

A MATURITY MODEL FOR HOSPITAL DEPARTMENT DIGITALISATION: DESIGN AND EXPERT VALIDATION

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Purpose: The purpose of this paper is to present a maturity model for healthcare digitalisation processes at the hospital ward level. The model is intended to support self-assessment of wards and facilitate both internal and external benchmarking. Identifying strengths and areas for improvement can help develop and implement digitalisation initiatives tailored to the specific characteristics of different types of hospital wards.

Design/methodology/approach: The maturity model was developed using Becker et al.'s methodology, which provides a systematic and scientifically rigorous framework for maturity model design. The development process included multiple stages of model construction and iterative validation conducted by domain experts, ensuring the consistency, relevance, and practical applicability of the proposed solution.

Findings: The article presents the complete structure of the maturity model, comprising five maturity levels and 20 assessment areas grouped into three perspectives: qualitative, organisational, and technical. In addition to defining the model structure, the paper specifies assessment criteria and reference points for each perspective, enabling the identification of low, medium, and high levels of maturity. The model therefore provides a comprehensive framework for evaluating both the implementation and practical use of information technologies within hospital wards.

Research limitations/implications: The validation process at all stages of model development relied exclusively on experts from Polish hospitals. Although the experts represented different healthcare organisations, the findings may reflect the specific context of the Polish healthcare system and may require further validation in other countries and healthcare settings.

Practical implications: The model provides hospital ward managers and healthcare professionals with a practical self-assessment tool to support improvement planning, investment decision-making, and the coordination of digitalisation activities across hospital departments.

Social implications: Improved digitalisation of healthcare processes may enhance accessibility and quality of medical services by enabling more effective use of information technology in clinical practice.

Originality/value: The originality of the proposed model lies in its focus on the hospital ward level. Unlike existing maturity models that assess digitalisation at the level of entire hospitals,

the proposed approach addresses the specific characteristics, processes, and digitalisation needs of individual wards.

Keywords: Maturity Model, Digital Maturity, Hospital Department, Health Information System, Strategic Planning.

Category of the paper: Research paper.

1. Introduction

Thanks to information technology, new opportunities are emerging to improve the quality of life. Its implementation enhances the effectiveness of organisational activities. It is recognised as a key tool for improving quality and accessibility in healthcare, demonstrating both administrative and medical benefits of hospital digitalisation (Barłóg, Mendryk, 2025; Sætra, Fosch-Villaronga, 2021). Digitalisation is considered one of the most effective responses to stakeholder pressure to improve healthcare quality and reduce costs (Saifudin et al., 2021). It involves the use of digital technologies—such as mobile devices, applications, artificial intelligence, and data analytics—to enhance healthcare delivery, diagnosis, patient monitoring, and overall quality of life. It encompasses a wide range of activities, from electronic health records and telemedicine to health-monitoring apps, wearable tracking devices, and other innovations (Woods et al., 2023).

Hospital digitalisation can be considered effective when it improves the quality of care, reduces costs through streamlined administrative processes, and ensures data confidentiality and security (Rachid et al., 2024). However, despite managerial efforts, hospitals have not achieved the same level of digital success as other industries, such as finance or retail (Khuntia et al., 2024). Many healthcare digitalisation projects have failed to meet expectations (Agarwal et al., 2010; Preko, Boateng, 2020). The main reasons include high organisational complexity, multiple decision-making levels, inconsistent procedures, and diverse staff competencies and roles (Hellstrand Tang et al., 2024; Krawczyk-Sołtys, Płatkowska-Prokopczyk, 2024). This causes problems in managing the digitalisation of hospitals, which is seen as the implementation of changes like process innovations, often even breakthrough ones (Bygstad, Øvrelid, 2020). Moreover, hospitals' structures may create local bottlenecks that hinder information flow (Winasti, Berden, van Merode, 2023).

Maturity models can help overcome these challenges, as they are widely used to assess and improve business processes and organisational performance. Their key principle is progression through successive stages—from basic to optimised maturity levels (Gomes, Romão, 2018; Knosp et al., 2018). In healthcare, such models assist managers in guiding complex digital transformation initiatives, fostering engagement, supporting organisational learning, and enabling systematic evaluation of outcomes (Bititci et al., 2015; Menukhin et al., 2025). Although critics note that digital transformation does not always follow a linear path (Teichert,

2019), maturity models remain valuable tools for understanding and supporting management practices (Carvalho et al., 2019; Ochoa-Urrego, Peña-Reyes, 2021).

