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Modeling the Antecedents and Outcomes of Knowledge Stagnation in the Ministry of Health, Treatment, and Medical Education

ABSTRACT

This study aimed to develop a multi-level interpretive structural model identifying the antecedents and outcomes of knowledge stagnation in the Ministry of Health, Treatment, and Medical Education. This research employed a mixed-method exploratory–confirmatory design, integrating qualitative analysis, fuzzy Delphi validation, and Interpretive Structural Modeling (ISM). In the qualitative phase, 20 experts—including faculty members and senior specialists in organizational behavior, human resource management, and administrative roles within the Ministry—were selected through purposive sampling until theoretical saturation. Semi-structured interviews were conducted to extract initial antecedents and outcomes of knowledge stagnation. The extracted factors were then evaluated by 44 additional experts using a fuzzy Delphi questionnaire to determine relevance, clarity, and appropriateness. Linguistic judgments were converted into triangular fuzzy numbers and defuzzified using Minkowski-based formulas to establish consensus. In the final phase, ISM was applied to model hierarchical relationships among confirmed antecedents and outcomes across structural, behavioral, and contextual dimensions, generating driving and dependence powers for each factor and determining multi-level structures. The ISM results revealed that structural weaknesses—including inadequate infrastructures, inappropriate hierarchical structures, and insufficient work processes—serve as the strongest antecedents driving knowledge stagnation. Behavioral determinants such as weak knowledge leadership, poor communication networks, lack of knowledge absorption, and resistance to change emerged as core behavioral drivers. Contextual factors, particularly weak national regulations and lack of cross-ministerial knowledge modeling, showed significant systemic influence. The outcomes hierarchy indicated that threatened organizational survival, diminished agility, reduced learning, loss of innovation, and declining societal knowledge quality are key consequences. The multi-level model demonstrated that foundational structural and contextual weaknesses cascade into behavioral stagnation and ultimately shape strategic and societal outcomes. Knowledge stagnation in the Ministry of Health arises from interconnected structural, behavioral, and contextual deficiencies that reinforce one another, and addressing it requires systemic interventions that strengthen infrastructures, leadership, learning culture, and inter-organizational knowledge governance.

Keywords: Knowledge stagnation; interpretive structural modeling; fuzzy Delphi; absorptive capacity; knowledge management; Ministry of Health

Introduction

Knowledge has increasingly been recognized as the primary strategic resource for building sustained competitive advantage, innovation capability, and superior organizational performance in both private and public sectors [1-3]. Knowledge management (KM) provides the infrastructure, processes, and cultural mechanisms through which organizations create, store, transfer, and apply knowledge in ways that support strategic objectives [4]. Empirical evidence shows that firms

which systematically invest in knowledge processes achieve higher innovation performance, market responsiveness, and long-term competitiveness, as knowledge-based capabilities become the foundation of dynamic adaptation in turbulent environments [5-7]. In public and non-profit settings, KM is also closely related to social performance, service quality, and stakeholder trust, particularly where value creation is not only economic but also social and developmental [8]. Health systems and ministries, as highly knowledge-intensive institutions, rely critically on the effective mobilization of professional expertise, evidence, and organizational learning, which makes the study of knowledge dynamics in this context especially important.

The KM literature highlights that knowledge creation, transfer, and utilization do not take place in a vacuum; they are embedded in organizational cultures, processes, and leadership systems that can either promote continuous learning or, conversely, generate inertia and stagnation [9, 10]. Organizational culture shapes the willingness of employees to share expertise, challenge routines, and participate in collective problem-solving, which is particularly salient in professional bureaucracies such as health organizations [10]. The voice and participation of knowledge employees are critical to transforming tacit expertise into explicit, shareable knowledge assets and to avoiding situations in which valuable knowledge remains localized, underutilized, or silenced [11]. Human resource practices and leadership approaches that support commitment, empowerment, and psychological safety have therefore been linked to higher levels of knowledge creation and ambidextrous learning, especially in complex, international, or multi-stakeholder contexts [12-14].

A central theoretical construct in this field is absorptive capacity, defined as the organization's ability to recognize the value of external knowledge, assimilate it, and apply it to commercial or operational ends [15]. Studies show that knowledge transfer mechanisms, routines for environmental scanning, and established KM practices significantly enhance absorptive capacity, which in turn strengthens innovation and responsiveness [6, 16]. Innovation management research also emphasizes that knowledge sharing and organizational capabilities are integral to sustaining competitive advantage, as organizations must balance exploration and exploitation over time [17-19]. At the micro-foundational level, incentives, social networks, and individual cognitive frames shape how knowledge is absorbed and recombined within teams, making KM a deeply multi-level phenomenon that spans individuals, groups, and the organization as a whole [20-22].

Recent research has extended this perspective by examining how technological level, organizational learning ability, and strategic innovation interact with absorptive capacity to influence performance outcomes across industries and institutional settings [23, 24]. Agent-based modeling of individual absorptive capacity has further illustrated that heterogeneity in employees' learning behaviors can significantly alter the effectiveness of knowledge transfer initiatives and the emergence of collective intelligence [25]. At the same time, KM in inter-organizational networks, alliances, and supply chains has been recognized as a crucial driver of innovation and resilience in sectors as diverse as agribusiness and manufacturing, emphasizing the importance of cross-organizational learning architectures and governance mechanisms [26-28]. Together, these studies underscore that knowledge flows are shaped not only by internal routines, but also by the broader ecosystem in which organizations are embedded.

The cross-border and cross-organizational dimensions of knowledge transfer are particularly relevant for systems that rely on collaboration between multiple institutions, such as health sectors, international development, and large public programs. Work on international interfirm alliances in the oil industry and on intergenerational KM in high-tech environments shows that the type of knowledge transferred and the mechanisms used can either build or undermine partners' innovation capacity

[29, 30]. Thematic analyses of KM practices in multinational manufacturing firms similarly demonstrate that performance benefits arise when firms deliberately structure their knowledge processes and align them with strategic goals and governance systems [31]. Research on organizational inertia and dynamic capabilities also suggests that if routines become rigid and are not regularly refreshed through knowledge renewal, organizations may experience declining performance and reduced adaptability, even when their initial capabilities were strong [32]. These insights can be transferred to public health systems, where coordination across agencies, hospitals, and universities is required to maintain up-to-date medical, managerial, and technological knowledge.

Leadership and governance play a decisive role in whether knowledge processes translate into innovation or stagnation. Studies in the automobile and transport industries highlight that leadership, intellectual capital, and KM practices jointly shape how organizations leverage their knowledge base for strategic renewal [33]. Knowledge governance frameworks, focusing on rules, structures, and incentives guiding knowledge creation and use, have been linked to innovative employee performance and agile organizational responses to environmental change [34]. At the same time, the way knowledge is communicated—through narratives, corporate storytelling, or user-centered tools—can deeply influence employees' engagement with knowledge resources and their willingness to adopt new practices and technologies [35, 36]. These factors are especially salient in highly professionalized, complex systems such as ministries of health, where expert autonomy, professional norms, and bureaucratic procedures interact.

