Cogitare Enfermagem

TECHNOLOGICAL INNOVATION

Technology prospecting of patents related to clinical reasoning in nursing*

HIGHLIGHTS

1. Educational technologies were underrepresented among the documents analyzed.
2. Patent documents focused on the initial stages of clinical reasoning.
3. Care and management technologies predominated in the landscape identified.
4. Nursing had low participation among the inventors identified.

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ABSTRACT

Objective: To analyze technologies related to clinical reasoning in nursing identified in patent documents available in the databases of the Instituto Nacional da Propriedade Industrial and the World Intellectual Property Organization. **Method:** A documentary, descriptive, and analytical technology prospecting study with a mixed-methods approach was conducted between June and September 2025. It analyzed patent documents filed between 2000 and 2025 that were classified as invention patents or utility models and had care, educational, or management applicability linked to clinical reasoning in health. **Results:** Of the 356 records identified, 172 patent documents made up the final sample. The predominant technologies targeted the initial stages of clinical reasoning, such as data collection, organization, and interpretation, with an emphasis on clinical decision support and information management. **Conclusion:** The documents analyzed reveal gaps in the development of solutions aimed at clinical judgment and decision-making, as well as low participation of nursing among the inventors identified.

DESCRIPTORS: Nursing; Clinical Reasoning; Patent; Technology; Intellectual Property.

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INTRODUCTION

Nursing is the largest health workforce in the world and plays a structuring role in health promotion, prevention, diagnosis, and continuous care at various levels of care. In Brazil, there are more than 2.9 million professionals, approximately 700,000 of whom are nurses, making up a category that is fundamental to the quality of services and the sustainability of health systems[1,2]. Growing care needs, population aging, the chronicity of diseases, and the expansion of information and communication technologies have made clinical practice more complex and increased the need for advanced decision-making competencies[3-5].

In this context, clinical reasoning emerges as a core competency in nurses' practice. It is a dynamic, contextual, and inferential process that involves collecting, interpreting, and analyzing data; formulating hypotheses; making clinical judgments and decisions; and evaluating outcomes[6,7]. The ability to recognize patterns, prioritize interventions, anticipate complications, and reflect critically on choices is essential to ensuring safety, effectiveness, and professional autonomy. However, the literature has indicated that developing this competency remains an educational challenge, partly because of fragmented curricula, the predominance of traditional teaching methods, and the lack of standardized assessment instruments[8].

More broadly, clinical reasoning also involves a deeper analytical component that enables nurses to integrate multiple sources of information, interpret clinical signs in different contexts, and anticipate possible outcomes. This process is continuously shaped by prior experience, theoretical repertoire, perceptual skills, and the capacity for deliberate reflection[6-8]. In this way, clinical reasoning is not merely a linear sequence of steps; rather, it is a continuous movement of constructing and reconstructing meanings in response to the patient's needs. This dynamic fosters the timely adjustment of interventions, the validation of hypotheses, and the refinement of clinical judgment as new information emerges.

From this perspective, clinical reasoning is not only a cognitive competency but also a situated practice that is sensitive to context and guided by the comprehensiveness and safety of care[7]. International bodies have reinforced the need to integrate clinical reasoning, critical thinking, and digital competencies into health education. The United Nations Educational, Scientific and Cultural Organization (UNESCO) establishes these elements as strategic components of education through 2050, highlighting their articulation with creativity, complex problem-solving, and emerging technologies[9].

Resources such as simulation, augmented reality, artificial intelligence, and virtual learning environments help promote clinical reasoning articulated with real and collaborative settings[10]. Nevertheless, the production of protected educational technologies remains limited in nursing, revealing a discrepancy between pedagogical innovation and its formalization through intellectual property.

Discussions of technological innovation in health increasingly include the legal protection of creations. The intellectual property system, especially patenting, plays a fundamental role in valuing scientific knowledge and stimulating technological development[11]. Patents grant inventors temporary exclusive rights and can protect both novel inventions (Invention Patent) and functional improvements applied to existing objects (Utility Model). Although technological innovation in health has expanded, a national study demonstrated that nursing's share of patent filings is still limited. This finding indicates the profession's low integration into the Brazilian intellectual property system and reveals marked underrepresentation[12].