Existing hospital maturity models—such as the Hospital Information System Maturity Model (HiSMM), NHS Infrastructure Maturity Model (NIMM), Telemedicine Service Maturity Model (TMSMM), and Electronic Medical Record Adoption Model (EMRAM)—focus on the hospital as a whole rather than on individual units. Yet, departments differ considerably in work characteristics, information needs, and IT use. To address this gap, this article presents a model for assessing the maturity of hospital department digitalisation, following the approach of Jäkel et al. (2024).

The proposed approach allows managers to view the hospital's digitalisation process through the lens of its individual departments. This enables the detection of so-called "bottlenecks" resulting from, among other things, differences in staff digital competencies, equipment availability, or work organisation. Since departments (e.g., surgical, internal medicine, pediatric) differ significantly in their work nature, information needs, and use of IT systems, a maturity model at the hospital level is often too general. This is especially true since developing local solutions in the design of IT systems promotes their actual use by users (Wiesche et al., 2024). Our model serves as a self-assessment tool that helps managers diagnose problems and identify appropriate solutions, such as integration with medical devices, training programs, workflow optimisation, patient data management, or system interface design. In this paper, we consciously employ the term 'digitalisation' rather than 'computerisation', as the proposed model extends beyond basic IT infrastructure installation to encompass advanced data utilisation, artificial intelligence, predictive analytics, and systemic integration within HIS.

The subsequent part of the article presents the theoretical foundations of maturity models and the existing approaches used in healthcare. Next, the methodology for developing the proposed model and its detailed characteristics is described. The following section concerns the results of expert verification, based on which the model's validity and utility were assessed. The discussion highlights its practical significance, application possibilities, and limitations. The article concludes with findings and recommendations on further research directions and the model's potential use in hospital management practice.

2. Digital maturity models in healthcare

2.1. The essence and application of maturity models

Maturity models are widely used to evaluate and improve business processes and selected areas of organisational functioning. The key principle of their construction is the progression through successive stages of development—from a basic level to increasingly advanced and

optimised states (Knosp et al., 2018). Gradually increasing maturity represents a path to improvement as the organisation evolves toward a desired future state.

Models of this type have found application in many sectors, including education, energy, finance, public administration, manufacturing, and healthcare (Li, Lau, 2019). A special category comprises Digital Maturity Models (DMMs), which enable measurement of digitalisation levels and support planning for an organisation's digital transformation (Haryanti et al., 2024).

2.2. Evaluating the utility of maturity models

Maturity models define hierarchically ordered levels of advancement, identifying characteristic practices and competencies. Consequently, organisations can diagnose their current situation and plan directions for improvement (Vargas et al., 2023). In healthcare, such models support managers in overseeing complex digitalisation initiatives (Menukhin et al., 2025).

The advantages of these models include, among others, stimulating management engagement, facilitating organisational learning, and providing a tool for systematic performance assessment (Bititci et al., 2015). At the same time, critics emphasise that the complexity of digital transformation cannot always be reduced to a linear sequence of stages and that there is no universal path for digital development (Teichert, 2019). However, assuming that a model is a simplification primarily intended to support better understanding and practical management, its value of application can be recognised (Carvalho et al., 2019; Ochoa-Urrego, Peña-Reyes, 2021).

2.3. Maturity models in healthcare

In recent years, numerous maturity models have been developed in the healthcare sector, although they remain at a relatively early stage (Vargas et al., 2023). Among the most frequently discussed are:

- Electronic Medical Record Adoption Model (EMRAM) – an eight-stage model developed by HIMSS, used to assess the advancement of electronic medical record implementation, considering system integration, security, and the use of clinical decision support tools (Najjar et al., 2021).
- Hospital Information System Maturity Model (HiSMM) – assesses the maturity of hospital information systems and staff competencies in their use, distinguishing six levels of development (Gastaldi et al., 2018).
- Healthcare Usability Maturity Model (UMM) – enables the assessment and improvement of IT system usability in healthcare, ranging from a lack of formal practices to their full optimisation (Carvalho et al., 2018).

