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Modelling of physicians' clinical information-seeking behaviour in Iran: a grounded theory study

Azra Daei ,[1] Mohammad Reza Soleymani,[2] Ali Zargham-Boroujeni,[3] Roya Kelishadi,[4] Hasan Ashrafi-rizi [2]

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For numbered affiliations see end of article.

Correspondence to
Prof. Hasan Ashrafi-rizi; hassanashrafi@mng.mui.ac.ir

ABSTRACT

Objectives Exploring clinical information-seeking behaviour (CISB) and its associated factors contributes to its theoretical advancement and offers a valuable framework for addressing physicians' information needs. This study delved into the dimensions, interactions, strategies and determinants of CISB among physicians at the point of care.

Design A grounded theory study was developed based on Strauss and Corbin's approach. Data were collected by semistructured interviews and then analysed through open, axial and selective coding.

Setting The study was conducted at academic centres affiliated with Isfahan University of Medical Sciences.

Participants This investigation involved recruiting 21 specialists and subspecialists from the academic centres.

Results The findings revealed that physicians' CISB encompassed multiple dimensions when addressing clinical inquiries. Seven principal themes emerged from the analysis: 'clinical information needs', 'clinical question characteristics', 'clinical information resources', 'information usability', 'factors influencing information seeking', 'action/interaction encountering clinical questions' and 'consequences of CISB'. The core category identified in this study was 'focused attention'.

Conclusions The theoretical explanation demonstrated that the CISB process was interactive and dynamic. Various stimuli, including causal, contextual and intervening conditions, guide physicians in adopting information-seeking strategies and focusing on resolving clinical challenges. However, insufficient stimuli may hinder physicians' engagement in CISB. Understanding CISB helps managers, policy-makers, clinical librarians and information system designers optimally implement several interventions, such as suitable training methods, reviewing monitoring and evaluating information systems, improving clinical decision support systems, electronic medical records and electronic health records, as well as monitoring and evaluating these systems. Such measures facilitate focused attention on clinical issues and promote CISB among physicians.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study employed a grounded theory design, which allowed for a detailed exploration of clinical information-seeking behaviour (CISB).
⇒ This is the first known study to identify dimensions, strategies and determinants of the physicians' CISB at the point-of-care questions.
⇒ This research addresses the CISB process as an interactive, dynamic, non-linear and a multidimensional phenomenon while dealing with clinical questions.
⇒ Like many qualitative studies, the generalisability of the findings may be limited.

INTRODUCTION

In recent years, physicians have encountered numerous challenges concerning the accessibility of pertinent information. These challenges encompass accelerated changes in clinical knowledge, information overload, the growing complexity of care and ongoing innovations in the field. Researchers have advocated for the utilisation of the best available evidence in health-related decision-making by all healthcare professionals as a means to address these challenges.[1 2] Additionally, several studies have demonstrated that using such resources can effectively address clinical inquiries and enhance physicians' performance.[3–7]

Despite the emphasis on evidence-based medicine (EBM), physicians have not consistently integrated EBM tools into their daily medical practices,[8–10] as indicated by several studies. Furthermore, there is a lack of proficiency among physicians in evaluating evidence effectively.[11 12] Additionally, research suggests that physicians only seek answers to approximately half of the clinical questions that arise during patient care and are able to find solutions to only a fraction of these inquiries.[13] Despite the availability of electronic medical records (EMR) and decision support systems, their design and implementation have encountered numerous challenges.[14–17] The learning EMR (LEMR) system aims to address these issues by leveraging physicians' information-seeking behaviour (ISB) model to enhance data presentation for upcoming

Table 1 Characteristics of participants

Characteristics	Participants in interviews
Age (years), mean±SD	45.52±6.8
Experience (years), mean±SD	13.14±7.6
Gender, no. (%)	
Male	13 (61.9)
Female	8 (38.1)
Specialty, no. (%)	
Specialist*	12 (57.1)
Sub-specialist†	9 (42.9)
Academic medical centres, no. (%)‡	
Alzahra	7 (33.3)
Amin	3 (14.3)
Beheshti	2 (9.5)
Kashani	4 (19.1)
Imam Hussein	3 (14.3)
Noor and Ali Asghar	2 (9.5)