Information systems capabilities and digital technologies have added another layer of complexity to the knowledge equation. Research on green absorptive capacity and collaborative knowledge creation emphasizes that information systems can enhance organizational agility and strategic flexibility, but only when aligned with learning and KM routines [37]. Innovation networks and knowledge diffusion studies show that digital connectivity and IT infrastructures accelerate cross-industry learning and spillovers, yet they also introduce new coordination challenges and risks of overload [7]. In solidarity organizations and public-sector contexts, KM systems have been linked to social performance outcomes, including improved inclusion, accountability, and stakeholder welfare, underlining the societal stakes of how knowledge is managed [8]. For ministries of health, the adequacy of information systems, data platforms, and digital tools can therefore be central to whether knowledge is effectively mobilized or becomes fragmented and underused.

Despite these advances, the literature also warns that organizations may experience “knowledge traps” when creation, sharing, and application processes are not fully integrated into decision-making and everyday work. Studies of innovation management and KM capabilities demonstrate that organizations can be simultaneously rich in data and poor in actionable, shared knowledge if incentives, structures, or cultures suppress knowledge use or encourage hoarding and fragmentation [17, 18]. Research on knowledge creation capability, organizational forgetting, and innovation performance among SMEs further points to the paradox that unlearning and the retirement of obsolete knowledge are necessary to maintain adaptive absorptive capacity and avoid inertia [38]. When such mechanisms are absent, organizations risk entering a state of “knowledge stagnation,” in which knowledge stocks are not updated, lessons are not internalized, and the system gradually loses agility, innovation capacity, and responsiveness.

Empirical work on Unilever South America's KM practices, cross-border M&A, and emerging economy firms suggests that enabling conditions such as supportive structures, human capital development, and deliberate innovation routines can mitigate these risks and sustain innovation, even in volatile environments [2, 14, 19]. Yet, in many public organizations and

ministries, KM remains fragmented, reliant on individual experts, and weakly linked to performance evaluation or policy learning. Research on determinants of innovation performance and on KM in development and agribusiness networks emphasizes the importance of context-sensitive models that reflect local institutional constraints and resource configurations [5, 26]. As large, complex, and politically embedded systems, ministries of health are particularly vulnerable to knowledge stagnation arising from bureaucratic structures, inadequate incentives, underdeveloped IT infrastructures, and weak cross-unit collaboration.

Although a growing body of studies has explored knowledge governance, absorptive capacity, and KM mechanisms in private and hybrid organizations, there is still limited understanding of how the antecedents and outcomes of knowledge stagnation manifest in public health ministries, especially in emerging economy contexts [6, 23, 27]. Existing research on cross-border innovation, product innovation practices, and dual innovation incentives confirms that context-specific models are needed to capture the feedback loops between knowledge structures, human behavior, and organizational performance [20, 24, 28]. However, few studies have systematically modeled the multi-level factors that cause knowledge to become stagnant—structural, behavioral, and contextual—and the consequences of such stagnation for agility, innovation, and the broader social mission of health ministries. Therefore, the aim of this study is to model the antecedents and outcomes of knowledge stagnation in the Ministry of Health, Treatment, and Medical Education using a multi-level interpretive structural approach.

Methodology

Study Design and Participants

This study employed a systematic, multi-phase research design based on both qualitative and quantitative approaches, aligned with the objectives of developing a comprehensive model of the antecedents and outcomes of knowledge stagnation within the Ministry of Health, Treatment, and Medical Education. Given the fundamental–applied orientation of the research, the study was conducted cross-sectionally from summer 2023 to winter 2024. The selection of the methodological approach followed the principle that method choice must reflect the nature, scope, and goals of the study, along with the practical feasibility of implementation. Accordingly, the research design was structured to begin with an exploratory qualitative phase aimed at identifying relevant antecedents and outcomes, followed by a confirmatory quantitative phase designed to validate and refine the components of the emerging model.

The target population for the qualitative phase consisted of domain experts whose knowledge, experience, and professional engagement made them suitable informants for identifying knowledge-related behavioral and organizational constructs. Expert-based sampling was essential because the purpose of the study was not to generalize to a broad population but to extract deep, concept-driven insights from individuals with significant expertise in organizational behavior, human resource management, and the health administration context. Participants in the expert panel included university faculty members in management fields, specialists with published work related to the topic, and senior professionals holding managerial roles within the Ministry of Health. Criteria for inclusion involved academic credentials such as holding a PhD, authorship of relevant scholarly work, managerial experience, and willingness and availability to participate in interviews and iterative evaluations. Through purposive sampling and continuing until theoretical saturation was achieved, twenty experts were recruited for the qualitative exploration.

The demographic characteristics of the interviewees reflected a diverse expert group in terms of gender, age range, professional specialization, and organizational responsibilities. All participants held doctoral degrees and represented fields such as organizational behavior management, human resource management, and specialized administrative roles in the Ministry of Health. Their profiles ranged from academic faculty to senior administrative decision-makers, each contributing a distinct perspective on the mechanisms and consequences of knowledge stagnation. For the subsequent model validation phase, an additional group of forty-four experts with similar characteristics was selected purposively. These individuals were engaged to evaluate the relevance, clarity, and adequacy of the antecedents and outcomes derived from the qualitative analysis. Saturation was once again used as the guiding principle to determine sample adequacy in the validation stage, ensuring the credibility and robustness of the model refinement process.

Data Collection Tools

Data collection followed a multi-method approach tailored to the hybrid qualitative–quantitative design of the study. In the exploratory stage, in-depth semi-structured interviews were employed to elicit expert insights on the drivers and consequences of knowledge stagnation in the ministry. Interviews continued until conceptual saturation was achieved, ensuring that no new categories or themes emerged. Throughout this phase, the researcher engaged in continuous analytic memo-writing to link raw data with emerging theoretical concepts and capture interpretive insights essential for later stages of analysis.

In the intermediate stage, a fuzzy Delphi questionnaire was developed to confirm and refine the antecedents and outcomes extracted from interviews. The questionnaire included both open-ended and structured items and sought evaluations on the suitability, importance, and relevance of each identified construct. A five-point Likert-type linguistic scale—ranging from “completely inappropriate” to “completely appropriate”—was used to capture expert judgments. These linguistic responses were then converted into triangular fuzzy numbers to address uncertainty inherent in subjective expert judgment. The fuzzy Delphi method was selected because classical Delphi techniques rely on crisp numerical judgments, whereas experts often express opinions with degrees of uncertainty better modeled through fuzzy logic. The fuzzification and defuzzification steps were executed using established procedures such as triangular membership functions and Minkowski-based defuzzification to compute aggregated expert consensus scores.

Following the Delphi refinement, an Interpretive Structural Modeling (ISM) questionnaire was administered to further analyze and structure the relationships among the validated antecedents and outcomes. ISM is a systematic procedure for identifying contextual relationships among complex variables and organizing them into hierarchical structural models. Experts provided judgments using standard ISM relational symbols indicating whether and how one variable influences another. This step enabled the modeling of causal pathways, dependencies, and hierarchical ordering of dimensions that collectively shape knowledge stagnation in the ministry.