- Informatics Capability Maturity Model (ICMM) – evaluates an organisation's capabilities in the use of medical informatics based on five development levels—from basic to innovative excellence (Gomes, Romão, 2018).
- Business Intelligence Maturity Model (BIMM) – used to assess the extent of business intelligence tool utilization in healthcare organizations, covering five levels from ad hoc solutions to full optimization (Gastaldi et al., 2018).

In addition to the above, other approaches have also been developed, such as the Digital Health Communication Maturity Model (DHCMM) (Kim, Namkoong, 2025), the Telemedicine Service Maturity Model (TMSMM) (Van Dyk, Schutte, 2013), and models related to demand and capacity management in healthcare facilities (Myrberg et al., 2024).

2.4. Research gap and the need for a new approach

Existing maturity models primarily focus on the institution as a whole. In practice, however, hospital departments differ significantly in the nature of their work, their information needs, and their use of IT systems. There is a lack of a tool to diagnose diversification between units within the hospital.

The maturity model for hospital department digitalisation proposed in this article aims to fill this gap. Its essence is to enable managers to assess the degree of digitalisation at the departmental level, enabling better problem identification, detection of "bottlenecks", and more precise improvement actions.

3. Research methodology

The maturity model for hospital department digitalisation processes was developed in accordance with the methodology proposed by Becker et al. (2009). The individual stages of the research approach are presented in Figure 1.

The model's development originated from the need to support the University Clinical Hospital (UCH) in Opole's digitalisation process. The project was carried out in collaboration with the Hospital Director and a team of researchers from the Faculty of Economics and Management at Opole University of Technology, enabling validation by both practitioners and the academic community. Expert validation was conducted at several stages: during the definition of maturity dimensions and aspects (Stage 3), throughout the iterative model design process (Stage 5), and during validation in selected departments of the UCH in Opole (Stage 6).

