Smart governance and digital logistics in Moroccan public health: accelerating the transition toward smart cities

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Abstract

Objectives The study aims to explore how the digitalization of hospital logistics contributes to the development of smart governance within Morocco's public health system. It seeks to understand the extent to which digital transformation enhances the performance, transparency, and resilience of hospital supply chains, thereby supporting the broader transition toward smart cities. This research is important because it addresses a critical intersection between healthcare performance, digital governance, and sustainable urban development, areas currently prioritised in Morocco's health and digital reforms, **Prior work** The paper builds upon recent studies on smart governance, healthcare digitalization, and logistics performance. These studies underline the role of digital infrastructures and data-driven management in improving service delivery and institutional coordination. However, few have examined how these dynamics unfold in developing country contexts, particularly in North Africa, where institutional reforms and digital transitions coexist, **Approach** A qualitative exploratory approach was employed, combining documentary analysis of official reports, strategic frameworks, and legislative documents—such as Morocco's Framework Law 06-22 and Digital Morocco 2030 strategy—with semi-structured interviews conducted among logistics managers, biomedical engineers, and administrative officers in public hospitals within the Casablanca-Settat region, **Results** The findings show that digitalization through integrated systems, such as ERP, WMS, IoT, and AI-based tools, significantly improves traceability, interdepartmental coordination, and supply chain responsiveness. Nonetheless, persistent challenges remain, notably insufficient digital competencies among staff, technological fragmentation, and the absence of coherent data governance mechanisms, which hinder the full potential of

digital transformation, **Implications** The results hold implications for policymakers, practitioners, and academics concerned with public sector performance and smart city development. Strengthening governance frameworks, investing in digital literacy, and ensuring interoperability among hospital information systems are essential for achieving sustainable digital transformation in healthcare logistics and **Value** The originality of this research lies in its integrative perspective linking digitalization, governance, and logistical performance within Morocco's health sector. It provides empirical insights into how digital logistics can serve as a lever for smart governance, offering a conceptual and practical contribution to the evolving discourse on smart, resilient, and citizen-centered health systems in emerging economies.

Keywords: smart governance; digital logistics; public health; morocco; smart cities.

1. Introduction

Over the past decade, the rapid expansion of digital technologies has profoundly reshaped public sector management, particularly within the fields of healthcare and urban governance. As governments strive to enhance institutional performance and the quality of public services, the digitalization of strategic functions, such as hospital logistics, has emerged as a key lever for strengthening smart governance [1] [2]. This shift aligns with a broader global transition toward smart cities, characterised by integrated digital infrastructures, increased connectivity, and data-driven decision-making processes [3] [4]. Within this paradigm, logistics, long regarded as a technical or operational function,takes on strategic significance, contributing to transparency, operational efficiency, and the resilience of public systems, especially in the healthcare sector [5] [6].

In emerging economies, integrating digital logistics into governance mechanisms represents both an opportunity and a challenge. Recent scholarship highlights that digital transformation enhances traceability, optimises coordination among stakeholders, and reinforces institutional accountability through real-time monitoring tools and interoperable information systems [7] [8]. However, while these findings are well documented in high-income countries, the dynamics of digital governance in developing contexts, particularly in North Africa, remain understudied [9] [10] [11]. Moreover, research on smart hospitals indicates that digital health innovations, such as the Internet of Things (IoT), artificial intelligence (AI), and integrated information systems, significantly enhance continuity of care and supply chain performance when supported by robust governance frameworks [12] [13]. The success of such initiatives nonetheless depends on the availability of digital competencies, regulatory clarity, and the interoperability of hospital information systems [14] [15].

In Morocco, digital transformation has become a cornerstone of ongoing public sector reforms. National strategies such as Morocco Digital 2030, the New Development Model (NMD) [16], and Framework Law 06-22 [17] governing the national health system emphasize the modernisation of public services and the transition toward smarter, data-driven governance. The establishment of the Territorial Health Groupings (THG) represents a major institutional innovation intended to strengthen multi-level coordination and improve the efficiency of public hospitals [18]. In this context, several recent studies underline the growing importance of digital tools in hospital and pharmaceutical supply chains, particularly in enhancing stock visibility, streamlining procurement processes, and improving service quality delivered to citizens [19] [20]. These developments position

Morocco as a relevant and fertile context for examining how digital logistics can act as a catalyst for smart governance and, more broadly, support the transition toward smart cities.

Nevertheless, significant challenges persist. Fragmented information systems, disparities in digital competencies among healthcare personnel, and the absence of robust data governance mechanisms continue to limit the full potential of digital transformation [21]. Moreover, although several smart city initiatives have been launched across major Moroccan urban centres, the effective integration of digital hospital logistics within these initiatives remains insufficiently addressed in academic research [22]. This gap underscores the need for empirical investigations capable of capturing the interplay between digital technologies, logistical performance, and governance mechanisms within the Moroccan public health sector.

It is within this context that the present study is situated. It seeks to analyse how the digitalization of hospital logistics contributes to the emergence of smart governance within Morocco's public health system. By mobilising national strategies, legislative frameworks, and operational practices observed in public hospitals, the study highlights the mechanisms through which digital logistics enhances transparency, interdepartmental coordination, and operational responsiveness, three foundational dimensions of smart governance [23]. The growing integration of systems such as ERP, WMS, IoT, and AI-based tools therefore opens promising avenues not only for improving logistical performance but also for fostering more coherent, inclusive, and data-oriented decision-making processes [24].

Accordingly, a central research question guides this work: To what extent can the digitalization of hospital logistics serve as a structuring lever for strengthening smart governance within Morocco's public health system and, consequently, accelerate the transition toward smart cities?

To address this question, the study adopts a qualitative exploratory approach based on a dual data collection strategy. It first relies on a comprehensive documentary analysis of legislative texts, institutional reports, and strategic frameworks underpinning Morocco's digital transformation in the health sector. It then draws on fifteen semi-structured interviews conducted with healthcare professionals working in public hospitals in the Casablanca-Settat region. The collected data were analysed using a thematic approach supported by NVivo software, enabling the identification of organisational mechanisms, technological levers, and institutional constraints that shape the contribution of digital logistics to smart governance.