Throughout all stages, methodological rigor was upheld through strategies consistent with Lincoln and Guba’s framework for ensuring trustworthiness. Participants reviewed interview transcripts and extracted codes to confirm accuracy, and a subset of interviews was independently coded by an additional researcher to verify coding reliability. Thick descriptions, transparent documentation of analytic procedures, and review of findings by external academic experts contributed to the credibility, dependability, and transferability of the study.

Data Analysis

Data analysis was conducted in sequential phases aligned with the hybrid qualitative–quantitative nature of the study. In the qualitative stage, interview transcripts were analyzed using open, axial, and selective coding, facilitated by MAXQDA software. Open coding involved identifying initial concepts, axial coding established relationships among categories, and selective coding integrated these relationships into overarching themes representing the antecedents and outcomes of knowledge stagnation. The analytic process followed a sequential approximation logic, starting from broad conceptualization and gradually refining the analysis into precise, theoretically coherent constructs. As coding progressed, categories became more refined, ambiguities were minimized, and an integrated conceptual framework began to emerge.

In the quantitative validation stage, fuzzy Delphi analysis was applied to confirm the conceptual accuracy and practical relevance of the identified constructs. Each linguistic variable was converted into a triangular fuzzy number representing lower, modal, and upper bounds of expert judgments. Defuzzification using the Minkowski approach allowed linguistic inputs to be transformed into crisp numerical scores, representing the consensus level on the suitability of each item. Fuzzy mean values were computed for each construct across all experts, and only those with defuzzified mean scores of 0.60 or higher were retained, following the recommended threshold for strong expert agreement. The remaining refined constructs were then categorized into broader dimensions, forming a structured list of antecedents and outcomes.

After completion of the Delphi process, Interpretive Structural Modeling (ISM) was used to map the hierarchical and interactive relationships among the refined constructs. The ISM procedure began with the construction of a self-interaction matrix, capturing expert judgments on inter-variable influences using the standard ISM symbolic logic. These relationships were then converted into a reachability matrix and subsequently used to classify constructs into hierarchical levels. By developing a multi-level structural model, the ISM analysis clarified which antecedents exert foundational influence, which function as intermediate enablers, and which outcomes represent the terminal effects of knowledge stagnation within the ministry. This structured modeling approach offered a clear path for interpreting the systemic dynamics of knowledge stagnation in a complex governmental organization.

Findings and Results

In the first stage of presenting the findings, after a comprehensive set of antecedents and outcomes of knowledge stagnation was identified through qualitative analysis and the application of the fuzzy Delphi method, these components were submitted to 44 experts for final validation and classification. This group consisted of faculty members from medical universities, academic staff from Islamic Azad University of Rafsanjan, and specialists from Valiasr University of Rafsanjan, all of whom were selected based on their expertise, managerial experience, and deep familiarity with the structure and processes of the Ministry of Health. The experts were asked to organize the identified components into the two main categories of antecedents and outcomes so that the necessary foundation for constructing the final model of knowledge stagnation, using the interpretive structural modeling approach, could be established. Analysis of the data from this stage indicated a considerable level of consensus among the experts regarding the nature of the factors, and the resulting classification facilitated the initiation of the structural model-building phase and the precise mapping of the relationships among the components.

Table 1*Structural Self-Interaction Matrix (Antecedents)*

i / j	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1 – Lack of information technology and social networks	–	O	O	O	O	V	O	V	O
C2 – Lack of infrastructures and information systems		–	O	V	V	V	V	V	O
C3 – Inappropriate hierarchical structure			–	O	V	V	V	V	V
C4 – Absence of computer systems				–	O	O	V	V	V
C5 – Lack of appropriate work systems and processes					–	V	V	V	V
C6 – Inadequate training structure						–	O	O	V
C7 – Lack of participation systems and employee empowerment							–	V	V
C8 – Absence of organizational performance evaluation systems								–	V
C9 – Lack of appropriate motivational rewards									–

Table 2*Structural Self-Interaction Matrix (Outcomes)*

i / j	C1	C2	C3	C4	C5	C6
C1 – Reduction of organizational agility	–	O	V	V	V	V
C2 – Lack of knowledge transfer infrastructure		–	V	O	V	V
C3 – Threatened organizational survival			–	A	A	A
C4 – Weak organizational performance				–	O	O
C5 – Reduced learning					–	V
C6 – Decline in organizational innovation						–

Table 3*Behavioral Self-Interaction Matrix (Antecedents)*

i / j	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1 – Absence of work teams	–	A	O	O	A	A	A	O	A	V
C2 – Organizational culture based on personal interest		–	V	A	O	O	O	V	O	V
C3 – Weak communication and poor work relationships			–	A	A	A	A	O	O	V
C4 – Weak knowledge leadership				–	O	O	V	V	V	V
C5 – Lack of commitment and senior management support					–	O	O	V	O	V
C6 – Lack of knowledge absorption						–	V	V	V	V
C7 – Absence of knowledge-sharing behavior							–	V	V	V
C8 – Resistance to change and lack of flexibility								–	O	O
C9 – Lack of personal knowledge management									–	O
C10 – Fear of trying new methods										–

Table 4*Behavioral Self-Interaction Matrix (Outcomes)*

i / j	C1	C2	C3	C4	C5
C1 – Lack of employee time and energy saving	–	O	O	A	O
C2 – Lack of employee risk-taking		–	V	V	V
C3 – Absence of innovation, initiative, and creativity			–	O	V
C4 – Lack of organizational learning				–	X
C5 – Lack of entrepreneurial behavior					–

Table 5*Contextual Self-Interaction Matrix (Antecedents)*

i / j	C1	C2	C3	C4	C5
C1 – Absence of knowledge modeling and structuring across ministries and public organizations	–	V	V	V	V
C2 – Weakness in national laws and regulations		–	A	A	V
C3 – Lack of a platform for continuous use and application of knowledge in organizations			–	V	V
C4 – Weakness in knowledge absorption capability				–	V
C5 – Individual-level factors					–

Table 6*Contextual Self-Interaction Matrix (Outcomes)*

i / j	C1	C2	C3	C4	C5
C1 – Lack of human–structural intelligence	–	V	O	V	V
C2 – Increased indirect organizational costs		–	O	O	A
C3 – Decline in knowledge quality at societal level			–	O	X
C4 – Increased rigidity and intellectual stagnation				–	A
C5 – Loss of creativity and innovation					–

The analysis of the six self-interaction matrices reveals the complex web of causal and relational dynamics among antecedents and outcomes of knowledge stagnation across structural, behavioral, and contextual dimensions

The structural antecedent matrix demonstrates strong bidirectional and unidirectional relationships among inadequate infrastructures, inappropriate hierarchical structure, absence of computer systems, and insufficient performance evaluation mechanisms, indicating that technological and structural deficiencies mutually reinforce the stagnation environment. Structural outcomes similarly show that reduced agility, weak performance, diminished learning, and threatened organizational survival are tightly interconnected, with survival risk positioned as a consequence influenced by multiple drivers. The behavioral antecedent matrix highlights the dominance of weak communication, lack of work teams, insufficient leadership, and resistance to change, showing how human-centered and relational deficits cascade through knowledge absorption, sharing, and personal knowledge management. Behavioral outcomes reflect how lack of risk-taking, absence of creativity, and failure in organizational learning mutually shape each other, creating a reinforcing cycle of non-innovative behavior. Contextual antecedents further illustrate broader systemic barriers, including weak national regulations, limited cross-organizational knowledge structuring, and insufficient organizational readiness for knowledge application. The contextual outcomes matrix underscores how these systemic constraints lead to increased intellectual rigidity, reduced societal knowledge quality, higher organizational costs, and eventual erosion of creativity. Collectively, the six matrices provide a comprehensive understanding of how multilevel deficiencies across structure, behavior, and context interrelate to form the foundational logic for the interpretive structural model of knowledge stagnation in the Ministry of Health, Treatment, and Medical Education.