*Specialties included obstetrics and gynaecology (n=1), emergency medicine (n=3), community medicine (n=1), internal medicine (n=2), general surgery (n=1), ENT (n=2), neurology (n=1), paediatric (n=1).
†Subspecialties included gastroenterology (n=2), paediatric nephrology (n=1), paediatric infectious (n=1), paediatric surgery (n=1), endocrinology (n=1), perinatology (n=1), neurosurgery (n=1), women health/preventive medicine (n=1).
‡The centre with the longest working hours was considered, physicians working in the two medical centres.
ENT, ear, nose and throat.

patients.[18] These identified deficiencies underscore the importance of identifying and understanding the clinical ISB (CISB) process.

Numerous studies have examined various aspects of CISB among physicians, including their information needs, used resources, frequency of posed questions, as well as barriers and facilitators.[13 19–23] While many of these studies have outlined the procedural aspects of CISB, few have delved into the specific activities, determinants and decision-making processes involved. Hung *et al*[24] introduced a hierarchical multilevel model of context-initiated information aimed at enhancing the representation of human search expertise. Similarly, Cook *et al*[15] employed grounded theory to characterise the barriers and decision-making processes associated with responding to clinical questions. King *et al*[18] argued that EMR systems should integrate the ISB model to mitigate cognitive overload by presenting relevant information to individual patients in a timely manner.

However, the existing literature highlights a lack of comprehensive investigation into the CISB and only a few studies have delved into determinants and CISB processes. This gap in the existing research could lead to an incomplete understanding of the CISB process, which could ultimately result in less effective medical tools. If we do not know how physicians search for information, we cannot optimise decision support systems to respond to their information needs. To address these deficiencies and improve the CISB process, we need a deeper understanding of its theoretical foundations including the activities, determinants and decision-making processes involved in CISB. This understanding could help better comprehend to enhance medical systems to meet physicians' information needs and ultimately contribute to providing better care for patients.

On the other hand, considering that ISB is heavily influenced by context and impacting factors, therefore, the CISB of physicians needs to be deeply studied in all aspects. Given that grounded theory, by delving into the phenomenon, seeks to discover existing interactions and social processes beyond describing what is said and observed in phenomena and focuses on processing and presenting theory, it can help identify dimensions, conditions, interactions, processes and motivations of the process. Therefore, the current study aimed to explore the dimensions, interactions, strategies and determinants of CISB among physicians in the clinical setting. To achieve this objective, the following subgoals were addressed:

1. Identifying the causal conditions affecting the CISB of physicians.
2. Identifying the contextual conditions affecting the CISB of physicians.
3. Identifying the intervening conditions affecting the CISB of physicians.
4. Identifying the action/interaction strategies adopted by physicians in CISB.
5. Identifying the consequences that originated after the CISB of physicians.

MATERIALS AND METHODS

A qualitative study was undertaken using the grounded theory approach, chosen for its capacity to foster the development of theory grounded in data through concurrent and systematic data collection and analysis.[25] This methodology was selected due to the absence of existing theoretical frameworks concerning the subject matter.[26] Grounded theory is well suited for elucidating phenomena within their contextual framework[25 27] and has been successfully applied in explaining ISB.[26 28]

The setting, participants and study design

The study was conducted from April 2018 to June 2020 at academic centres affiliated with Isfahan University of Medical Sciences (IUMS), which comprises 11 academic hospitals in Isfahan, including tertiary referral hospitals. Participants consisted of 12 specialists and nine subspecialists, meeting 2 specific criteria. First, participants were required to attest to the use of EBM tools in their clinical practice, as evidenced by self-declaration and endorsement from the vice-chancellor for education or research. Second, participants were mandated to have authored at