The challenges related to technological production in nursing include a limited culture of innovation, the need for greater knowledge of intellectual property, and

institutional and technical obstacles to developing and protecting technologies[12,13]. These aspects may contribute to nursing's reduced participation in the intellectual property system and to the lower formalization of its technological production. Furthermore, the complexity of intellectual property protection processes may constitute an additional barrier to formalizing the technologies developed in nursing[12,13]. Even at universities, where scientific production is robust, the filing, grant, and commercialization rates for nursing technologies remain low[11,12].

Technology prospecting, a methodology that systematically analyzes patents to identify trends and gaps, is a strategic tool for understanding the dynamics of innovation in health[14]. In nursing, studies of this kind are still in their early stages and, when conducted, generally address specific areas such as patient safety[15]. Research that integrates clinical reasoning, digital innovation, and intellectual property is scarce, especially at the international level.

Patent analysis can reveal priority areas for technological development, show how innovations address the stages of clinical reasoning, and identify opportunities for education, research, and professional practice, especially in view of the rapid evolution of emerging technologies and their potential to transform health systems[16]. It also contributes to strengthening nursing's integration into innovation ecosystems and expanding the visibility, autonomy, and social impact of the knowledge produced.

Against this backdrop, it is relevant to analyze and characterize patents related to clinical reasoning in nursing and to identify how digital technologies, software, computational methods, decision support systems, and smart devices have been applied to the stages that underpin clinical judgment.

This study aimed to analyze technologies related to clinical reasoning in nursing identified in patent documents available in the databases of the Instituto Nacional da Propriedade Industrial and the World Intellectual Property Organization.

METHOD

This documentary, descriptive, and analytical technology prospecting study with a mixed-methods approach was conducted between June and September 2025 and analyzed patent documents related to clinical reasoning in nursing. The identification, screening, eligibility assessment, and inclusion of documents were organized in successive stages. The study adapted the transparency elements and the presentation of the selection flow recommended by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020); however, it is not a systematic review or scoping review.

The search was conducted in the public databases of the Instituto Nacional da Propriedade Industrial (INPI) and the World Intellectual Property Organization (WIPO), covering records filed between January 1, 2000, and June 30, 2025. This time frame was chosen because it corresponds to the period in which digital technologies applied to health expanded.

Descriptors and keywords in Portuguese and English related to clinical reasoning and digital technologies were used, including clinical reasoning, clinical decision-making, nursing, decision support, diagnosis, assessment, monitoring, education, artificial intelligence, and simulation. The search was refined with International Patent Classification code G16H, which covers information and communication technologies applied to health.

Documents were included if they were invention patent or utility model applications describing technologies, methods, computer programs, devices, or systems that were

capable of supporting stages of clinical reasoning and had potential use in nursing care, management, or educational contexts. Only documents with a title, abstract, or technical description available for analysis were included.

Duplicate records across the databases searched were excluded. Documents without sufficient public access for analysis were not included, nor were exclusively automated technologies with no interface with the clinical decision-making process or with professional nursing practice.

Selection took place in successive stages. First, records were identified in the selected databases. Next, duplicates were removed, and titles and abstracts were read to assess thematic relevance. Potentially eligible documents were assessed in full to confirm inclusion. The selection and classification of documents were performed by the principal investigator and reviewed by the advisor, without the participation of an independent reviewer.

Data were organized in a spreadsheet containing application number, filing date, title, abstract, international classification, country of origin, applicant, type of protection, purpose of the technology, application setting, target audience, stages of clinical reasoning addressed, and functional area of the technology. Quantitative analysis was performed using simple descriptive statistics, with absolute and relative frequencies. For the qualitative analysis, the abstracts and technical descriptions were read and interpreted, and the functionalities identified were grouped thematically. The technologies were then classified according to the stages of clinical reasoning they addressed.

The study used only information available in public patent document databases, without collecting data directly from participants or accessing nonpublic personal information. Therefore, submission to the CEP/CONEP system was not required, in accordance with Article 1, sole paragraph, items II and III, of Resolution No. 510/2016 of the Conselho Nacional de Saúde.