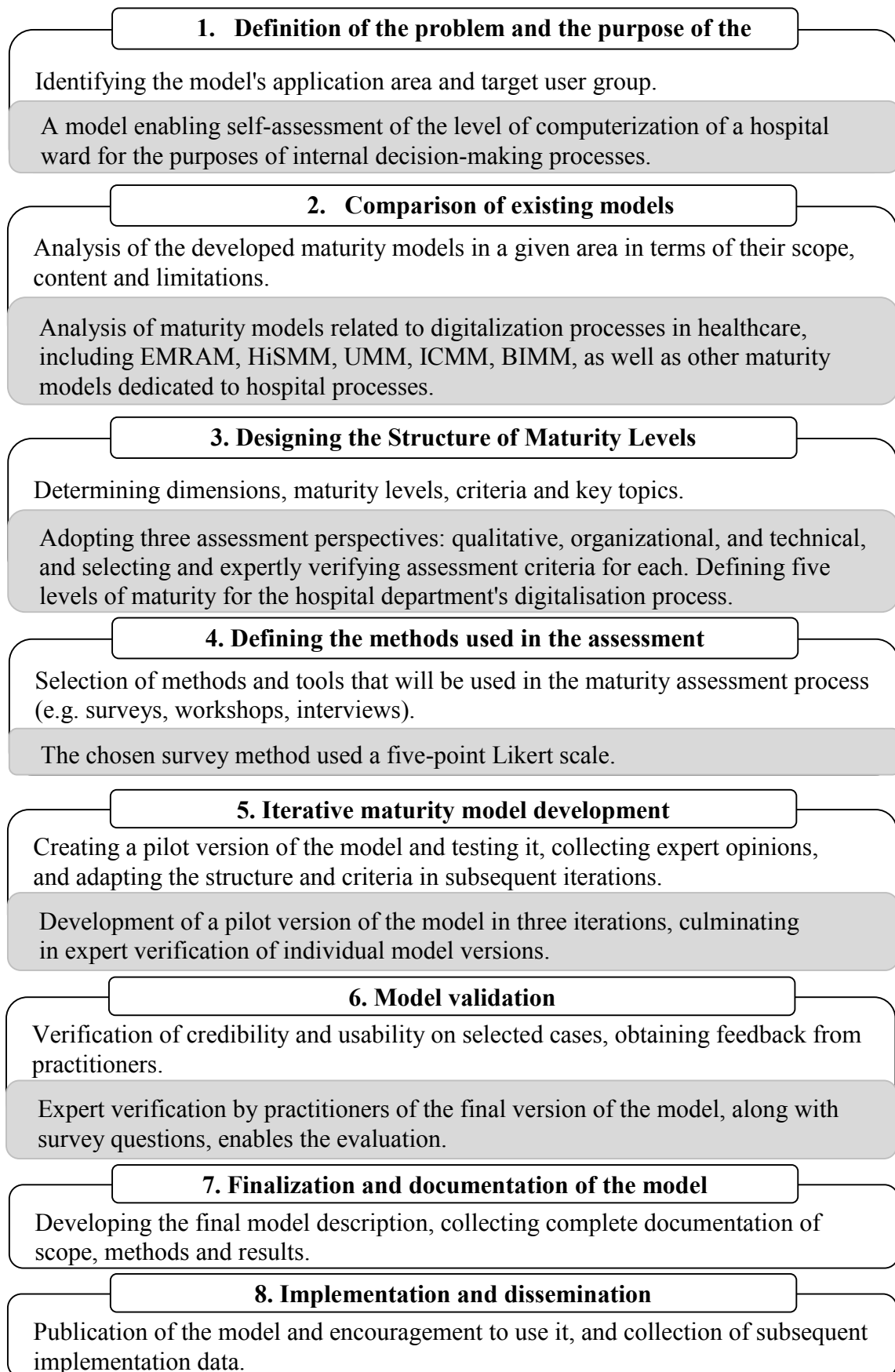


Figure 1. Methodology for developing a maturity model of digitalisation processes in hospital departments.

3.1. Initial verification

The first significant verification occurred during the phase in which dimensions, maturity levels, and evaluation criteria were defined. A three-step approach was adopted:

1. consultations with scientific experts who participated in the model development and literature analysis,
2. verification by practitioners – directors of eleven clinical hospitals in Poland,
3. presentation of the preliminary version of the model structure at the 10th International Conference "Knowledge and Information Technologies in Creating Entrepreneurship", combined with the 4th Congress of Economic Informatics (October 2023, Poland).

3.2. Design and detailed verification

To ensure high validity and reliability of the developed model, a rigorous multi-stage expert validation process was conducted during the design stage, involving a total of 25 specialists: 13 independent external experts and 6 internal validators during the thematic validation phase, and another 6 internal validators in the questionnaire build stage.

A purposive sampling strategy was used to recruit 13 external experts, based on a strict alignment between their verified professional competencies and the model's specific dimensions. To ensure objective assessment and prevent bias, all 13 external experts were fully independent and had no professional or hierarchical subordination to the research team.

Due to the complexity of the multi-stage verification and the difficulty of recruiting high-level specialists for a comprehensive, overarching review, the evaluation scope was strictly divided into distinct thematic streams. Each expert evaluated only the components directly matching their domain of expertise, which effectively eliminated the risk of evaluative overlap between groups. The verification was conducted across three perspectives: qualitative, organisational, and technical (Table 1). Each group of experts assessed only the areas consistent with their professional competencies.

Table 1.

Participation of experts in verifying the model at the design stage

Qualitative perspective	Organizational perspective	Technical perspective
Assessment by seven experts, including two from the UCH in Opole. • Healthcare quality specialists – individuals responsible for audits, ISO standards, and hospital accreditations. • Personal data protection experts (GDPR) – specialists in data processing compliance with legal regulations. • Clinicians with IT experience – doctors and nurses with practical experience using IT systems and their impact on the quality of care.	Assessment by six experts, including two from the UCH in Opole. • Healthcare managers – individuals managing hospitals or departments, familiar with organisational and administrative challenges. • Project management specialists – especially those with experience in healthcare or IT system implementation. • Change management experts – especially those with experience implementing technology in medical facilities.	Assessment by six experts, including two from the UCH in Opole. • Medical IT specialists - individuals involved in the design, implementation, and maintenance of IT systems in hospitals. • IT system architects - specialists in IT infrastructure and system integration. • Cybersecurity specialists - individuals responsible for data security in medical facilities.

The updated model underwent additional verification by 6 experts at the UCH in Opole. Each of the six participants received a full version of the model, encompassing all three perspectives, with questions formulated for each criterion. The set of questions was then reviewed again, this time to ensure its adequacy and to assess the branch management's ability to conduct a self-assessment without external auditors.

3.3. Final validation

In the final validation phase, an empirical study was conducted to assess the maturity of digitalisation processes using the proposed model. The study involved a multidisciplinary cohort of 59 respondents, representing every hospital department, primarily clinicians - including physicians, nurses, technicians, and medical secretaries—as well as administrative staff and IT specialists. During this verification stage, participants were also asked to evaluate the model's structure for validity and comprehensiveness as a measurement tool.

