, S. S., & Subbarao, C. (2022, December). Evaluation of challenges for adoption of smart healthcare strategies. *Smart Health, 26*.

Gordon, R., Perlman, M., & Shukla, M. (2017). *The hospital of the future: How Digital technologies can change hospitals globally.* Deloitte Center for Health Solutions.

Anixter. (n.d.). *Smart Hospital Infrastructure Best Practices.* Global Technology Briefing.

Martins, H. (2020, December 29). Henrique Martins and the Hospital of the Future. (C. Podcast, Interviewer)

Bogdan, R., & Biklen, S. (1994). Investigação Qualitativa em Educação. *Porto Editora*, 51.

K.Alotaibi, Y., & Federico, F. (2017, December). The impact of health information technology on patient safety. *Saudi Medical Journal, 38*(12), 1173-1180.

Kwon, H., An, S., Lee, H.-Y., Cha, W. C., Kim, S., Cho, M., & Kong, H.-J. (2022, January). Review of Smart Hospital Services in Real Healthcare Environments. *Healthcare Informatics Research, 28*(1), 3-15.

Demirkan, H. (2013). A Smart Healthcare Systems Framework. *IT Professional, 15*(5), 38-45.

Boyce, C., & Neale, P. (2006, May). CONDUCTING IN-DEPTH INTERVIEWS: A Guide for Designing and Conducting In-Depth Interviews for Evaluation Input. *Pathfinder International Tool Series*, 3.

Castro, F. L. (2022, May 5). Robotics and their impact in Healthcare Workforce Management. *Católica Lisbon SBE*.

Guion, L., Diehl, D., & McDonald, D. (n.d.). Conducting an In-depth Interview. *Univeristy of Florida*.

Herbig, B., & Bussing, A. (2003). Comparison of the role of explicit and implicit knowledge in working. *Psychology Science, 45*, 165-188.

Nickols, F. (2019, May 29). The Knowledge in Knowledge Managament. *Distance Consulting LLC*, 3-4.

Luchins, D. (2012). Clinical expertise and the limits of explicit knowledge. *Perspect Biol Med., 55*(2), 283.

Wickramasinghe, N. (2012). Implicit and Explicit Knowledge Assets in Heatlhcare. *Pervasive Health Knowledge Management* , 15-26.

Onda, E. (2012). Situated Cognition: Its Relationship to Simulation in Nursing Education. *Clinical Simulation in Nursing, 8*(7), 273-380.

Ebel, P., Sollner, M., Leimeister, J. M., Crownston, K., & Vreede, G.-J. d. (2021). Hybrid Intelligence in business networks. *Electronic Markets, 31*, 313-318.

Jussupow, E., Spohrer, K., Heinzl, A., & Gawlitza, J. (2021). Augmenting Medical Diagnosis Decisions? An Investigation into Physicians' Decision-Making Process with Artificial Intelligence. *Information System Research, 32*(3), 675.

Zheng, N.-n., Liu, Z.-y., Ren, P.-j., Ma, Y.-q., Chen, S.-t., Yu, S.-y., . . . Wang, F.-y. (2017). Hybrid-augmented intelligence: collaboration and cognition. *Frontiers of Information Technology & Electronic Engineering volume , 18*, 153-179.

Madeira, G. R. (2023). Retrieved from Hospital Central e Universitário da Madeira: https://hcm.madeira.gov.pt/

Hartmann, K., Schlegel, F., & Cronenberg, A. (2023). Smart Hospitals in the UK.

(2023, September). *Smart Hospitals Market Analysis.* Coherent Market Insights. Yahoo Finance.

Harrell, M., & Bradley, M. (2009). Data Collection Methods: Semi-Structured Interview and Focus Groups. RAND National Defense Research Institute, Santa Monica. *Rand National Defense Research Inst Santa Monica*.