Table 7*Initial Reachability Matrix – Structural Antecedents*

i / j	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1 – Lack of IT and social networks	1	0	0	0	0	1	0	1	0
C2 – Lack of infrastructures and information systems	0	1	0	1	1	1	1	1	0
C3 – Inappropriate hierarchical structure	0	0	1	0	1	1	1	1	1
C4 – Absence of computer systems	0	0	0	1	0	0	1	1	1
C5 – Lack of adequate systems and work processes	0	0	0	0	1	1	1	1	1
C6 – Inadequate training structure	0	0	0	0	0	1	0	0	1
C7 – Lack of participation systems and employee empowerment	0	0	0	0	0	0	1	1	1
C8 – Absence of organizational performance evaluation systems	0	0	0	0	0	0	0	1	1
C9 – Lack of appropriate motivational rewards	0	0	0	0	0	0	0	0	1

Table 8*Initial Reachability Matrix – Structural Outcomes*

i / j	C1	C2	C3	C4	C5	C6
C1 – Reduction of organizational agility	1	0	1	1	1	1
C2 – Lack of knowledge-transfer infrastructure	0	1	1	0	1	1

C3 – Threatened organizational survival	0	0	1	0	0	0
C4 – Weak organizational performance	0	0	1	1	0	0
C5 – Reduced learning	0	0	1	0	1	1
C6 – Decline in organizational innovation	0	0	1	0	0	1

Table 9*Initial Reachability Matrix – Behavioral Antecedents*

i / j	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1 – Absence of work teams	1	0	0	0	0	0	0	0	0	1
C2 – Organizational culture based on personal interest	1	1	1	0	0	0	0	1	0	1
C3 – Weak communication and poor work relations	0	0	1	0	0	0	0	0	0	1
C4 – Weak knowledge leadership	0	1	1	1	0	0	1	1	1	1
C5 – Lack of commitment and senior management support	1	0	1	0	1	0	0	1	0	1
C6 – Lack of knowledge absorption	1	0	1	0	0	1	1	1	1	1
C7 – Absence of knowledge-sharing behavior	1	0	1	0	0	0	1	1	1	1
C8 – Resistance to change and lack of flexibility	0	0	0	0	0	0	0	1	0	0
C9 – Lack of personal knowledge management	1	0	0	0	0	0	0	0	1	0
C10 – Fear of trying new methods	0	0	0	0	0	0	0	0	0	1

Table 10*Initial Reachability Matrix – Behavioral Outcomes*

i / j	C1	C2	C3	C4	C5
C1 – Lack of employee time and energy saving	1	0	0	0	0
C2 – Lack of employee risk-taking	0	1	1	1	1
C3 – Absence of innovation, initiative, and creativity	0	0	1	0	1
C4 – Lack of organizational learning	1	0	0	1	1
C5 – Lack of entrepreneurial behavior	0	0	0	1	1

Table 11*Initial Reachability Matrix – Contextual Antecedents*

i / j	C1	C2	C3	C4	C5
C1 – Absence of knowledge modeling and structuring across ministries	1	1	1	1	1
C2 – Weak national laws and regulations	0	1	0	0	1
C3 – Lack of a platform for continuous knowledge utilization	0	1	1	1	1
C4 – Weak knowledge absorption capability	0	1	0	1	1
C5 – Individual-level factors	0	0	0	0	1

Table 12*Initial Reachability Matrix – Contextual Outcomes*

i / j	C1	C2	C3	C4	C5
C1 – Lack of human–structural intelligence	1	1	0	1	1
C2 – Increased indirect costs	0	1	0	0	0
C3 – Decline in knowledge quality at societal level	0	0	1	0	1
C4 – Increased intellectual rigidity	0	0	0	1	0
C5 – Loss of creativity and innovation	0	1	1	1	1

The six initial reachability matrices (Tables 7 to 12) collectively illuminate the direction and strength of influence among antecedents and outcomes of knowledge stagnation across structural, behavioral, and contextual dimensions. The structural antecedent matrix shows that critical deficiencies—such as lack of IT, weak infrastructures, inadequate training structures, and absence of performance evaluation systems—tend to reinforce themselves through a network of strong one-directional influences, indicating that structural problems propagate across the system. Structural outcomes similarly reveal that

weakened knowledge infrastructure and reduced learning strongly converge toward the central and most vulnerable point: threatened organizational survival, which receives influence from almost all other variables. Behavioral antecedents show a dense pattern of interrelationships in which weak leadership, lack of knowledge absorption, absence of sharing behavior, and personal knowledge management deficits play central roles in reinforcing a culture of stagnation. Behavioral outcomes reflect that lack of risk-taking and absence of creativity are major nodes that drive broader failures such as lack of organizational learning and entrepreneurial behavior. On the contextual side, the antecedents indicate that systemic weaknesses—such as poor national regulations and lack of cross-organizational knowledge structuring—are foundational issues that influence all other contextual factors. Finally, contextual outcomes demonstrate how these systemic pressures result in increased intellectual rigidity, diminishing societal knowledge quality, rising organizational costs, and ultimately the erosion of creativity and innovation. Together, the matrices depict a multilevel and mutually reinforcing ecosystem of constraints that shape the final interpretive structural model of knowledge stagnation in the Ministry of Health, Treatment, and Medical Education.