Table 2 Example quotations illustrating the themes

Themes	Subthemes	Example quotation (participant specialty, year of experience)
Theme 1: Clinical information need	Diagnostics	'… From a patient's course of treatment or management, which can be one of the diagnostic steps, consisting of the history and physical exam…until you're going to request a series of paraclinical measures until you interpret the paraclinical data to find out what the final diagnosis is…' (emergency medicine, 10)
	Treatment	'… What is now the gold standard for this disease, what treatment for this disease has very high evidence, what is now first-line…' (ENT, 27)
	Updating information	'… Considering clinical manifestations to see if something new has been added or not is sometimes related to re-education or retraining…' (pediatric infectious, 14)
Theme 2: Clinical questions characteristics	Question complexity	A simple question: '… now and then, I'll ask a basic question: is this medicine secreted in breast milk? For instance, simple search helps to find the same response…' (endocrinology, 14) Complicated question: '… we had a patient with neuromyelitis optica, we started a treatment, we expected the treatment to be very effective, but the patient had a very severe recurrence … When the disease became complicated, I searched and consulted with colleagues here and in the Tehran …'(neurology, 18)
	Question significance	Significant questions: '…If the case is critical, the patient is about to a specific attack, for example, you don't react to all first-, second-, or third-line treatments, or you have a patient whose failure to treat may cause other harms…' (emergency medicine, 10) Less significant questions: '… Is the care we're giving our patient now adaptable with new knowledge, or has it changed? …' (gastroenterology, 6)
	Question originated from involvement duration	Short-term involvement duration: '…If the patient is an outpatient who isn't in the hospital or if her condition needs to be clarified right away, I'll look into it immediately…' (ENT, 30) Long-term involvement duration: '… the patient is hospitalized; ten days in the ward, he isn't too bad, but the treatments don't seem to be working. This line of treatment is not effective. During this period, we usually become entirely engrossed in the patient; we continuously try to obtain information… ' (internal medicine, 8)
Theme 3: Information usability	Service accessibility	'…it's better to access to the Internet whenever we go, for example in the operating room, ward, clinic, and there should be no problem with VPN to open any database we need ….' (general surgery, 7)
	Resources accessibility	Comprehensive access: '… Most of the time, I utilize PubMed… since it is more comprehensive… PubMed usually provides us with the information we require. It is the database; you'll find everything you need…' (gastroenterology, 6) Full access: '… Our biggest issue is that we don't have the complete ability to obtain all of the data with full-texts for decision-making…' (neurosurgery, 22) Variety of resources: '… Clinical Key which has journals, articles and books … I choose its clinical sub-categories and then my topic from among them. That means you'll be able to find practically anything within…' (gastroenterology, 16).
	Physician capability	Information retrieval skills: '… there are several elements connected to the individual, such as your capacity to search for resources, do you have experience with this, for example, are you familiar with basic knowledge about the Internet, about the first search with search engines…' (emergency medicine, 8) English language skills: '…English is the world's scientific language, and all of our physicians should be so proficient in it that they can simply access the sources, but we see that it is not so…' (ENT, 27) Occupational conditions: '… one of the reasons they haven't been able to search information is that they just don't have the time cause of workload. They have to do occupational therapy, education, and research and all are required for them… despite their desire, they do not have the time…' (women health/preventive medicine, 17)
Theme 4: Clinical information resources	Personal information resources	Colleagues: '… Cases that are rare and particularly unique, for which we do not have a practical diagnose or treatment, we examine them with colleagues, including residents and professors…' (neurosurgery, 22) Other fields specialists: '… In complicated disorders, I get the opinion of specialists in those domains on the various systems involved, such as nerve, lung, renal involvements, etc…' (pediatric infectious, 14)
	Interpersonal information resources	Textbook, guideline, and database: '… Texts are our primary sources, followed by valid guidelines in any discipline, and last, if they aren't available, I search databases…' (endocrinology, 14) Forums, social media, and a search engine: '… YouTube help me a lot with its videos! I use Google to search for my terms because it is so convenient. I get a generic policy from Google. Even Google can say whether the fingerprint of this work is diagnostic or treatment in medical databases like PubMed…' (neurosurgery, 22)

least one research paper in their respective fields, either as the first author or corresponding author.

Purposive sampling was initially used for the selection of participants in the interviews. Subsequently, as codes and themes began to emerge, theoretical sampling was employed to gather the necessary data. The process of participant selection, data collection and analysis continued until theoretical saturation was achieved. Saturation was attained after the 18th interview, whereby no new codes emerged. However, interviews were conducted with a total of 21 participants to ensure comprehensive data collection.