By situating the Moroccan experience within the broader international debate on smart cities and the digital transformation of public services, this article offers an integrated perspective that links digitalization, governance, and logistical performance in the health sector. Such a perspective is essential for understanding how health system reforms can foster the emergence of resilient, inclusive, and sustainable smart cities, particularly in contexts facing simultaneous institutional and technological transitions. The empirical insights generated by this research are therefore intended to inform policymakers,

practitioners, and scholars committed to building smarter, more responsive, and citizen-centred health systems in Morocco and other emerging economies.

2. Literature review

The scholarly literature addressing digital transformation in the public sector and the evolution of healthcare logistics has expanded considerably in recent years, reflecting the profound restructuring effects of emerging technologies on institutional functioning and governance processes. A critical issue now lies in understanding how digital infrastructures reconfigure coordination mechanisms, strengthen the operational performance of supply chains, and contribute to the development of smarter and more resilient health systems—particularly within emerging economies engaged in ambitious structural reforms. Accordingly, this literature review synthesises the principal theoretical contributions related to smart governance, public-sector digitalization, and digital supply chain management, while situating these frameworks within the specific dynamics of Morocco's health system. This analytical foundation enables a deeper examination of the strategic role played by digital hospital logistics in enhancing transparency, inter-organisational coherence, and overall system performance, which collectively constitute essential conditions for accelerating the transition toward smart cities.

2.1. Theoretical framework

The analysis of how the digitalization of hospital logistics contributes to smart governance draws on a set of complementary theories that together capture the technological, organisational, institutional, and human dimensions involved. The main theoretical lenses mobilised include smart governance theory, dynamic capabilities theory, contingency theory, stakeholder theory, and integrated supply chain management theory. Their combined use provides a holistic understanding of the digital transformation process within the Moroccan health system.

Smart governance theory serves as a central analytical framework for understanding how public administrations mobilise digital technologies to enhance transparency, efficiency and citizen participation. Scholl and Scholl (2014) [25] conceptualise smart governance as a decision-making model rooted in interoperable information systems, open data and multi-actor coordination. In the health sector, this perspective helps illuminate how digital infrastructures—such as hospital information systems, logistics traceability platforms or decision dashboards—support more proactive, anticipatory and user-centred governance [2]. In the Moroccan context, the establishment of the Territorial Health Groups (THG) reflects an institutional translation of this logic, as they aim to reinforce regional health governance through data integration, harmonisation of practices and improved interprofessional coordination [26]. Smart governance theory therefore helps identify how logistical digitalization modernises decision-making processes, facilitates information flows and strengthens transparency across hospital supply chains [27].

Dynamic capabilities theory, developed by Teece (2007) [28], posits that high-performing organisations are those capable of sensing technological opportunities, seizing them and reconfiguring internal resources to adapt to change. Applied to the health sector, this framework sheds light on how hospitals mobilise technical, managerial and digital

competencies to effectively integrate tools such as ERP systems, WMS platforms, Internet of Things (IoT) devices or predictive algorithms. Recent studies show that digitalising logistics requires continuous organisational learning, process reengineering and advanced digital competencies to ensure coherent information flows and reliable data [5] [29]. In Morocco, adaptive capacity is particularly crucial given the fragmentation of hospital information systems (HIS), disparities in digital competencies and institutional challenges associated with the implementation of the national health reform [19] [15].

Contingency theory [30] highlights that organisational performance is maximised when structures, tools and processes are aligned with environmental demands. This framework is particularly relevant for analysing digitalised logistics, which depends heavily on technological infrastructures, regulatory frameworks, human capacities and governance practices. In Morocco, several contingencies shape the effectiveness of digital systems: the progressive implementation of Framework Law 06-22; public investments linked to Digital Morocco 2030; advanced regionalisation and the creation of THG; budgetary constraints; and the pressing need to modernise public hospitals. As emphasised by Novaes (2021) [21] and Labus et al. (2022) [13], system interoperability, digital maturity and infrastructure robustness are key conditions for hospitals to fully exploit digital technologies.

Stakeholder theory [31] offers an essential framework for understanding the complexity of hospital supply chains, which involve a multiplicity of actors: logistics managers, biomedical engineers, pharmacists, IT specialists, administrative staff, suppliers, public authorities and patients. In a digitalised environment, effective coordination among these actors becomes crucial to ensuring fluid and reliable information flows. Research on smart cities and digital governance also underscores the importance of greater collaboration between public institutions, private organisations and citizens for the successful implementation of technological initiatives [8] [9]. In Morocco, THG embody this multi-stakeholder approach by promoting the harmonisation of practices and the integrated management of hospital supply chains [18].

Integrated supply chain management theory focuses on the synchronised coordination of physical, informational and financial flows to improve overall system performance [32]. Technological advancements—such as IoT sensors, RFID, WMS platforms, integrated ERP systems and artificial intelligence—now enable greater visibility, finer traceability and continuous optimisation of resources [24]. In the hospital sector, this theory is particularly relevant as it explains how digitalization reduces stock-outs, improves demand forecasting, decreases human error, enhances coordination across clinical and administrative services and strengthens supply chain resilience. Evidence from Khouna et al. (2025) [19] clearly demonstrates that digitalization enhances the visibility of pharmaceutical flows in Morocco, while international studies confirm that digital integration is a key driver of performance and governance in smart hospitals [12] [23].