Table 13*Final Reachability Matrix – Structural Antecedents*

i / j	C1	C2	C3	C4	C5	C6	C7	C8	C9	Driving Power
C1 – Lack of IT and social networks	1	0	0	0	0	1	0	1	1	4
C2 – Lack of infrastructures and information systems	0	1	0	1	1	1	1	1	0	6
C3 – Inappropriate hierarchical structure	0	0	1	0	1	1	1	1	1	6
C4 – Absence of computer systems	0	0	0	1	0	0	1	1	1	4
C5 – Lack of adequate systems and work processes	0	0	0	0	1	1	1	1	1	5
C6 – Inadequate training structure	0	0	0	0	0	1	0	0	1	2
C7 – Lack of participation systems and employee empowerment	0	0	0	0	0	0	1	1	1	3
C8 – Absence of performance evaluation systems	0	0	0	0	0	0	0	1	1	2
C9 – Lack of appropriate motivational rewards	0	0	0	0	0	0	0	0	1	1
Dependence	1	1	1	2	3	5	5	7	8	

Table 14*Final Reachability Matrix – Structural Outcomes*

i / j	C1	C2	C3	C4	C5	C6	Driving Power
C1 – Reduction of organizational agility	1	0	1	1	1	1	5
C2 – Lack of knowledge-transfer infrastructure	0	1	1	0	1	1	4
C3 – Threatened organizational survival	0	0	1	0	0	0	1
C4 – Weak organizational performance	0	0	1	1	0	0	2
C5 – Reduced learning	0	0	1	0	1	1	3
C6 – Decline in organizational innovation	0	0	1	0	0	1	2
Dependence	1	1	6	2	3	4	

Table 15*Final Reachability Matrix – Behavioral Antecedents*

i / j	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	Driving Power
C1 – Absence of work teams	1	0	0	0	0	0	0	0	0	1	2
C2 – Organizational culture based on personal interest	1	1	1	0	0	0	0	1	0	1	5
C3 – Weak communication and work relations	0	0	1	0	0	0	0	0	0	1	2
C4 – Weak knowledge leadership	1	1	1	1	0	0	1	1	1	1	8
C5 – Lack of commitment and senior management support	1	0	1	0	1	0	0	1	0	1	5
C6 – Lack of knowledge absorption	1	0	1	0	0	1	1	1	1	1	7
C7 – Absence of knowledge-sharing behavior	1	0	1	0	0	0	1	1	1	1	6
C8 – Resistance to change and inflexibility	0	0	0	0	0	0	0	1	0	0	1
C9 – Lack of personal knowledge management	1	0	0	0	0	0	0	0	1	1	3
C10 – Fear of trying new methods	0	0	0	0	0	0	0	0	0	1	1
Dependence	7	2	6	1	1	1	3	6	4	9	

Table 16*Final Reachability Matrix – Behavioral Outcomes*

i / j	C1	C2	C3	C4	C5	Driving Power
C1 – Lack of employee time and energy saving	1	0	0	0	0	1
C2 – Lack of employee risk-taking	0	1	1	1	1	4
C3 – Absence of innovation and creativity	0	0	1	1	1	3
C4 – Lack of organizational learning	1	0	0	1	1	3
C5 – Lack of entrepreneurial behavior	1	0	0	1	1	3
Dependence	3	1	2	4	4	

Table 17*Final Reachability Matrix – Contextual Antecedents*

i / j	C1	C2	C3	C4	C5	Driving Power
C1 – Absence of inter-ministerial knowledge modeling and structuring	1	1	1	1	1	5
C2 – Weak laws and regulations	0	1	0	0	1	2
C3 – Lack of continuous knowledge utilization	1	1	1	1	1	5
C4 – Weak knowledge absorption capability	0	1	0	1	1	3
C5 – Individual-level factors	0	0	0	0	1	1
Dependence	2	4	2	3	5	

Table 18*Final Reachability Matrix – Contextual Outcomes*

i / j	C1	C2	C3	C4	C5	Driving Power
C1 – Lack of human–structural intelligence	1	1	1	1	1	5
C2 – Increased indirect costs	0	1	0	0	0	1
C3 – Decline in societal knowledge quality	0	1	1	0	1	3
C4 – Increased intellectual rigidity	0	0	0	1	0	1
C5 – Loss of creativity and innovation	0	1	1	1	1	4
Dependence	1	4	3	3	3	

The final reachability matrices (Tables 13 to 18) reveal the stabilized and fully computed interaction structure among antecedents and outcomes across all three dimensions—structural, behavioral, and contextual. In the structural domain, key drivers such as lack of infrastructures, inappropriate hierarchical structures, and absence of work processes display the highest driving power, while factors like inadequate motivation and evaluation systems show high dependence, indicating their role as terminal structural vulnerabilities. Structural outcomes illustrate that threatened organizational survival sits at the core of the outcome network, receiving influence from almost all other variables, while reduced agility and poor learning exert strong driving effects toward this central outcome. In the behavioral dimension, weak knowledge leadership, lack of absorption, and absence of knowledge-sharing behavior emerge as dominant high-driving-power variables, demonstrating their pivotal role in shaping knowledge stagnation behaviors. Behavioral outcomes such as lack of risk-taking, poor creativity, and absence of learning reveal a dense pattern of interdependence, with learning-related deficits exerting both driving and dependent influence. Contextual antecedents indicate that systemic issues—particularly the absence of cross-ministerial knowledge structuring and lack of continuous knowledge utilization—form the highest-impact drivers that shape all other contextual constraints. Finally, contextual outcomes show that lack of human–structural intelligence and loss of creativity are the strongest driving outcomes, while increased rigidity and declining societal knowledge quality reflect the most dependent consequences in the system. Combined, the matrices establish a multi-layered, hierarchical understanding of how knowledge

stagnation emerges and evolves, forming the analytical foundation for the interpretive structural model of the Ministry of Health, Treatment, and Medical Education.

Table 19

Determining Level 1 – Behavioral Outcomes

Row	Prerequisite	Reachability	Intersection	Level
1	1, 4, 5	1	1	1
2	2	2, 3, 4, 5	2	—
3	2, 3	3, 4, 5	3	—
4	2, 3, 4, 5	1, 4, 5	4, 5	—
5	2, 3, 4, 5	1, 4, 5	4, 5	—

Table 20

Structural Levels – Antecedents

Row	Factor	Level
1	Lack of IT and social networks	3
2	Lack of infrastructures and information systems	5
3	Inappropriate hierarchical structure	5
4	Absence of computer systems	4
5	Lack of adequate work systems and processes	4
6	Inadequate training structure	2
7	Lack of participation systems and employee empowerment	3
8	Absence of performance evaluation systems	2
9	Lack of appropriate motivational rewards	1

Table 21

Structural Levels – Outcomes

Row	Factor	Level
1	Reduction of organizational agility	4
2	Lack of knowledge-transfer infrastructure	4
3	Threatened organizational survival	1
4	Weak organizational performance	2
5	Reduced learning	3
6	Decline in organizational innovation	2

Table 22

Behavioral Levels – Antecedents

Row	Factor	Level
1	Absence of work teams	2
2	Organizational culture based on personal interest	3
3	Weak communication and poor work relations	2
4	Weak knowledge leadership	4
5	Lack of commitment and senior management support	3
6	Lack of knowledge absorption	4
7	Absence of knowledge-sharing behavior	3
8	Resistance to change and lack of flexibility	1
9	Lack of personal knowledge management	3
10	Fear of trying new methods	1

Table 23*Behavioral Levels – Outcomes*

Row	Factor	Level
1	Lack of employee time and energy saving	1
2	Lack of employee risk-taking	4
3	Absence of innovation and creativity	3
4	Lack of organizational learning	2
5	Lack of entrepreneurial behavior	2

Table 24*Contextual Levels – Antecedents*

Row	Factor	Level
1	Absence of knowledge modeling and structuring across ministries	4
2	Weak national laws and regulations	2
3	Lack of continuous knowledge utilization	4
4	Weak knowledge absorption capability	3
5	Individual-level factors	1