4. Maturity model of digitalisation processes in hospital departments

4.1. Model structure

The final version of the hospital department digitalisation maturity model encompasses three complementary perspectives: qualitative, organisational, and technical. Each perspective is defined by a set of 6-7 criteria, each with detailed benchmarks for assessment. The model is based on a five-level maturity scale (Table 2), with levels arranged hierarchically - from fragmented, characterised by a lack of systematic IT support, to excellent, where the department utilises advanced analytics, artificial intelligence tools, and a proactive approach to process improvement.

Table 2.
Characteristics of maturity levels

Level name	Characteristic
Fragmentary	Lack of systematic IT support, dominance of paper processes and ad hoc activities.
Basic	Partial, limited use of IT in the hospital department, lack of integration and stability.
Intermediate	IT systems support most of the hospital's departmental key processes; there is partial integration, and data is beginning to support decision-making.
Advanced	Extensive and consistent system integration, use of reports, indicators, qualitative analyses; managers actively manage processes through IT.
Excellent	Complete system integration, use of AI, predictive analytics, and decision support tools; proactive quality and safety improvement.

The authors intended the model to serve both diagnostic and developmental purposes: to determine the current level of maturity of the department's digitalisation processes and to support management and staff in planning improvement activities and making investment

decisions. It is intended to serve as a self-assessment tool for departments, primarily for internal hospital management purposes.

4.2. The qualitative perspective

The qualitative perspective assesses the extent to which IT systems are utilised in the department's clinical and administrative processes, with particular emphasis on their impact on the quality and safety of patient care, the completeness of documentation, and the ability to make data-driven decisions. This perspective identifies seven criteria that capture various qualitative aspects of the department's operations. To simplify the description in Table 3, three aggregated rating levels have been introduced: low (fragmented and basic levels), medium (intermediate level), and high (advanced and excellent levels).

Table 3.
Criteria for the qualitative perspective

Criterion	Brief characteristics from the perspective of aggregated levels of the maturity model
Coordination of clinical processes	• <i>low</i>: no IT support, paper documentation, • <i>medium</i>: the system supports most processes, including team communication, • <i>high</i>: full integration of patient records in real time, using AI, predictive analytics, and remote consultations,
Clinical knowledge management and EDM documentation	• <i>low</i>: documentation is mostly paper-based, • <i>medium</i>: full EDM management with access to it in the system, • <i>high</i>: integration of data from various sources, patient access is online, EDM is AI-supported, and electronic consents for treatments,
Clinical decision support	• <i>low</i>: lack of IT tools, decisions based solely on experience and analysis of traditional documents, • <i>medium</i>: basic alerts (e.g., drug interactions), treatment recommendations, • <i>high</i>: reports integrated with EMR, risk prediction, dynamic treatment suggestions, integration with knowledge bases,
Big Data analysis in clinical and administrative processes	• <i>low</i>: traditional analysis tools only, mostly manually collected data, • <i>medium</i>: access to reports and quality indicators, basic dashboards, • <i>high</i>: regular operational and quality analysis using IT, automatically generated alerts, full use of BI, AI, IoT; predictive analytics and benchmarking,
Adapting the IT infrastructure to the needs of the branch	• <i>low</i>: infrastructure not tailored to needs and unstable, staff lack trust in the IT systems used. • <i>medium</i>: IT systems operate stably, medical devices are partially integrated with IT systems, and IT support responds to failures. • <i>high</i>: regular collaboration with the IT department on expanding the IT infrastructure, flexible and proactive infrastructure, integrated with BI/AI, and the department participates in pilots of new solutions.
The degree of integration of medical devices with hospital systems	• <i>low</i>: no integration, data transcribed manually, • <i>medium</i>: partial integration of selected devices, • <i>high</i>: full automatic integration and analysis of device data, alerts generated based on device data,
Supporting the quality and safety of care	• <i>low</i>: no recording of adverse events (potentially harmful) and risk incidents in IT systems, • <i>medium</i>: regular use of quality modules in IT systems to analyse and prevent adverse events, responding to security alerts generated by systems, • <i>high</i>: real-time analysis of quality indicators, use of BI, predictive analytics, and monitoring the effectiveness of actions.