RESULTS

A total of 621 records were identified in the INPI and WIPO databases. After the International Patent Classification G16H filter was applied, 356 documents remained. Of these, 67 duplicates and 6 records with no available abstract were excluded. At the eligibility stage, 111 documents had no direct relationship with clinical reasoning, resulting in 172 patent documents included in the analysis. These documents made up the final sample and underwent qualitative synthesis according to their technological nature, applicability, and relevance to clinical reasoning in nursing.

The flowchart in Figure 1 systematically shows the search, screening, eligibility, and inclusion stages of the records analyzed.

Invention patents predominated (152; 88.4%), followed by utility models (20; 11.6%). The period from 2021 to 2025 accounted for 86 (50.0%) filings and 108 (63.0%) publications, indicating accelerated growth in recent technological production. The mean time between filing and publication was 21 months at INPI and 15 months at WIPO. Regarding the legal status identified in the databases consulted, 5 (8.6%) of the 58 relevant INPI documents had "granted" status. Of the 114 relevant WIPO documents, 33 (28.9%) had "granted" status, according to the classification provided by that database. Most patents (112; 65.0%) were applicable in both hospital and out-of-hospital settings, demonstrating the versatility of the technologies developed.

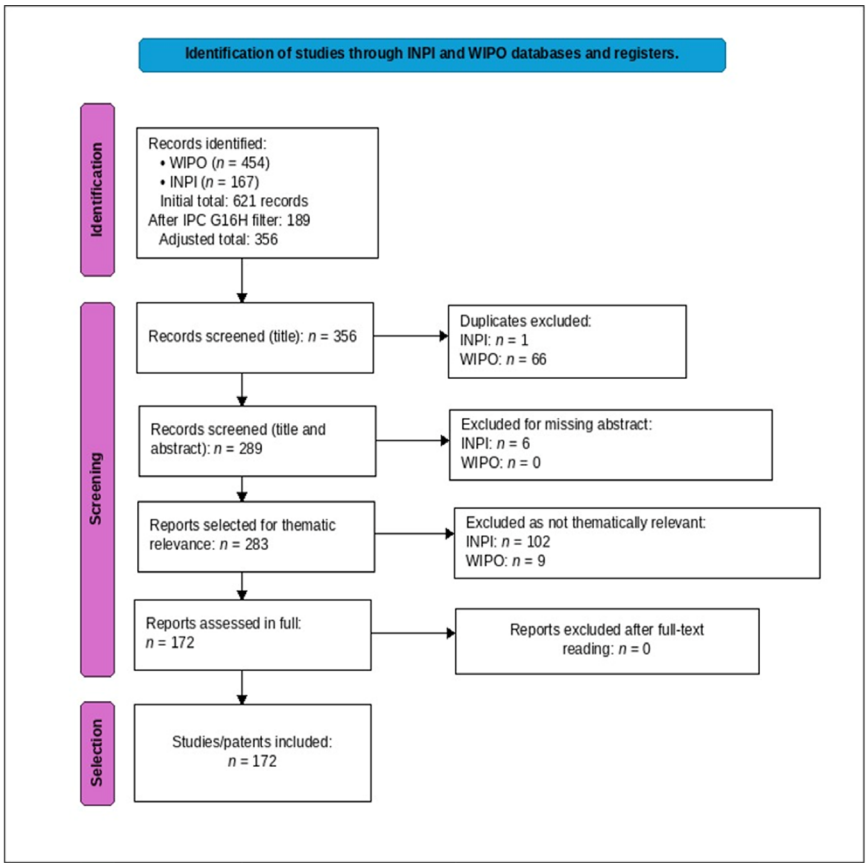

Figure 1. Flowchart of the identification, screening, and selection of patents in the technology prospecting study. São Paulo, SP, Brazil, 2025

Source: The authors (2025).

Table 1. Distribution of patent documents by filing year, publication year, legal status, and application setting (N = 172). São Paulo, SP, Brazil, 2025

Variables	n	%
Filing year		
2000-2005	1	0.5
2006-2010	6	3.5
2011-2015	24	14.0
2016-2020	55	32.0
2021-2025	86	50.0
Publication year		
2000-2005	1	0.5
2006-2010	5	3.0
2011-2015	8	4.5
2016-2020	50	29.0
2021-2025	108	63.0
Legal Status		
INPI Granted	5	8.6[1]
WIPO Granted	33	28,9[2]
Application setting		
Out-of-hospital	25	14.0
Hospital	35	20.0
Hospital and out-of-hospital	112	65.0

Note: [1]Percentage calculated based on the 58 relevant documents identified in INPI. [2]Percentage calculated based on the 114 relevant documents identified in WIPO.