Table 1. Example of a table

Theory	Key principles	Contribution to the study	References
Smart Governance Theory	Strategic use of ICT in the public sector; Interoperable information systems; Transparency, participation and multi-actor coordination; Data-driven decision-making	Explains how digital technologies support more transparent, integrated and efficient hospital governance	Scholl & Scholl (2014); Meijer & Bolívar (2016); Kraus et al. (2021); Baalla & Jellouli (2025)
Dynamic Capabilities Theory	Ability to sense, seize and reconfigure resources; Adaptation to technological change; Development of digital competencies	Shows how hospitals adapt to logistics digitalization through capability development, organisational learning and process reconfiguration	Teece (2007); Ivanov & Dolgui (2020); Iyawa (2021); Khouna, El Bouazzaouy & Amri (2025)
Contingency Theory	Fit between organisational structure and environment; Importance of technological and institutional context; Influence of local contingencies	Helps explain why logistics digitalization succeeds differently across hospitals depending on infrastructures, digital maturity and regulatory environment	Donaldson (2001); Novaes (2021); Labus et al. (2022); Jardini, El Kyal & Amri (2016)
Stakeholder Theory	Coordination and management of multiple actors; Information sharing and accountability; Engagement of professionals and institutions	Highlights the complexity of hospital supply chains and the need for strengthened interprofessional coordination	Freeman (1984); Portal & Fabrègue (2022); Basu (2025); Baalla & Jellouli (2025)
Integrated Supply Chain Management Theory	Synchronisation of physical and information flows; Traceability, visibility, predictability; Process optimisation through digital tools	Shows how digital technologies improve logistics performance, reduce stock-outs and strengthen supply chain resilience	Christopher (2016); Carroll & Richardson (2019); Khouna et al. (2025); Božić (2020); Langa & Thakhathi (2022)

Source: Authors' elaboration

The combined mobilisation of these theories makes it possible to understand how logistics digitalization influences smart governance through organisational, institutional and technological mechanisms. These theoretical foundations underpin the conceptual framework, which articulates the relationships between logistics digitalization, logistics performance and smart governance within the context of the Moroccan health system.

2.2. Conceptual framework

The combined mobilisation of these theories makes it possible to understand how logistics digitalization influences smart governance through organisational, institutional and technological mechanisms. These theoretical foundations underpin the conceptual framework, which articulates the relationships between logistics digitalization, logistics performance and smart governance within the context of the Moroccan health system.

The proposed conceptual framework seeks to articulate the key mechanisms through which the digitalization of hospital logistics contributes to strengthening smart governance within the Moroccan health system. It builds on the insights derived from the theoretical

framework presented earlier, as well as on the institutional specificities of Morocco's health reform, notably the creation of the Territorial Health Groups (THG) and the national shift toward data-driven public governance. Three central conceptual dimensions structure this framework: the digitalization of hospital logistics, logistics performance, and smart governance—each shaped by a set of institutional, technological, and human factors. This perspective aligns with the broader smart city literature, which emphasises the role of digital infrastructures in enhancing transparency, citizen participation, and institutional coherence [33].

Hospital logistics refers to the set of activities involved in planning, coordinating, procuring, storing, distributing, and tracking the flows of products, equipment, information, and services required for the functioning of a healthcare facility. It encompasses the management of medicines, medical devices, consumables, biomedical equipment, as well as patient flows, documents, and data [20]. According to Landry and Beaulieu (2010) [34]and Tiwari, Wee & Daryanto (2018) [6], hospital logistics is a major determinant of overall hospital performance, as it directly influences continuity of care, patient safety, resource availability, and operational efficiency. In emerging economies, this function also plays a strategic role in system resilience and crisis management.

Logistics digitalization refers to the integration of digital technologies into procurement, storage, distribution, and product traceability processes in healthcare settings. It relies on a wide range of tools such as hospital ERP systems, WMS platforms, IoT devices, RFID solutions, pharmaceutical management platforms, stock optimisation systems, decision dashboards, and artificial intelligence technologies for demand forecasting [24]. This digital transformation reshapes hospital supply chains by automating sensitive operations, reducing human error, improving product traceability, and enabling real-time information flow across departments [13]. These technologies are consistent with the analyses of Vrabie (2022) [35], who highlights the growing role of artificial intelligence in modernizing public organizations and advancing the development of smart cities. It thus serves as a key lever for enhancing transparency, predictability, and responsiveness within healthcare institutions.

In Moroccan hospitals, logistics digitalization has emerged as a strategic priority to address persistent dysfunctions such as limited stock visibility, fragmented hospital information systems, procurement delays, and shortages of essential products [19] [14]. The gradual introduction of digital solutions—including e-procurement platforms, pharmaceutical information systems, traceability tools, and connected biomedical equipment—paves the way for more integrated, coordinated, and data-driven management. As such, logistics digitalization is not merely a technological upgrade; it represents a structural transformation that reshapes professional practices, strengthens interdepartmental coordination, and supports the emergence of more intelligent and effective governance mechanisms aligned with Morocco's health reform agenda.

Logistics performance constitutes an essential intermediate dimension linking digitalization to smart governance. It refers to the system's ability to ensure continuous availability of health products, reduce procurement lead times, optimise stock levels, and

improve service quality delivered to patients [32] [5]. Digital technologies significantly enhance logistics performance by reducing human error, automating information flows, enabling continuous product traceability, improving coordination among administrative, pharmaceutical, and clinical departments, and reinforcing demand predictability through data analytics [13]. In the Moroccan context, strengthening logistics performance lies at the heart of current reforms, particularly to address challenges of territorial equity, resource optimisation, and public hospital modernisation [26].

Smart governance represents the ultimate outcome of the conceptual model. It is characterised by data-driven decision-making, reinforced inter-institutional coordination, enhanced transparency, and improved public service orientation toward citizen needs [25] [2]. In hospitals, smart governance materialises through faster and better-informed decision processes, coherent and interoperable information systems, more efficient management practices, heightened responsiveness to health crises, and patient-centred governance. In Morocco, smart governance is closely linked to the rise of THGs, which aim to establish harmonised regional coordination based on data sharing, fluid information flows, and digital supervision of public health facilities [27] [9].

The relationship between logistics digitalization and smart governance is influenced by several transversal factors: digital competencies among staff, which determine the capacity to effectively use and adapt to technological innovations [21]; the interoperability and maturity of information systems, since the benefits of digitalization can only be fully realised through integrated, reliable, and coherent hospital information systems [13]; the institutional and regulatory framework—particularly Framework Law 06-22 [17]—which shapes governance practices and conditions technology adoption [26]; and organisational and managerial capabilities (adaptability, digital leadership, innovation culture), which facilitate the uptake of advanced technological solutions [28]. These factors modulate the intensity, direction, and mechanisms through which logistics digitalization contributes to smart governance.