Interview guide

The researcher (AD) conducted in-depth, one-on-one interviews using a semistructured interview guide. Interviews were held face to face in the wards and clinics. Each interview session lasted for 45–60 min. The process was audio recorded with the consent of participants. This interview guide (online supplemental file 1) was developed through discussions with team members, informal conversations with physicians and librarians, and a review of prior studies on CISB.[15 29–31] During the interviews, probing questions were employed to elucidate information and gather supplementary data.

Qualitative analysis

The interviews were recorded in their entirety, transcribed and subsequently reviewed and approved by the participating individuals. Data analysis was conducted using Strauss and Corbin's grounded theory approach,[25] encompassing open coding, axial coding and selective coding. Additionally, the constant comparative approach, theoretical sensitivity and memoing were employed throughout each stage of analysis to facilitate theory development. Data collection and analysis were conducted concurrently. Various software tools were used for qualitative data analysis, including Microsoft Word and MAXQDA V.10.

During the open coding phase, three researchers (AD, HA-R and AZ-B) independently scrutinised the three texts (participant specialty, year of experience: emergency medicine, 8; ear, nose and throat, 27; general surgery, 7) line-by-line, extracting related concepts and keywords. This process was conducted iteratively, resulting in the identification of 344 concepts. Discrepancies in coding were resolved through discussion with other investigators (MS and RK). Also, the text of several interviews, codes and extracted categories were made available to a number of experts in the qualitative research who did not participate in the study, to review and ensure that the initial codes were derived from the interview content and not the interpretations or preconceptions of the researchers. Furthermore, the extracted categories and concepts from the interviews were also shared with some of the participants to ensure that their intended meaning was reflected in the results.

Subsequently, these initial codes were synthesised into 70 concepts through multiple revisions based on shared characteristics. During the axial coding stage, all interviews were systematically coded. Subsequently, the research team (which are experts in the qualitative researches) collaboratively consolidated these codes into 25 subthemes through consensus. Connections were established between these subthemes and various elements such as causal conditions, intervening and contextual factors, strategies and consequences. Finally, through selective coding, seven principal themes were synthesised into a core category, forming the foundation of the principal theoretical framework.

The researchers ensured trustworthiness by engaging in detailed transcription and description of methods, systematic planning and coding following Lincoln and Guba guidelines.[32 33] Additionally, the research followed the Consolidated Criteria for Reporting Qualitative Research reporting guideline[34] (online supplemental file 2).

Patient and public involvement

None.

RESULTS

As depicted in table 1, a total of 21 physicians from educational-medical centres partook in the interviews. The participants ranged in age from 35 to 57 years and possessed clinical experience spanning from 2 to 30 years. The analysis yielded 7 principal themes and 25 subthemes.

Theme 1: clinical information needs

Subtheme 1: diagnostics

Physicians expressed the view that prompt and accurate diagnosis is imperative for resolving clinical issues. They identified numerous questions surrounding paraclinics, differential diagnosis, atypical presentations of illnesses and the utilisation of minimally invasive diagnostic methods.

Subtheme 2: treatment

Following diagnosis, physicians emphasised the importance of accessing clinical information to meet their needs pertaining to medical and surgical treatments, disease management and pharmacotherapy.

Subtheme 3: updating clinical information

Physicians expressed the necessity of acquiring clinical information to facilitate ongoing training and skills development, ensuring adherence to treatment standards, staying abreast of the latest scientific advancements and recognising emerging treatment protocols (refer to table 2 for supporting quotes).

Theme 2: clinical question characteristics

Subtheme 1: question complexity

Physicians perceive questions as straightforward when they relate to simple illnesses, allowing straightforward