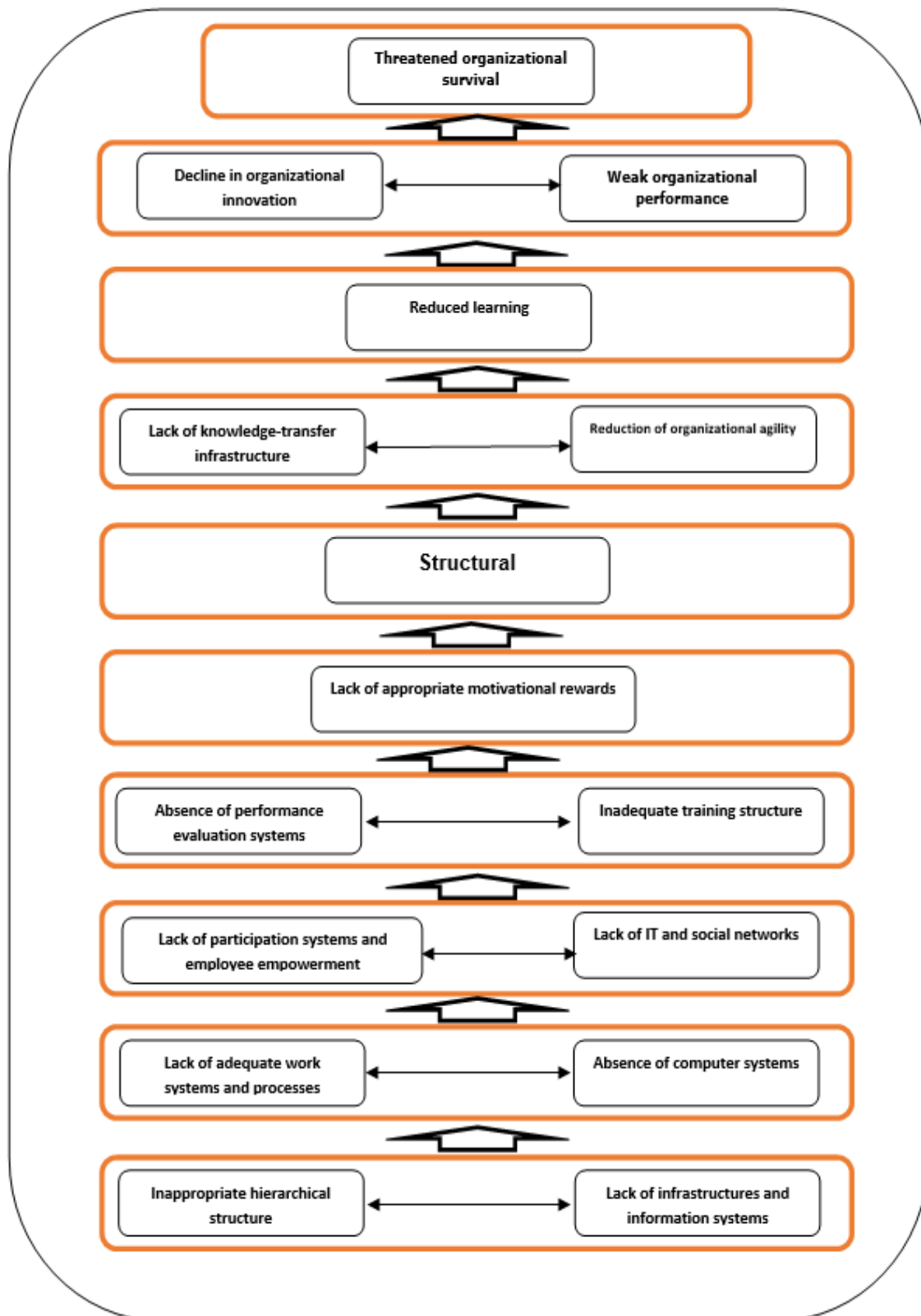
Table 25*Contextual Levels – Outcomes*

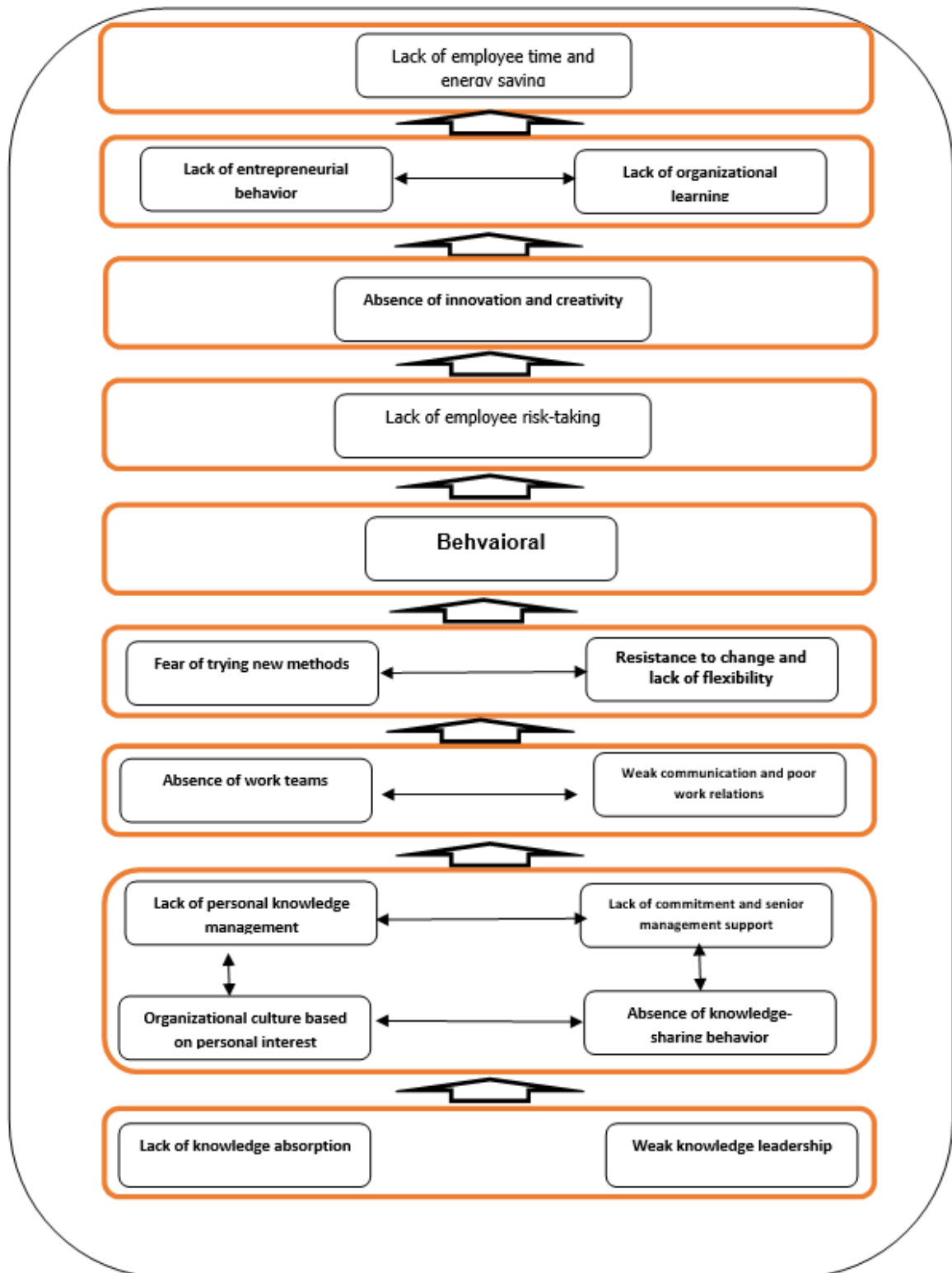
Row	Factor	Level
1	Lack of human–structural intelligence	3
2	Increased indirect costs	1
3	Decline in societal knowledge quality	2
4	Increased intellectual rigidity	1
5	Loss of creativity and innovation	2