Table 2. Key concepts

Key Concepts	Definitions	Main Dimensions	Key References
Hospital Logistics	All activities involved in planning, procuring, storing, distributing, and monitoring the flow of products, equipment, information, and services necessary for hospital functioning.	Procurement, Storage, Distribution, Traceability, Information flows, Interdepartmental coordination.	Landry & Beaulieu (2010); Tiwari et al. (2018); Khouna et al. (2025)
Digitalization of Hospital Logistics	Integration of digital technologies into hospital logistics processes to improve traceability, coordination, and operational efficiency.	ERP, WMS, IoT, RFID, E-procurement, Dashboards, Predictive AI, Integrated HIS.	Carroll & Richardson (2019); Labus et al. (2022); Khouna et al. (2025); Vrabie (2022)
Hospital Logistics Performance	The system's ability to ensure continuous availability of health products, optimise inventory levels, reduce procurement lead times, and improve service quality.	Availability, Reliability, Speed, Cost efficiency, Traceability, Coordination, Predictability.	Christopher (2016); Ivanov & Dolgui (2020); Labus et al. (2022)
Smart Governance	A governance model based on data-driven decision-making, transparency, participation, multi-actor coordination, and intensive use of digital technologies.	Interoperability, Open data, Participation, Coordination, Data-driven decision-making.	Scholl & Scholl (2014); Meijer & Bolívar (2016); Kraus et al. (2021); Baltac (2019)
Moroccan Institutional Framework	Set of reforms aimed at modernising the health system and digitalising public sector practices.	Framework law, Health decentralisation, THGs, National digital strategies.	Baalla & Jellouli (2025); Hachimi & Cherkaoui (2023)
Digital Competencies of Health Personnel	Knowledge, skills, and attitudes required to effectively use digital technologies in logistics processes.	Training, Technical abilities, Digital culture, Adaptability.	Novaes (2021); Iyawa (2021)
Interoperability and Maturity of Information Systems	Degree of integration, consistency, and reliability of hospital information systems (HIS).	System integration, Reliability, Standardisation, Data management.	Labus et al. (2022); Carroll & Richardson (2019)
Organisational and Managerial Capabilities	Capacities for adaptation, process reengineering, digital leadership, and innovation.	Leadership, Adaptability, Innovation culture, Process reengineering.	Teece (2007); Ivanov & Dolgui (2020)

Source: Authors' elaboration

3. Materials and methods

The methodology adopted in this study is based on an exploratory qualitative approach, which is particularly suitable for analysing complex, emerging, and insufficiently documented phenomena such as the digitalization of hospital logistics and its interactions with smart governance in the Moroccan context.

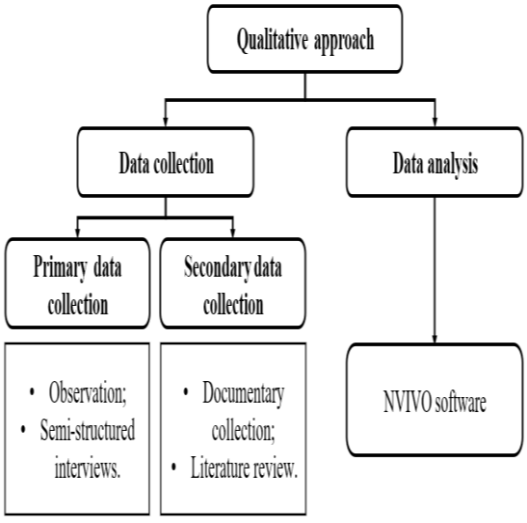

Fig. 1. Qualitative methodological framework of the study.
Source: Authors' elaboration

As noted by Creswell (2014) [36] and Yin (2018) [37], qualitative inquiry is especially useful for understanding processes, perceptions, and organisational dynamics in transforming environments, particularly when the aim is to explore a phenomenon that remains theoretically and empirically unsettled. This approach makes it possible to capture in depth the representations of actors, logistical practices, coordination mechanisms, and institutional logics that characterise healthcare facilities engaged in digital transformation. It also offers a relevant analytical framework for examining the interactions between technology, organisation, and governance [38], while accounting for the institutional specificities of Morocco's health reform, notably the implementation of Framework Law 06-22 and the establishment of Territorial Health Groups (THG).

The study was conducted in public hospital institutions located in the Casablanca–Settat region of Morocco, which is considered one of the country's most dynamic territories in terms of digital transformation and health system modernization. This choice is justified by several structural, institutional, and technological factors. First, the region hosts a dense and diverse hospital ecosystem, including regional hospital centers, provincial hospitals, and various specialized health facilities, allowing for the observation of multiple logistical and organizational configurations.

Moreover, although the pilot phase of the Territorial Health Groups (THG) was launched in the Tanger–Tétouan–Al Hoceïma region, Casablanca–Settat plays a strategic role in the national health reform due to its high demographic pressure, the complexity of its care flows, and its importance within the national hospital service offer.

In addition, Casablanca is one of Morocco's leading urban laboratories for territorial digital transformation through the Casablanca Smart City program, initiated by the city and Casa Events & Animation. This program aims to develop digital infrastructures, urban management platforms, dematerialized public services, and intelligent decision-support

systems. These initiatives position Casablanca among the most advanced Moroccan cities in terms of smart governance and public service modernization [39]. The smart city environment therefore provides fertile ground for experimenting with digital health solutions, reinforcing the relevance of focusing the fieldwork on hospital logistics digitalization.

Furthermore, the region has experienced a notable intensification of hospital digitalization projects, including the progressive deployment of hospital information systems (HIS), the introduction of logistical ERP systems, pharmaceutical traceability platforms, IoT tools for biomedical maintenance, and regional dashboards for flow management. This dynamic makes it possible to examine varying levels of digital maturity and to analyse differences across institutions.