The qualitative perspective is the foundation of the entire model, as it allows for the assessment of the extent to which IT solutions actually translate into the department's basic tasks, i.e., ensuring the effectiveness of clinical processes, making data-driven therapeutic decisions, and ensuring patient safety.

4.3. Organisational perspective in the digitalisation maturity model of hospital departments

The organisational perspective encompasses aspects of process and resource management that determine the effectiveness of IT use within a department. It addresses compliance with legal regulations and security, employee digital competence, risk management, infrastructure development, and the degree of digitalisation of administrative processes. An assessment from this perspective allows us to understand the extent to which a unit can systematically implement and develop IT in its daily operations. This perspective is briefly summarised in Table 4.

Table 4.
Criteria for the organisational perspective

Criterion	Brief characteristics from the perspective of aggregated levels of the maturity model
Compliance management	• <i>low</i>: lack of awareness and procedures, lack of training and monitoring; incidents of non-compliance reported sporadically, • <i>medium</i>: compliance procedures are in place, and staff are trained in them; the manager monitors their application, and incidents are recorded, • <i>high</i>: active participation in a compliance culture, systematic audits, employees report potential risks and contribute to the creation of good practices,
Digital competences of the team	• <i>low</i>: lack of IT training, knowledge acquired informally by staff, no IT competency assessment in employee appraisal, • <i>medium</i>: available training program and educational materials, initial IT competency assessment, manager gathers information on IT training needs, • <i>high</i>: personalised development programs, mentoring, periodic competency assessment, culture of IT knowledge sharing,
IT Operational Risk Management	• <i>low</i>: lack of knowledge of security procedures, no IT adverse event log or contingency plans, • <i>medium</i>: established procedures for reporting IT adverse events, reporting log, department participates in developing contingency plans, • <i>high</i>: active threat monitoring, periodic training and exercises, proactive reporting of potential risks, participation in audits and procedure improvement,
Patient interaction with HIS systems and telemedicine	• <i>low</i>: no electronic patient access to any documentation created in the department, communication is primarily paper-based or one-way, • <i>medium</i>: some results available online, partial e-registration, teleconsultations conducted sporadically, consents for procedures recorded electronically, • <i>high</i>: full patient access to documentation and online communication, systematic teleconsultations, remote monitoring (IoT), active promotion and support for patients in using digital tools,
Managing the development of IT infrastructure and systems	• <i>low</i>: lack of reporting of IT infrastructure development needs, lack of participation in IT projects, • <i>medium</i>: regular and formal reporting of IT infrastructure development needs, participation of branch staff in consultations and tests, assessment of the impact of IT projects on branch processes, • <i>high</i>: close cooperation with the IT department on infrastructure development projects, initiation of innovations, systematic collection of feedback, and implementation of improvements,

Cybersecurity	• <i>low</i>: lack of procedures and training, low awareness of threats, lack of incident records, bad habits and practices (e.g., password sharing), • <i>medium</i>: adherence to established procedures, basic training within the department (taking into account specifics), incident logging, internal audits, • <i>high</i>: proactive identification of risk factors and threats, periodic training, safety culture, participation in simulations, and co-creation of educational materials focused on the specifics of the department,
Digital Administrative Processes (ERP)	• <i>low</i>: no ERP systems, processes conducted manually or in spreadsheets, • <i>medium</i>: use of selected ERP functions (e.g., requisitions, leave), some electronic processes, basic training, • <i>high</i>: full support for ERP processes, real-time reporting, use of data for decision-making and optimization, participation in process improvement,

4.4. Technical perspective

The technical perspective encompasses aspects of the hospital department's IT infrastructure and tools. This perspective allows us to assess the extent to which technical solutions support clinical and administrative processes and whether they enable the department's digitalisation process to progress. Ultimately, the level of technical advancement, described in Table 5, determines the stability, consistency, and security of the department's digitalisation.