Source: The authors (2025).

Because the same patent document could be classified in more than one category of application site, target audience, and purpose, the frequencies presented are not mutually exclusive. The main application sites were hospitals (153 records), followed by clinics (135), nursing homes (96), home settings (38), and university contexts (7).

Regarding the target audience, most technologies were aimed at the multiprofessional team (137; 55.0%), followed by those aimed at patients, at caregivers, and at family members, with 36 (14.0%) records each, whereas only 7 (3.0%) were intended for teachers/students. Concerning their purpose, care technologies prevailed (159; 66.0%), followed by management technologies (77; 32.0%) and educational technologies (4; 2.0%).

Of the 172 patent documents analyzed, most were filed by private companies (119; 69.0%), followed by independent professionals (27; 16.0%), educational institutions (20; 11.5%), and public-private partnerships (6; 3.5%). Regarding the origin of filings, North America predominated (89; 52.0%), followed by South America (34; 19.5%), Asia (18; 10.5%), Europe (14; 8.0%), WO (15; 8.5%), Oceania (2; 1.0%), and Africa (1; 0.5%).

In the INPI database, the inventors' nationality could be identified in 58 patent documents: in 34 (59.0%) the inventors were Brazilian, and in 24 (41.0%) they were foreign. Among Brazilian inventors, the Southeast region predominated (19; 56.0%), followed by the South (7; 20.0%), the Northeast (5; 15.0%), and the Center-West (3; 9.0%). In addition, 22 healthcare providers were identified among the inventors: 3 nurses, 14 physicians, 2 dentists, 1 pharmacist, 1 psychologist, and 1 social worker.

All selected records included at least one stage of clinical reasoning. International patent documents covered the stages more completely than national ones, and 58 (51.0%) reached the hypothesis stage. However, only two (2.0%) were assessed as covering the complete clinical reasoning process. The patent records found were organized by functionality, yielding 10 main thematic groups.

Table 2. Categorization of patent records by thematic group and number of occurrences (N = 172). São Paulo, SP, Brazil, 2025

Thematic group	n
Information management and electronic health records	51
Clinical decision support and assisted diagnosis	76
Monitoring and traceability	12
Patient safety and error prevention	3
Education, literacy, and training	4
Rehabilitation and treatment adherence	5
Patient engagement and empowerment	5
Health promotion and prevention	4
Integrated platforms and interoperability	3
Clinical performance management and evaluation	4
Other / unclassified	5

Source: The authors (2025).

DISCUSSION

The predominance of invention patent records observed in this study suggests a pursuit of greater originality, greater potential impact, and broad protection, a phenomenon consistent with technology prospecting analyses in various health

fields[17-19]. Because invention patents require a higher inventive step, technical framing, and documentary rigor, they undergo longer and more selective examination processes, which contributes to the low grant rate identified both in this study and in national analyses of INPI[11] and international mappings of other biomedical fields[20]. This situation demonstrates that, despite a growing effort to innovate, important structural barriers separate technological production from the effective protection of inventions.

Although numerically smaller, utility models play a strategic role, especially in professions such as nursing, which frequently develop incremental solutions applied to everyday practice, such as devices, operational adjustments, or technical improvements[21,22]. This type of protection becomes relevant in contexts in which innovation takes the form of practical adaptations and process refinements, and it contributes to the functionality and safety of interventions. The global growth in filing volume also reflects the intensification of technological competitiveness and the advancement of more internationally articulated innovation systems[23].

The mapped technologies were concentrated in digital solutions aimed at decision support, monitoring, clinical data organization, and management assistance, revealing the movement toward the digital transformation of health systems. These solutions align with the advancement of smart technologies that reconfigure information flows, optimize response times, and expand professionals' analytical capacity, which are central aspects of modern nursing care[4,5,24]. The focus on these functionalities indicates that the sector prioritizes more objective and measurable stages of care, especially those with greater potential for algorithmic standardization.