Finally, the coexistence of urban, peri-urban, and semi-rural hospitals within the region offers significant institutional and organizational diversity. This heterogeneity represents a major asset for understanding the practices, constraints, and differentiated trajectories of digital transformation within Moroccan public health institutions.

In light of these contextual elements, it becomes essential to structure the analysis around a research model that clarifies the relationships between the different dimensions under study. This model aims to operationalise the conceptual links established in the literature review by articulating the digitalization of hospital logistics, logistics performance, and smart governance. It also integrates the institutional, technological, and human factors identified as influential variables in the Moroccan context. Presenting this conceptual model thus provides a solid interpretative framework to guide the collection and analysis of qualitative data, while making explicit the research propositions that underpin the empirical investigation.

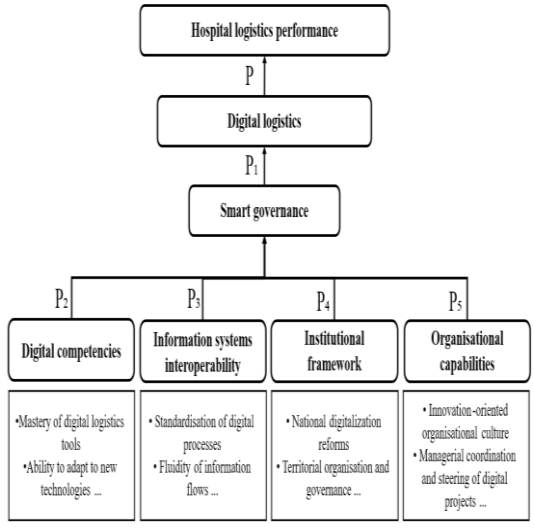

Fig. 2. Proposed research model for analysing the contribution of logistics digitalization to smart governance in Moroccan public hospitals.
Source: Authors' elaboration

Based on this conceptual framework, it becomes possible to operationalise the theoretical relationships identified in the literature review and to structure the empirical analysis around clearly formulated propositions. The model highlights the central articulation between hospital logistics digitalization, logistics performance, and smart governance, while integrating a set of explanatory variables—institutional, technological, and organisational—likely to influence or moderate these relationships. To translate these theoretical links into analytical orientations, it is necessary to formulate research propositions that will guide the interpretation of qualitative data and the analysis of the mechanisms observed in the field. The following propositions are directly aligned with the logic of the proposed model and constitute the analytical foundation of the study:

P. The digitalization of hospital logistics positively contributes to the logistics performance of public healthcare institutions in Morocco;

P_1. Smart governance plays a mediating role in the relationship between logistics digitalization and hospital logistics performance;

P_2. The level of digital competencies among healthcare personnel influences the effectiveness of logistics digitalization in strengthening smart governance;

P_3. The interoperability and maturity of information systems enhance the contribution of logistics digitalization to smart governance;

P_4. The institutional framework positively moderates the relationship between logistics digitalisation and smart governance;

P_5. Organisational and managerial capacities shape the extent to which logistics digitalization contributes to smart governance.

3.1. Data collection

Data collection relied on a qualitative strategy combining semi-structured interviews and document analysis, in line with the recommendations of Kvale and Brinkmann (2015) [40], who emphasise the relevance of interviewing for exploring complex organisational phenomena through the perspectives of key actors. Semi-structured interviews were selected because they provide both a coherent structure aligned with the research model and the flexibility needed for participants to elaborate freely on their experiences and perceptions.

The interview guide was developed based on the main dimensions of the conceptual model: hospital logistics digitalization, logistics performance, smart governance, digital competencies of personnel, interoperability and maturity of information systems, institutional framework, and organisational and managerial capabilities. This structure ensured consistency between the theoretical framework, the empirical field, and the issues explored, while allowing health professionals to address the specificities of their working environments.

A purposive sampling strategy was adopted to select health professionals and hospital managers occupying key roles in logistics processes and digital transformation initiatives. The final sample included logistics managers, hospital pharmacists, biomedical engineers, hospital information system managers, administrative officers, department heads, and representatives of provincial health authorities. This diversity of profiles reflects the

plurality of logistical configurations found in Moroccan public hospitals and allowed for a refined understanding of operational, technological, and institutional dynamics.

Table 3. Profile and distribution of interview participants

Interview Code	Position	Institution	Duration of the interview
INT-01	Logistics Manager	Regional Hospital Centre	35 min
INT-02	Hospital Pharmacist	Provincial Hospital Centre	40 min
INT-03	Biomedical Engineer	Regional Hospital Centre	32 min
INT-04	HIS Manager	Regional Hospital Centre	38 min
INT-05	Administrative Officer	Provincial Hospital Centre	28 min
INT-06	Department Head	Provincial Hospital Centre	45 min
INT-07	Logistics Manager	Provincial Hospital Centre	33 min
INT-08	Hospital Pharmacist	Provincial Hospital Centre	41 min
INT-09	Biomedical Engineer	Provincial Hospital Centre	29 min
INT-10	HIS Manager	Provincial Hospital Centre	36 min
INT-11	Administrative Officer	Provincial Health Delegation	27 min
INT-12	Pharmacist	Provincial Health Delegation	39 min
INT-13	Pharmacist	Provincial Hospital Centre	31 min
INT-14	Logistics Manager	Provincial Hospital Centre	34 min
INT-15	Chief Physician	Provincial Hospital Centre	42 min
INT-16	Biomedical Officer	Provincial Hospital Centre	30 min
INT-17	Administrative Manager	Provincial Health Delegation	26 min
INT-18	Head Nurse	Provincial Hospital Centre	33 min
INT-19	Chief Physician	Provincial Health Delegation	40 min
INT-20	Head Nurse	Provincial Hospital Centre	28 min

Source: Authors' elaboration

A total of 20 semi-structured interviews were conducted, a sample size consistent with Creswell (2014) [41] and Guest, Namey and Chen (2020) [42], who indicate that 15–25 interviews are generally sufficient to reach data saturation in exploratory qualitative research. Interviews were conducted either face-to-face or online depending on participants' availability and lasted between 35 and 60 minutes. With informed consent, all interviews were audio-recorded and fully transcribed to ensure rigorous data processing. Strict confidentiality and anonymity measures were applied in accordance

with qualitative research ethics [43]. Participants' identities and the names of the institutions were anonymised during transcription and analysis.