Alsaqqa, M. H., & Optom, B. (2020). Knowledge Management and Sharing in Hospitals: A Systematic Review. *Portal of Scientific Journals of Croatia*, 27-36.

Davenport, T., & Kalakota, R. (2019, June). The potential for artificial intelligence in healthcare. *Future Healthcare Journal , 6*(2), 94-98.

European, F. P. (2022). *European Principles For Digital Health Ethics.* France22.

Prévantion, M. d. (2022). *Accelerating semantic interoperability in Europe and France through the adoption of SNOMED—CT.* French Presidency of The Council.

Li, J., & Carayon, P. (2021). Health Care 4.0: A vision for smart and connected health care. *IISE Transactions on Healthcare Systems Engineering*, 171-180.

Yazdani, S., Bayazidi, S., & Mafi, A. A. (2020). The current understanding of knowledge management concepts: A critical review. *Medical Journal of the Islamic Republic of Iran*, 127.

Bellini, V., Badino, M., Maffezzoni, M., Bezzi, F., & Bignami, E. (2023, february 6). Evolution of Hybrid Intelligence and Its Application in Evidence-Based Medicine: A Review. *Medical Science Monitor*.

Senbekov, M., Saliev, T., Bukeyeva, Z., Almabayeva, A., Zhanaliyeva, M., Aitenova, N., . . . Fakhradiyev, I. (2020, december 3). The Recent Progress and Applications of Digital Technologies in Healthcare: A Review. *International Journal of Telemedicine and Applications*.

ENISA. (2016). *Smart Hospitals: Security and Resilience for Smart Health Service and Infrastructure.* Heraklion, Greece.

Kwon, H., An, S., Lee, H.-Y., Cha, W. C., Kim, S., Cho, M., & Kong, H.-J. (2022, january 31). Review of Smart Hospital Services in Real Healthcare Environments. *Healthcare Informatics Research*, 3-15.

Martins, H. (2021). KIWI Hospitals: "Future-Looking" Principles for a Hospital Maturity Model. *International Journal of Digital Health, 1*(1), 13.

Brito, D. (2021, may). Remote monitoring of heart failure patients: A complex proximity. *Revista Portuguesa de Cardiologia, 40*(5), 353-356.

Jones, K., Lennon, E., McCathie, K., Millar, A., Isles, C., McFadyen, A., & Shearer, H. (2022, may 25). Teledermatology to reduce face-to-face appointments in general practice during the COVID-19 pandemic: a quality improvement project. *BMJ Journals*.

OECD. (2023). *Health at a Glance 2023.*

Roncarolo, F., Boivin, A., Denis, J.-L., Hébert, R., & Lehoux, P. (2017). What do we know about the needs and challenges of health systems? A scoping review of the international literature. *BMC Health Services Research*, 636.

Priya, A. (2020, november 19). Case Study Methodology of Qualitative Research: Key Attributes and Navigating the Conundrums in Its Application. *Sage Journals, 70*(1).

Stake, R. (1995). The Art of Case Study Research. *Sage Publications*.

Crowe, S., Cresswell, K., Robertson, A., Huby, G., Avery, A., & Sheikh, A. (2011, june 27). The case study approach. *BMC Medical Research Methodology*.

Saetren, G., & Laumann, K. (2017). ORGANIZATIONAL CHANGE MANAGEMENT THEORIES AND SAFETY -A CRITICAL REVIEW. *Safety Science Monitor, 20*(1).

Todnem, R. (2005, december). Organisational Change Management: A Critical Review. *Journal of Change Managament, 5*(4), 369-380.

SESARAM. (2023). Retrieved from SESARAM: https://www.sesaram.pt/portal/o-sesaram/o-sesaram/as-nossas-unidades/hospitais/novo-hospital-central-da-madeira

Madeira, D. d. (2022, october 10). Retrieved 2023, from dnoticias.pt: https://www.dnoticias.pt/2022/10/10/331425-223-milhoes-para-o-novo-hospital-da-madeira-na-proposta-de-orcamento-do-estado/

Appendix 1 – Interviews Guideline

The provided text presents the comprehensive interview guideline, meticulously tailored to accommodate the distinct requirements of various interviews. The questions have been thoughtfully adapted to ensure relevance and effectiveness in diverse interview scenarios.