Table 3 Example quotations illustrating the themes

Themes	Subthemes	Example quotation
Theme 5: Factors influencing information seeking	Personal factors	Intrinsic motivation '… influencing factors is a huge riddle, one is motivation, and this is one of the personal components. Individual motivations work 100%…' (community medicine, 12) Professional commitment: '… because I have some responsibilities to the patient to enhance his condition and I have a commitment to him, I will go and find the sources to know what to do for the patient to solve his clinical problem…' (internal medicine, 4) Attending in teaching and referral centres: '…a significant topic is that if you work in a training or referral centres, you must stay updated on your own; you must be aware of the most up-to-date treatment procedures; it might drive you even more, and the atmosphere itself acts as a push-button…' (emergency medicine, 10)
	Organisational factors	Education and empowerment: '…our educational planning must shift such that our output is a physician who knows the ways to treat the patient and the ways to seek information…' (ENT, 27) Evaluation and incentive systems: '… many physicians do not have motivation; they say there is no much difference between someone who works with EBM and the one who is involved in texts of 8 years ago…' (women health/preventive medicine, 17) Educational and research facilities: '… the correct proportion between the number of students and professors, the proportion of numbers, physical space, facilities, hardware and software facilities are all vital…' (ENT, 27)
	Technical factors	User-interface design: '… it is hard if there are a lot of sub-categories, it's layered, and you have to click a lot… The easier a site is to navigate during a patient's therapy, and the more information may be gleaned with a single glance…it will undoubtedly become more appealing…' (emergency medicine, 8) Infrastructure for Information and Communication Technology: '… When you want to search for something, you can't be due of the Internet's slow speed or disruption, which you gave it up…' (emergency medicine, 4) '… Watching films of treatment techniques on YouTube, but encountering internet constraints like filtering…' (ENT, 30)
	Social factors	Social pressures: '…Previously, medical errors were not discovered at all; however, now, in social networks, everyone knows fast, so we attempt to provide the least harmful and finest treatment for our patients… ' (obstetrics and gynecology, 2) Social awareness: 'Now the patient is so alert that she get along with the physician well, ask questions regarding what she should do, resulting in becoming more focused not to make mistakes…'

research to provide answers. Conversely, complex questions arise from intricate and multisystemic diseases, feature complicated clinical presentations and involve multiple bodily organs.

Subtheme 2: question significance

Significant questions are paramount, as leaving them unanswered can lead to numerous challenges and severe complications for the patient. In contrast, less significant questions typically pose minimal risk to the patient. For example, seeking new information to enhance personal knowledge is a question used in this area.

Subtheme 3: the question originated from the involvement duration

Physicians noted that the physician's intermittent and long-term engagement with outpatient or inpatient care influenced their ISB. Short-term involvement typically occurred in outpatient settings and during patient follow-up programmes, while prolonged engagement was observed in inpatient care or cases where patients did not respond to treatment. Importantly, extended durations of involvement were perceived as conducive to acquiring clinical information (refer to table 2 for supporting quotes).

Theme 3: information usability

Subtheme 1: service accessibility

Physicians reported having quick, easy and convenient access to resources facilitated by Wi-Fi, virtual private network connections to various databases and the availability of personal digital assistants, computers and other technical equipment related to the internet within medical centre departments.

Subtheme 2: resource accessibility

Physicians emphasised that resources with the highest accessibility were in high demand. They highlighted the importance of resource diversity, including access to databases containing articles, books, educational videos and images. Moreover, they underscored that comprehensiveness, coverage, access to full-text materials and availability of free information resources were essential facilitators of clinical decision-making.

Subtheme 3: physician capability

Physicians identified sufficient information-seeking skills and proficiency in English, as the global language of science, as facilitators of CISB. However, they emphasised that the most significant barriers to clinical information

seeking were the lack of time and workload overload. These circumstances often resulted in physicians being unable or uninterested in fulfilling their information needs (refer to table 2 for supporting quotes).

Theme 4: clinical information resources

Subtheme 1: personal information resources

Physicians typically rely on personal information resources to address clinical inquiries, primarily due to their prompt accessibility and perceived reliability. Colleagues within the same specialty often serve as advisors during the final decision-making process for implementing specific care. Additionally, specialists from diverse fields are often consulted to manage complex diseases involving multiple organs.

Subtheme 2: interpersonal information resources

Physicians identified the latest editions of textbooks and guidelines used by physicians as their primary and secondary sources of information, respectively, owing to their authenticity. Medical databases, comprising contemporary diagnostic, therapeutic and disease management techniques, were cited as the third source of information. Additionally, physicians mentioned academic websites, medical associations, Google and social media platforms such as YouTube, which featured educational materials on therapy and surgical protocols (refer to table 2 for supporting quotes).

Theme 5: factors influencing information seeking

Subtheme 1: personal factors

Physician motivation was identified as a crucial factor influencing information needs. Professional dedication compels physicians to resort to information-seeking as a problem-solving approach in complex situations. Physicians emphasised that an inherent spirit of inquiry fosters curiosity when confronted with clinical questions, driving them to seek answers. Moreover, attending teaching and referral centres was cited as a motivating factor for physicians to seek information about the unknown.