In addition to interviews, a corpus of institutional documents was collected, including national digitalization roadmaps, Ministry of Health circulars related to the national health reform and the establishment of Territorial Health Groups (THG), internal reports on hospital information systems, technical documentation on traceability platforms, and regional digital governance reports. As Bowen (2009) [44] highlights, document analysis strengthens methodological triangulation and provides essential contextual depth for understanding the Moroccan fieldwork.

3.2. Data analysis

Data analysis was carried out following a rigorous qualitative approach based on the thematic analysis process developed by Braun and Clarke (2006) [45]. This method provides a structured framework for identifying, organising, and interpreting recurring patterns within the interview data, while enabling an in-depth understanding of the logistical, organisational, and institutional dynamics associated with digitalization in Moroccan public hospitals.

All interviews were first fully transcribed to ensure a reliable textual corpus. An initial phase of familiarisation allowed immersion in the material and the identification of preliminary impressions and recurrent discursive patterns. An open coding stage was then conducted using a combined inductive and deductive logic: inductive, to allow themes emerging from the realities of the Moroccan field to surface; and deductive, to ensure coherence with the dimensions of the conceptual model (hospital logistics digitalization, logistics performance, smart governance, digital skills, information system interoperability, institutional framework, and organisational capabilities).

Codes were subsequently grouped into thematic categories through axial coding, enabling the examination of relationships between concepts, mechanisms, and perceptions expressed by participants. This step helped establish links between empirical findings and the research propositions, highlighting the organisational and institutional mechanisms through which logistics digitalization influences performance and governance processes.

To strengthen analytical robustness, a systematic triangulation was performed across three sources: interview data, institutional documents (HIS reports, ministerial circulars, national digitalization roadmaps), and theoretical concepts. This triangulation, in line with Patton's (2015) [46] recommendations, enhanced the coherence of the emerging themes, reduced interpretative bias, and enriched the contextual understanding of the Moroccan healthcare environment.

The analysis process was supported by the qualitative data analysis software NVivo, which facilitated corpus management, coding organisation, thematic indexing, and the visualisation of relationships between categories.

Finally, the interpretation of results followed an iterative and reflexive approach, alternating between returning to the field notes, re-reading the transcripts, and adjusting the thematic categories, in accordance with the qualitative research principles outlined by Denzin and Lincoln (2018) [38]. This reflexive stance ensured an analysis that remained coherent, context-sensitive, and faithful to the experiences shared by healthcare professionals.

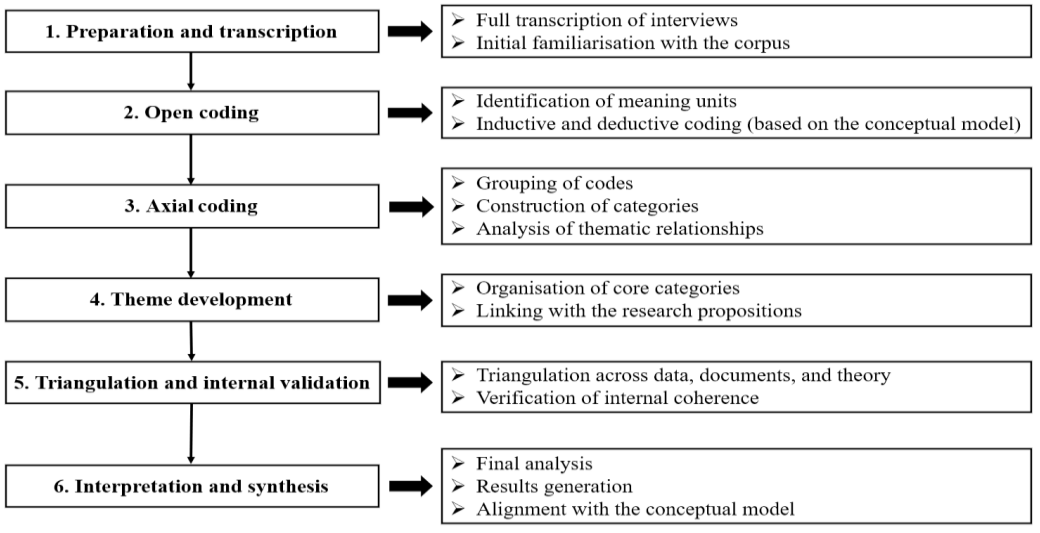

Fig. 3. Thematic analysis process adopted in the study.
Source: Authors' elaboration

4. Findings and discussion

The results presented in this section stem from the thematic analysis of the interview corpus and institutional documents collected from public healthcare facilities in the Casablanca–Settat region. The aim is to shed light on the organisational, technological, and institutional dynamics that shape the digitalization of hospital logistics and its articulation with smart governance. The analysis revealed several central themes that reflect both the progress achieved, the persistent challenges, and the mechanisms specific to the Moroccan context. The first subsection provides a structured synthesis of these empirical findings, while the second discusses them in relation to the conceptual model and the theoretical frameworks mobilised, in order to highlight their conceptual and managerial implications. This dual structure ensures an integrated reading of the results and clarifies how logistics digitalization contributes to performance and to the transformation of hospital governance in Morocco.

4.1. General presentation of the findings

The thematic analysis conducted across the twenty interviews with healthcare professionals in the Casablanca–Settat region reveals a set of converging dynamics that shape the digitalization of hospital logistics and its articulation with the principles of smart governance. To complement this qualitative analysis, a visual figure was generated in the form of a word cloud based on the coded verbatim.