Table 5.
Criteria of the technical perspective

Criterion	Brief characteristics from the perspective of aggregated levels of the maturity model
Data management and reporting	• <i>low</i>: lack of consistent data, manual or scattered reports; management does not use metrics, • <i>medium</i>: access to basic reports and analyses; data supports clinical and administrative planning, • <i>high</i>: advanced reporting tools used in the department BI, AI, prediction, and real-time reporting,
Interoperability and integration of IT systems	• <i>low</i>: the department uses multiple independent systems, and data is transferred manually, • <i>medium</i>: systems provide insight into key clinical data from various sources, partially integrated interfaces, • <i>high</i>: full integration of IT platforms in real time, data available immediately, integration with external sources (e.g., ZUS, P1),
End-user support	• <i>low</i>: lack of formal IT support, problems solved ad hoc, lack of training tailored to the department's needs, • <i>medium</i>: helpdesk in place, procedures for reporting and resolving problems, training aligned with the department's identified needs, • <i>high</i>: advanced user support portal supported by AI and chatbots, reporting on the quality of department support from IT, personalized training,
Scalability and flexibility	• <i>low</i>: outdated IT infrastructure, lack of business continuity plans, IT systems not adapted to mobile devices, • <i>medium</i>: modular IT systems, partial scalability, basic BCP and DRP plans, • <i>high</i>: flexible infrastructure (e.g., cloud), dynamic scaling, resilience to load increases, automated DRP testing, and resource optimization,

Cont. table 5.

Advanced and ergonomic IT systems	• <i>low</i>: limited use of IT systems on the ward, non-intuitive interfaces, lack of automation of routine activities, • <i>medium</i>: IT systems supporting most processes on the ward, ergonomic interfaces, partial automation of typical activities, • <i>high</i>: intelligent systems with AI and ML, adaptive interfaces, automatic process optimization, systems learning based on user behavior patterns,
Security and data transmission	• <i>low</i>: no data encryption at the department or use of outdated methods; basic backup system, • <i>medium</i>: encrypted communication channels, two-factor authentication, automatic backups, • <i>high</i>: blockchain and SSI solutions, full transparency, intelligent risk detection systems, compliance with ISO/IEC standards,

5. Discussion

The essence of the proposed maturity model is the assessment and improvement of digitalisation processes at the hospital department level. Departments differ in their workflows, patient profiles, information needs, and how they utilise IT systems. Analysis at the organisation-wide level does not capture these differences. It often blurs local barriers, such as differences in staff digital competencies, hardware limitations, specific workflows, or management's differing attitudes toward digitalisation. Drilling down to the department level allows for more precise diagnosis and, consequently, more effective implementation of solutions, for example, customised training, system interface modifications, or optimisation of therapeutic and administrative procedures. From an economic perspective, the proposed maturity model serves as a decision-support tool for capital budgeting in healthcare. By identifying departments with the lowest digital maturity, hospital managers can prioritise investments where the marginal utility of IT adoption is highest, preventing the inefficient "siloed" spending that often plagues public healthcare systems.

The lack of consistent digitalisation across departments creates significant challenges throughout the hospital. Situations in which some departments use electronic ordering systems while others continue to rely on paper or ad hoc processes result in fragmented information flows and organisational chaos. This applies not only to collaboration with diagnostic departments but also with the pharmacy, administration, and other support units. Ensuring consistency in areas critical to patient safety, such as communicating information about drug intolerances, coordinating inter-departmental consultations, and preparing patients for procedures, is particularly important. From a hospital-wide perspective, the lack of integration at the department level results in delays, increased risk of errors, and higher costs. The model's granular approach addresses internal information asymmetries within complex hospital structures. By quantifying maturity at the departmental level, the framework enables a more

precise evaluation of the relationship between digital advancement and operational efficiency (e.g., reductions in length of stay or error rates), which is a key focus in health econometrics.

Involving departments in the testing and implementation of new technologies is also particularly important. On a smaller scale, this reduces risk and costs while increasing the accuracy of solutions, as clinical and administrative staff are best placed to identify areas where information-flow problems occur. Therefore, the model also supports creating a space to discuss digitalisation processes that are not always visible at the hospital management level.

An additional value of the proposed approach is its potential for benchmarking. Comparisons between departments within a single hospital, as well as between similar departments in different facilities, help identify gaps and set priorities for improvement. Benchmarking, in this context, provides a practical tool that supports gradual, continuous improvement by enabling hospitals to compare their performance against models and industry standards. Furthermore, the model facilitates analysis of opportunity costs associated with delayed digitalisation. Inefficient digitalisation at the clinical unit level leads to hidden costs from redundant administrative tasks and suboptimal resource utilisation. Our framework provides a strategic roadmap to mitigate these economic losses.