The predominance of technologies linked to the initial stages of clinical reasoning, namely the collection, organization, and interpretation of information, confirms this trend[6,7]. These stages depend heavily on structured data and indicators, which fosters the development of digital tools with low operational variability. The presence of hospital and out-of-hospital applications reinforces the idea that more complex clinical settings, where there is a large volume of information and high demand for rapid decisions, are fertile ground for technologies that support clinical reasoning, in addition to the integration of systems and different data sources[5,25].

In contrast, the proportion of solutions with an educational purpose was low. This result is particularly relevant, considering that clinical reasoning is a structuring competency in nursing education and that global trends point to growth in innovative methodologies such as simulation, immersive environments, and advanced learning platforms[9,10,26]. Studies have indicated that few educational technologies are effectively protected as intellectual property and that filings related to direct care and care practices prevail[5,22]. This phenomenon may be related to challenges in the articulation between universities, technology innovation centers, and research groups, which still face institutional barriers to transforming educational products into protected technologies[27,28].

Another relevant finding is the low participation of nursing care providers as inventors or patent holders. This result aligns with challenges documented in the literature, such as the limited culture of innovation in Brazilian nursing, little training in intellectual property, insufficient institutional encouragement, and the complexity of patenting procedures in the country[12,13,17,29]. A study of patent applications from Brazilian universities identified weaknesses in technical writing or lack of inventive step as recurrent reasons for rejection[29], highlighting the need for capacity-building strategies, legal support, and more structured innovation environments.

Although technologies aimed at data collection and processing are advancing rapidly, a marked gap persists in the complex stages of clinical reasoning, notably hypothesis formulation, critical judgment, decision-making, and reflective practice[6-8,28]. These stages involve contextual integration, subjective interpretation, professional

experience, inferential reasoning, and advanced cognitive processing, which makes them difficult to translate directly into algorithms. However, recent advances in artificial intelligence systems, predictive modeling, interpretable machine learning, and adaptive simulated environments open new possibilities, as yet little explored in nursing, for supporting these higher levels of reasoning[4,5,25].

The findings of this study point to strategic opportunities for strengthening nursing's presence in technological innovation: protecting educational products; developing technologies that integrate simulation, artificial intelligence, and clinical reasoning; expanding digital competencies in curricula; creating robust institutional intellectual property policies; encouraging adequate technical writing; and further internationalizing filings[1-5,25,26,30]. These elements are fundamental to reducing the historical invisibility of solutions produced by nursing and to consolidating its participation in the global health innovation chain.

Some limitations should be considered when interpreting the results. Although the search strategy was structured with descriptors and International Patent Classification codes, some records related to the topic may not have been retrieved because of terminological diversity and heterogeneity in the classification of patent documents.

The analysis also depended on the information provided in the records themselves, whose descriptions do not always allow precise identification of the purpose and applicability of the technologies. The thematic classification was performed by the principal investigator and reviewed by the advisor, without validation by an independent reviewer, which may introduce the subjectivity inherent in document analysis. Nevertheless, the study provides a consistent overview of the interface between clinical reasoning, technological innovation, and intellectual property in nursing and contributes to a broader understanding of the profession's integration into the contemporary landscape of health innovation.

CONCLUSION

Technology prospecting made it possible to characterize patent documents related to clinical reasoning in nursing and revealed opportunities for technological development, especially in supporting the more complex stages of the clinical process. The study also showed low representation of technologies intended for educational purposes and reduced participation of nursing care providers among the inventors identified.

For nursing practice, the findings reinforce the importance of bringing together care, education, research, and innovation, especially in developing technologies that support clinical judgment, decision-making, and outcome evaluation. Strengthening the culture of intellectual property and digital competencies may foster greater participation of nursing in the conception, protection, and development of technological solutions aligned with care needs.

It is essential to invest in institutional strategies that strengthen technological competencies throughout education, expand access to innovation environments, and encourage the development of technologies capable of supporting more complex levels of clinical reasoning. Strengthening these initiatives may expand nursing's participation in health innovation and contribute to safer and higher-quality care practices.

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Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work - **de Queiroz PGS, Alves RC, de Oliveira PC.** Drafting the work or revising it critically for important intellectual content - **de Queiroz PGS, Alves RC, de Oliveira PC.** Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved - **de Queiroz PGS, Alves RC, de Oliveira PC.** All authors approved the final version of the text.

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