Fig. 4. Word cloud.
Source: Result of data analysis generated using NVivo software

This word cloud, dominated by terms such as “digitalization,” “systems,” “tools,” “logistics,” “information,” “coordination,” “reporting,” “staff,” “training,” and “interoperability,” provides a lexical synthesis of the concepts most frequently mentioned by participants. Its interpretation highlights three major axes: the persistent fragmentation of digital tools; a partial yet tangible improvement in logistics performance; and the growing importance attributed to transparency, information flows, and institutional coordination.

The findings confirm that the digitalization of logistics practices is indeed underway, but remains incomplete and heterogeneous. Professionals describe an ecosystem composed of disparate tools: non-integrated HIS modules, Excel spreadsheets, locally developed internal platforms, and informal communication channels. While these tools have enhanced stock visibility, strengthened traceability, and accelerated information exchange, their contribution remains constrained by the lack of interoperability between logistics, pharmaceutical, biomedical, and administrative systems.

Regarding logistics performance, interviewees report measurable improvements: reduced stock-outs, better anticipation of needs, and faster request processing. However, these gains remain fragile. Their sustainability depends heavily on data quality, staff engagement with digital tools, and the persistence of time-consuming manual practices such as double or triple data entry and paper-based validation circuits.

These trends also align with the dynamics observed in the field of smart governance. Participants emphasise a gradual shift toward more structured, data-driven decision-making supported by digital dashboards and consolidated reports. These tools contribute to enhancing transparency, accountability, and interdepartmental coordination within hospitals and provincial delegations. Nevertheless, the effectiveness of this digital

governance remains hampered by the continued fragmentation of information systems and the absence of integrated platforms enabling seamless data circulation.

Finally, several transversal factors emerge as critical to the successful digitalization of hospital operations: the highly variable level of digital competencies among staff; the lack of formal and structured training programmes; infrastructure limitations; and the impact of institutional reforms, notably Law 06-22 and the establishment of Territorial Health Groups (THG), which require more intensive digital reporting without necessarily providing the corresponding resources.

Overall, the analysis—reinforced by the visualisation provided by the word cloud—depicts an ecosystem in transition, where meaningful progress in logistics digitalization coexists with structural, institutional, and human constraints that continue to impede the emergence of fully realised smart governance within public healthcare settings.

4.2. Discussion of the findings

The results obtained confirm the relevance of the proposed conceptual model and align closely with contemporary research on smart governance, public sector digitalization, and hospital logistics performance. The prominence of terms highlighted in the word cloud—such as digitalization, systems, information, coordination, reporting, staff, and interoperability—reflects the centrality of the theoretical dimensions underpinning this study, ranging from digital governance [25] [2], to organizational capabilities [28], and integrated logistics management [32].

- Partial digitalization and systemic fragmentation:

The perception of incomplete and fragmented digitalization, relying on heterogeneous tools, corroborates the findings of Carroll and Richardson (2019) [24], who highlight the technical and organizational challenges that hinder digital integration in hospitals. The recurring issue of limited interoperability between logistics, pharmaceutical, and biomedical systems echoes the observations of Labus et al. (2022) [13] regarding the difficulty of connecting independently developed platforms. In the Moroccan context, this fragmentation results from a gradual yet uncoordinated adoption of digital tools, further reinforced by disparities in infrastructure across healthcare facilities.

- Logistics performance: real but uneven improvements:

The perceived gains in stock visibility, traceability, and reduced processing delays are consistent with analyses by Ivanov and Dolgui (2020) [5] and Tiwari et al. (2018) [6], which demonstrate the role of digital technologies in optimizing supply chain operations. However, the persistence of stockouts, duplicate data entry, and paper-based validation processes reveals a major paradox: digitalization enhances performance only when systems are reliable, integrated, and consistently used. This aligns with contingency theory [30], which stresses that performance depends on the fit between technologies, competencies, processes, and institutional context.

- Smart governance: enhanced transparency, but coordination still reliant on Informal Practices:

The findings indicate that digitalization contributes to greater transparency, improved accountability, and the emergence of more data-driven decision-making, in line with the work of Gil-Garcia et al. (2016) [433] and Kraus et al. (2021) [27]. Digital dashboards help justify needs, support coordination meetings, and structure interdepartmental discussions. However, the continued reliance on informal communication channels—such as WhatsApp or phone calls—signals a hybrid form of governance still distant from smart city standards, where interoperability and seamless information flows are essential [3] [4].

- Digital skills and organizational culture: a critical lever:

The prominence of the terms training, skills, staff, and support within the word cloud confirms that human resources are a decisive factor in the success of digital transformation. The results align with the findings of Iyawa et al. (2016) [29] and Novaes (2021) [21], which emphasize the need to develop digital human capital to sustain organizational transformation. Resistance to change—particularly among administrative or senior staff—also reflects the analyses of Freeman (1984) [31] and Portal & Fabrègue (2022) [8] regarding the complexity of multi-actor environments in governance systems.

- Moroccan reforms: strong institutional impulse, limited capacities:

National reforms—including Law 06-22, the New Development Model (NMD), and the establishment of Territorial Health Groups (THG)—serve as a powerful driver for strengthening digital reporting and structuring hospital governance. They create an institutional framework encouraging the use of technology and the circulation of information, consistent with the analyses of Baalla & Jellouli (2025) [26] and Khouna et al. (2025) [20]. However, this shift also reveals significant constraints: insufficient financial resources, lack of formal training, limited digital infrastructure, and the absence of integrated systems. As highlighted by Khalifi et al. (2024) [22] and Langa & Thakhathi (2022) [23], these barriers restrict the ability of Moroccan hospitals to fully align with the smart city paradigm.