While the inclusion of advanced technologies such as blockchain, predictive analytics, and AI-supported solutions at high levels of maturity may appear speculative, they serve a dual methodological purpose. First, these criteria are realistic reference points for leading Polish academic and clinical hospital centres, which are digital pioneers and have successfully piloted and implemented cloud computing, BI, and AI tools. Second, incorporating these advanced components ensures the model's longevity and 'future-proofing', allowing it to remain a relevant and forward-looking diagnostic framework as the broader digital transformation of the healthcare sector accelerates over the coming years.

From a theoretical perspective, the proposed model provides a framework for examining the evolution of IT processes at the micro level - i.e., within hospital organisational units. It thus offers a new perspective on assessing digital maturity in the healthcare sector, enabling benchmarking and the design of future models that account for both local specificities and the possibility of cross-organisational comparisons.

6. Conclusions

The maturity model for digitalisation processes in hospital departments presented in this article enables a more detailed and differentiated assessment of digitalisation levels than previous approaches that focus on entire institutions. Previous assessments conducted for external stakeholders (primarily the National Health Fund and the Ministry of Health in Poland) are highly aggregated and therefore less responsive to the needs of individual hospital

managers. From an economic standpoint, the model acts as a framework for evidence-based investment prioritisation. Disaggregating digital maturity at the departmental level enables hospital management to mitigate the risk of misallocated capital and ensures that IT investments are directed to units where they can generate the greatest efficiency gains and improvements in service delivery.

The proposed model, based on three perspectives – qualitative, organisational, and technical – enables the identification of the strengths and weaknesses of the digitalisation process in relation to the realities of clinical, managerial, and technological work. The model's structure also incorporates the practical aspect of self-assessment: each perspective can be assessed in collaboration with relevant stakeholders, for example, the technical perspective with the IT department, the organisational perspective with central administration, and the qualitative perspective with auditors or clinicians. The goal of the model was to create a tool primarily for internal use by hospital management in decision-making. The model provides significant practical value by offering departmental management and staff a self-assessment tool to support improvement planning, investment decision-making, and coordination of activities across hospital units. The ability to compare results both between departments within a single facility and between hospitals is also critical. However, this isn't about competition; it's about sharing experiences and identifying best practices to support standardisation processes and contribute to the gradual improvement of healthcare IT systems. An inherent limitation of any model based on self-assessment is the risk of subjective bias or overestimation by departmental managers, particularly in sensitive areas such as compliance culture, cybersecurity practices, and operational risk management. However, within this model's framework, this risk is substantially mitigated by two factors. First, the evaluation is designed as a collaborative internal process involving multiple stakeholders within each ward, creating a system of peer accountability where assessments are transparent to colleagues. Second, since the model is explicitly designed as an internal diagnostic tool for self-improvement rather than an external ranking or punitive auditing instrument, departments have a strong practical incentive to provide accurate data to identify real operational bottlenecks and resource needs.

From a theoretical perspective, the model builds on research on healthcare maturity models, shifting the focus from the entire institution to the departmental level. This approach better captures the complexity of hospital digitalisation processes, the diversity of needs across individual units, and the importance of organisational and cultural factors in the adoption of digital technologies. Furthermore, the model suggests directions for potential process standardisation within similar departments, which can also provide essential inspiration for IT system manufacturers, who often focus on hospital-wide aspects while ignoring the specifics of clinical units. Moreover, the model helps reduce information asymmetry between healthcare providers and IT vendors. By defining clear maturity benchmarks, hospitals can more precisely specify their technological needs, potentially leading to more competitive procurement processes and reduced long-term costs of system ownership and integration. In this context,

identifying best practices for collaborating with patients and their families in similar departments, such as geriatrics, paediatrics, or those caring for chronically ill patients, is particularly important. It should be emphasised that work to date has primarily focused on expert validation.

Future research will focus on the extensive empirical testing of the proposed model across a wider network of hospital departments, both nationally and internationally. A key objective of subsequent studies is to investigate how specific maturity scores correlate with measurable clinical and operational outcomes, such as medical documentation completeness, adverse event reduction, patient waiting times, length of stay (LOS), and cost per patient day. Following the full validation and academic evaluation phase, the model is intended to be made publicly and openly accessible. This open-access approach encourages hospitals to adopt it and establishes a collaborative data-collection framework that will enable longitudinal analysis of the effects of digitalisation on healthcare efficiency and patient safety.

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