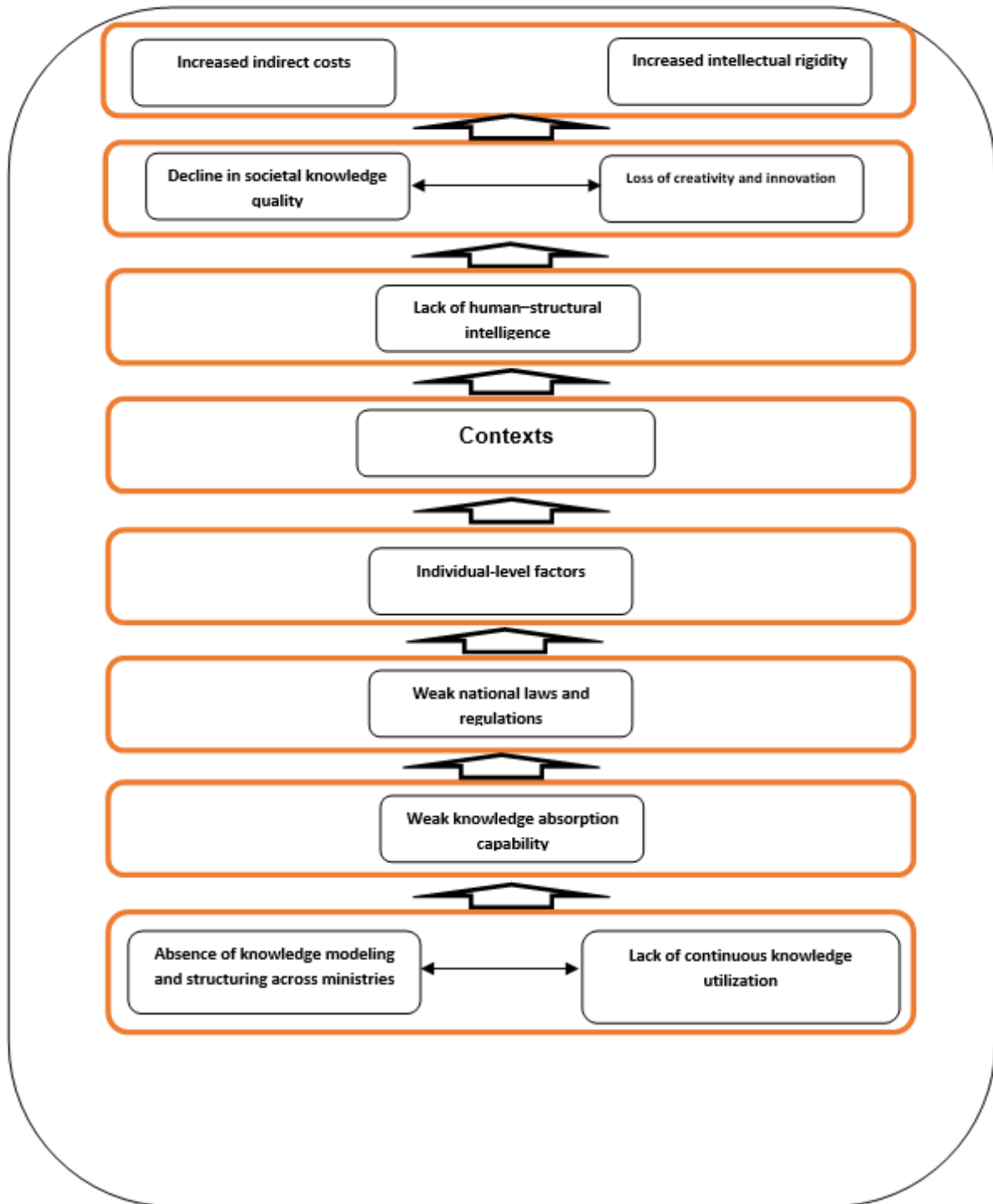
The results presented in Tables 19 through 24 outline the hierarchical structuring of antecedents and outcomes across structural, behavioral, and contextual dimensions, forming the foundation of the interpretive structural model. In the structural antecedent hierarchy, lack of appropriate motivational rewards emerges as the most foundational driver at Level 1, while major systemic shortcomings such as weak infrastructures and inappropriate hierarchical structure occupy the highest levels, showing their broad impact on the system. Structural outcomes reveal threatened organizational survival as the deepest and most dependent variable, with reduced agility and insufficient knowledge-transfer infrastructure forming higher-level drivers. Behavioral antecedents display a clear stratification in which resistance to change and fear of trying new methods form fundamental behavioral constraints, while weak knowledge leadership and lack of knowledge absorption stand at the highest strategic level, exerting strong influence over all other behavioral weaknesses. Behavioral outcomes indicate that loss of time and energy efficiency is the most basic consequence, whereas risk aversion represents the highest-level behavioral outcome shaping broader innovation-related deficits. Contextual antecedents highlight individual factors as the fundamental determinant, while absence of cross-ministerial knowledge structuring and lack of continuous knowledge utilization form the strongest contextual drivers. Contextual outcomes situate increased indirect costs and intellectual rigidity at the most basic level, while the deeper societal consequences—declining knowledge quality and loss of creativity—emerge at higher levels. Collectively, these hierarchical layers reveal the multi-level architecture of knowledge stagnation, clarifying how foundational weaknesses propagate upward to shape strategic and systemic outcomes in the Ministry of Health, Treatment, and Medical Education.

Figure 1

Final Model of the Study







Discussion and Conclusion

The purpose of this study was to develop a structured and multi-level model of the antecedents and outcomes of knowledge stagnation within the Ministry of Health, Treatment, and Medical Education. The results revealed that knowledge stagnation is not a single-dimensional phenomenon; rather, it emerges through interconnected structural, behavioral, and contextual deficiencies that accumulate and reinforce one another over time. From a structural perspective, the findings

showed that inadequate information infrastructures, inappropriate hierarchical structures, insufficient computer systems, poor training structures, and the absence of performance evaluation mechanisms are among the most influential determinants of stagnation. These findings align with prior research indicating that knowledge-based performance requires reliable knowledge infrastructures, supportive IT systems, and formal mechanisms for knowledge sharing [1, 9]. In particular, the lack of technological readiness, combined with rigid structural constraints, contributes to poor knowledge flow and fragmented organizational learning, echoing previous studies that highlight the centrality of technological capacity and digital coordination for effective KM systems [8, 37].