Table 4. Discussion of the results in light of the theoretical framework

Discussion Axis	Empirical Findings	Link to the Literature	Theoretical and Managerial Implications
Partial digitalization and systemic fragmentation	Heterogeneous tools (HIS non-integrated modules, Excel files, local platforms); lack of interoperability; reliance on informal communication.	Carroll & Richardson (2019); Labus et al. (2022).	Need for system integration, standardisation of digital tools, and harmonised processes across logistics, pharmacy, and biomedical units.
Logistics performance: real but uneven improvements	Better stock visibility, improved traceability, shorter processing times; persistent stockouts, duplicate entries, and manual validations.	Ivanov & Dolgui (2020); Tiwari et al. (2018); Donaldson (2001).	Performance improves only when tools, skills, processes, and infrastructure are aligned; reinforces contingency theory.
Smart governance: enhanced transparency but coordination still informal	Improved accountability and data-driven decision-making; dashboards support coordination; continued reliance on phone calls.	Gil-Garcia et al. (2016); Kraus et al. (2021); Albino et al. (2015); Kitchin (2014).	Necessity of integrated platforms to reduce informal practices and stabilise governance; interoperability remains a key condition.
Digital skills and organizational culture as critical levers	Uneven digital competencies; absence of formal training; resistance among senior/administrative staff.	Iyawa et al. (2016); Novaes (2021); Freeman (1984); Portal & Fabrègue (2022).	Investing in structured training, strengthening digital human capital, and addressing cultural resistance are essential for sustainable digitalization.
Impact of Moroccan reforms: strong institutional push, limited capacities	Reforms (Law 06-22, NMD, GST/THG) encourage digital reporting; lack of resources, training, and integrated systems.	Baalla & Jellouli (2025); Khouna et al. (2025); Khalifi et al. (2024); Langa & Thakhathi (2022).	Align institutional requirements with operational capacities; provide funding, infrastructure, and technical support to enable transition toward smart-city-oriented hospital governance.

Source: Authors' elaboration

- Smart cities perspective: positioning digital logistics within Morocco's urban transformation:

Beyond the organisational and technological dynamics identified, the findings also highlight the broader implications of hospital digitalisation for Morocco's transition toward smart cities. Smart cities rely on interconnected systems, data-driven decision-making, and seamless information flows across sectors — principles that closely resonate with the transformations observed in public hospitals. The partial but emerging digital infrastructures within Moroccan healthcare facilities reflect an early stage of urban intelligence, where hospitals progressively evolve from isolated administrative units to integrated nodes within wider territorial information ecosystems. This aligns with international perspectives suggesting that smart health is a foundational pillar of smart cities, enabling real-time monitoring, more efficient resource allocation, and improved citizen well-being. Nonetheless, the persistent fragmentation of digital tools, disparities in infrastructure, and limited data

interoperability observed in the interviews indicate that hospitals have not yet reached the level of systemic integration required to function as fully embedded components of smart urban environments. As Moroccan cities such as Casablanca, Rabat, Tangier, and Marrakech accelerate their digital agendas, the maturity of hospital information systems will increasingly condition the extent to which public health can contribute to — and benefit from — national smart city strategies.

In summary, the discussion highlights that the digitalization of hospital logistics in Morocco is progressing, yet remains constrained by structural, organisational, and human factors that limit its full potential. While tangible improvements in performance and transparency are evident, these advances are uneven and heavily dependent on system interoperability, staff competencies, and the alignment between institutional reforms and operational capacities. Overall, the findings point to an ecosystem in transition—one that possesses strong foundations for digital transformation, but still requires coordinated investments, integrated platforms, and sustained capacity-building efforts to fully converge toward the standards of smart governance and smart health systems.

5. Conclusion

This study examined the digitalization of hospital logistics in Morocco through the lens of smart governance, organisational capabilities, and integrated supply chain management. Drawing on a qualitative approach based on twenty semi-structured interviews conducted with healthcare professionals in the Casablanca–Settat region, the research provides an in-depth understanding of how digital tools are adopted, perceived, and operationalised within a health sector undergoing significant institutional reforms.

The findings reveal a digital transformation that is progressing yet remains uneven, marked by notable advances in stock visibility, traceability, information flows, and decision-making transparency. However, these improvements are constrained by persistent systemic fragmentation, lack of interoperability across systems, heterogeneous digital competencies among staff, and a continued reliance on time-consuming manual practices. The results also underscore the decisive role of organisational culture, human skills, and institutional dynamics — particularly the reforms introduced by Law 06-22 and the establishment of Territorial Health Groups (THG) — in shaping the successes and limitations of hospital digitalization.

Theoretically, this study confirms the relevance of combining perspectives from digital governance, organisational capabilities, and logistics performance to understand digital transitions in healthcare. Empirically, it contributes to the growing body of research on hospital digitalization in developing countries by offering original insights from a context characterised by rapid reforms and resource constraints. Managerially, the findings highlight the urgent need to strengthen information system integration, deploy structured training programmes, improve digital infrastructure, and ensure stronger alignment between national strategies and the operational capacities of health institutions.

Furthermore, this research aligns with broader reflections on the emergence of smart cities in Morocco. The gradual integration of digital solutions within public hospitals represents

an essential component of the transition toward more intelligent, connected, and sustainable urban ecosystems. The digitalization of hospital logistics contributes directly to improving public service quality, enhancing decision-making efficiency, increasing transparency, and optimising resource management — all core dimensions of Morocco's smart city strategies, particularly in cities such as Casablanca, Rabat, Marrakech, and Tangier. However, the findings also reveal that the hospital ecosystem remains distant from smart city standards due to limited interoperability, weak digital infrastructure, and territorial disparities. Advancing toward a truly connected health system that supports smart cities will require greater investment in interoperability, cybersecurity, data governance, and interinstitutional coordination.

Despite its contributions, the study presents certain limitations, notably the variability of practices across institutions, restricted access to some internal data, and the purely qualitative nature of the analysis. Future research could build on these findings through mixed-methods designs, comparative regional studies, or longitudinal assessments of digital maturity within Moroccan healthcare institutions.

Overall, the study highlights a system in transition: a Moroccan hospital sector engaged in a promising digitalization process, yet still hindered by structural, organisational, and human constraints. The convergence between digitalization, logistics performance, and smart governance nonetheless opens significant opportunities to strengthen the resilience, quality, and efficiency of the health system, while supporting the country's broader transition toward smarter, more inclusive, and more sustainable cities.

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