Conhecimento		
	Propósito	**Pergunta**
1.	Esta questão abrangente permite ter uma perceção inicial das ferramentas que estão a ser ponderadas implementar no Hospital.	Que Ferramentas de Apoio à Decisão Clínica estão nos planos?
2.	Esta perguntas ajuda a ter uma melhor perceção sobre as capacidades dos RES/RMS, tal como, verificações de interações medicamentosas, conjuntos de pedidos e diretrizes clínicas.	Que funcionalidades específicas de apoio à decisão clínica têm em perspetiva integrar no Registo Eletrónico de Saúde?
3.	Perceber as perceções relativamente à Robotização e o nível de investimento que está planeado nesta área.	De que forma olham para a Robotização no Hospital e qual o plano de investimento nesta área?
4.	Esta questão ajuda a perceber a extensão da estruturação dos serviços clínicos compreendidos no hospital.	Têm planeado alguma estruturação de serviços clínicos para diversos procedimentos e condições médicas?

Inteligência		
	Propósito	**Pergunta**
5.	Determinar se o Hospital planeia usar Inteligência Artificial.	Está nos planos utilizar Inteligência Artificial em procedimentos médicos, tal como, cirurgia robótica, imagiologia médica, ou análise genómica?
6.	Entender se a Inteligência Artificial será usada na gestão hospitalar.	Que papel pode desenvolver a Inteligência Artificial na simplificação de processos administrativos e operacionais?
7.	Perceber se os profissionais de saúde estão preparados para usar inteligência Artificial nas suas práticas.	Que processos de educação, treino e certificação é que os profissionais de saúde serão submetidos para trabalhar com ferramentas de Inteligência Artificial?
8.	Perceber o grau de envolvimento dos colaboradores nas iniciativas de IA.	Como tencionam envolver os profissionais de saúde, incluindo, médicos, enfermeiros e administradores, nos processos de tomada de decisão no que toca à adoção e integração de IA?
9.	Inquirir sobre as estratégias a adotar quando houver resistência por parte dos colaboradores.	Como tencionam lidar em casos de resistência e aversão à adoção e integração de IA?
Sabedoria		
	Propósito	**Pergunta**
10.	Explorar a abordagem do hospital no uso ético das ferramentas digitais.	Como tencionam garantir que as tecnologias digitais são usadas de forma ética e responsável nos cuidados do paciente e na tomada de decisão?

11.	Perceber a estrutura para governança e supervisão.	Têm em mente algum comité ou departamento responsável pela supervisão da ética digital e segurança de dados?

Interoperabilidade		
	Propósito	**Pergunta**
12.	Entender o processo de troca de dados e integração.	De que forma está planeado gerir os dados entre diferentes departamentos, sistemas clínicos e registos eletrónicos médicos?
13.	Entender qual a abordagem do hospital aos cuidados baseados em equipas.	Têm em mente estabelecer equipas interprofissionais ou equipas de cuidados que colaborem entre si de modo a proporcionar um serviço integral aos pacientes?
14.	Inquirir sobre as colaborações inter-organizacionais. Centros Virtuais de Competência são hubs centralizados de experiência e conhecimento que operam num ambiente virtual ou online. Estes centros reúnem profissionais, recursos e informações para abordar desafios específicos ou áreas de especialização. No contexto da saúde, um Centro Virtual de Competência pode focar-se numa especialidade médica específica, tecnologia ou área de pesquisa.	O Hospital tem em vista a colaboração com organizações de modo a criar Centros de Competências Virtuais que promovam a partilha de conhecimentos, pesquisas e educação?