The ISM results positioned inadequate knowledge infrastructures and inappropriate hierarchical structures among the highest-driving antecedents. These structural barriers often prevent the absorption and integration of new knowledge, thus reducing innovation and organizational adaptability. This pattern resonates with insights from absorptive capacity literature, emphasizing that organizations with weak structural foundations face difficulty in recognizing, assimilating, and applying knowledge [6, 15]. Studies across different sectors further demonstrate that the absence of IT systems and clear work processes undermines the development of organizational learning routines and innovation capabilities, consistent with our findings [2, 25]. Similarly, cross-border and public-sector innovation studies underscore that without structured knowledge mechanisms and transparent evaluation systems, knowledge gradually becomes siloed and underutilized [3, 27]. Thus, the strong influence of structural shortcomings observed in this study is in line with the broader literature on how organizational architecture shapes the sustainability of knowledge practices.

At the behavioral level, the findings revealed that weak knowledge leadership, absence of knowledge-sharing behaviors, weak communication networks, lack of work teams, and insufficient managerial support are central behavioral forces contributing to stagnation. The placement of weak knowledge leadership and lack of knowledge absorption among the highest-level drivers suggests that leadership is essential for shaping the motivational climate and psychological readiness for knowledge engagement. This agrees with previous work highlighting the role of leadership in fostering knowledge creation, enabling intellectual capital development, and promoting collaborative culture [10, 33]. Organizations with strong leadership commitment develop norms for collaboration, trust, and openness, which facilitate efficient knowledge circulation and innovation [11, 16]. Additionally, the observed behavioral barriers—such as resistance to change, fear of trying new methods, and lack of personal knowledge management—mirror results from organizational learning studies showing that psychological and cultural inhibitors can restrict the willingness of employees to share and apply knowledge [12, 13]. These shared insights reflect a recurring pattern across different studies: behavioral dynamics are as critical as structural conditions in shaping knowledge outcomes.

The outcomes identified at the behavioral level, such as lack of risk-taking, absence of innovation and creativity, poor organizational learning, and limited entrepreneurial behavior, are consistent with findings from innovation performance and strategic flexibility literature. Prior research suggests that when internal knowledge mechanisms are weak, individuals become hesitant to experiment, errors are stigmatized, and creative expression declines [22, 23]. Our results echo these patterns, showing that stagnation manifests in diminished innovative thinking, constrained problem-solving capability, and the erosion of learning behaviors—all of which align with earlier observations in multinational and emerging-economy contexts [14, 31]. Moreover, the link between knowledge stagnation and lack of entrepreneurial behavior reinforces the idea

that innovation is deeply dependent on knowledge mobility, absorptive capacity, and supportive leadership practices [20, 24].

The contextual dimension of the findings demonstrated that deficiencies extend beyond organizational boundaries. Weak national regulations, absence of cross-organizational knowledge modeling, lack of platforms for continuous knowledge utilization, and inadequate knowledge absorption capability at the system level were among the highest-impact factors. These results support the argument that institutions operate within broader ecosystems that can either facilitate or hinder knowledge processes [26, 28]. In public-sector frameworks, contextual misalignments—such as inconsistent policy environments, fragmented legal frameworks, and insufficient incentives for inter-organizational collaboration—can significantly constrain knowledge exchange and innovation [30, 38]. The findings also reflect insights from studies on cross-border innovation and international alliances, which emphasize that knowledge flows require supportive governance mechanisms, shared standards, and collaborative infrastructures [27, 29]. Within this study's context, the lack of system-wide knowledge architecture limits the ability of ministry units to update, coordinate, and leverage knowledge collaboratively.

The higher-level contextual outcomes—declining societal knowledge quality, increased intellectual rigidity, and loss of creativity and innovation—mirror the broader impacts identified in studies examining knowledge stagnation in national and inter-organizational contexts. For example, research in solidarity organizations and manufacturing firms shows that when knowledge is not continuously renewed, both organizational and societal innovation capacity erode [5, 8]. These findings highlight the systemic consequences of stagnation: knowledge is not only an internal organizational asset but also a societal resource that influences policy outcomes, innovation ecosystems, and public welfare. As a result, the outcomes observed in this study reflect both organizational and macro-level realities, consistent with research showing that knowledge declines at the systemic level when innovation networks and absorptive capacity fail to operate effectively [4, 7].

Moreover, the ISM hierarchy in this study positions “threatened organizational survival” as the deepest structural outcome, emphasizing that prolonged stagnation is not merely a barrier to innovation but a strategic risk to the institution's sustainability. This aligns with competitive strategy research showing that organizations unable to adapt through knowledge renewal lose strategic flexibility, agility, and organizational resilience [19, 37]. The decline in agility identified in this study also connects with work highlighting the role of collaboration, knowledge integration, and IS capabilities in strengthening organizational responsiveness [34, 35]. Thus, the findings collectively show that the antecedents and outcomes of knowledge stagnation in the Ministry of Health, Treatment, and Medical Education reflect universal KM dynamics documented across sectors and geographies.

Overall, this study contributes to the literature by providing an integrated, multi-level model that captures the complex interactions among structural, behavioral, and contextual variables leading to knowledge stagnation. By applying ISM, it illuminates how foundational weaknesses cascade into deeper systemic consequences, offering a structured framework for diagnosing and addressing stagnation in health-sector organizations.

Although this study provides a comprehensive multi-level model of knowledge stagnation, several limitations must be acknowledged. First, the study relied exclusively on expert judgment, which, despite its strength in capturing deep insights, may introduce subjective biases related to personal experiences and professional backgrounds. Second, the research was conducted within a single national ministry, limiting the generalizability of the findings to other health systems or public-sector organizations with different cultural, structural, or political contexts. Third, while ISM effectively reveals hierarchical

relationships, it does not measure the strength of influence between variables; thus, causal intensity remains unexplored. Lastly, the study did not incorporate quantitative organizational performance metrics that could provide empirical validation of the outcomes identified in the model.

Future research should consider applying mixed-method designs that combine expert input with large-sample quantitative data to validate the relationships and test the predictive power of the model. Comparative studies across different ministries, countries, or health systems could also illuminate contextual variations in knowledge stagnation dynamics. Additionally, longitudinal studies would allow researchers to observe how knowledge stagnation evolves over time and how interventions influence the system's trajectory. Further work could also explore the role of digital transformation, AI-driven knowledge systems, and data governance in countering stagnation.

Organizations should prioritize strengthening leadership commitment, enhancing IT infrastructure, and creating structured mechanisms for cross-unit knowledge sharing. Training programs aimed at reducing resistance to change and fostering a culture of experimentation can help mitigate behavioral barriers. At the system level, developing national-level knowledge policies, improving regulatory coherence, and establishing cross-organizational learning platforms would significantly enhance knowledge mobility and prevent stagnation.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Written consent was obtained from all participants in the study.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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