Subtheme 2: organisational factors

Education and empowerment initiatives regarding information retrieval, access to educational and research equipment, facilities and dedicated physical spaces within clinical settings play a crucial role in enabling physicians to seek clinical information actively. However, the inadequate assessment of faculty members' medical and educational contributions compared with their research endeavours highlights the absence of an effective evaluation system to measure these activities qualitatively. Moreover, the current assessment system fails to differentiate between physicians who use EBM principles and those who do not. An evidence-based framework must be integrated into all aspects of the healthcare system to assist healthcare providers in leveraging the most credible evidence in their decision-making processes.

Subtheme 3: technical factors

Physicians emphasised the importance of a user-friendly system, stating that it facilitates ease of learning and retention of usage procedures. Additionally, such a system streamlines uncomplicated tasks, eliminating the need for lengthy processes. Furthermore, physicians highlighted the system's extensive search capabilities and its ability to cater to individual search preferences, competencies and skills. Moreover, the system's capability to categorise information into distinct classes enables users to extract relevant data without confusion. Consequently, this type of system is deemed suitable for physicians with busy schedules who may not have the time to seek information or actively acquire related skills.

In general, information and communication technology infrastructure can create a conducive environment for physicians' communication and access to information. However, it is crucial to acknowledge that domestic Internet filtering systems, which restrict access to services such as YouTube, and international bans on purchasing certain information resources can exacerbate disinterest in using such resources.

Subtheme 4: social factors

Physicians expressed the belief that public awareness and societal pressures could influence physicians' interests, judgements and decisions regarding information-seeking. Heightened public awareness was seen as increasing the need for accurate information. In instances of medical errors, the media's scrutiny could exert pressure on physicians, motivating them to prevent such occurrences by seeking the most authentic and reliable evidence (refer to table 3 for supporting quotes).

Theme 6: action/interaction encountering clinical questions

Subtheme 1: type of action

Focused attention on addressing clinical questions and meeting information needs empowers physicians to either take action or refrain from engaging in ISB. Physicians who choose to take action actively seek information to resolve clinical issues consciously and intentionally. Conversely, opting not to engage in ISB occurs in various scenarios, such as when physicians believe the question has no solution, lack access to information sources, rely on existing knowledge to address the problem or perceive the case severity as too high. Additionally, physicians may refrain from seeking information due to feelings of inadequacy in overcoming challenges or concerns about legal repercussions. In such situations, physicians may rely on existing knowledge or refer the patient to another healthcare provider.

Subtheme 2: action strategy

The strategy of taking action can vary in terms of explicitness, frequency and timing of occurrence. Physicians typically exhibit explicit behaviour when seeking information. Still, they may adopt a more conservative approach if they fear jeopardising their current position, particularly

Table 4 Example quotations illustrating the themes

Themes	Subthemes	Example quotation
Theme 6: Action/ interaction encountering clinical questions	Type of action	Taking an action to engage in ISB: '…we're in the middle of an operation, and we notice a new case or some other issue in the diseased organ. I feel compelled to investigate the extent of the problem. What is the best way to solve the situation? …' (perinatology, 11) Taking no action to engage in ISB: '… When my treatment is ineffective for the patient or there are concerns about the patient's safety, I urge the patient to go to another centre or refer to other specialist…' (neurosurgery, 22)
	Action strategy	Explicit: '… At the point of care, in the operation room or the ward I look for the answer. It makes no difference where I am…' (Section 16) Conservative: '… I'm afraid that if I admit I don't know anything right now and then go in front of others to find out what they're saying, I'll lose my credibility… Experienced physicians may be humiliated…' (pediatric surgery, 11) Multiple: '… We had a patient with peculiar symptoms that I suspected it was Wegener's disease, which had an underlying rheumatic immunodeficiency disease. The patient had evolved into a multisystemic and complex condition. We must search databases and books a lot, consult with colleagues… (ENT, 30) One time: '… the evidence-based resources make the necessary evaluations before, I trust them, and I perform the search once…' (women health/preventive medicine, 17) Immediately: '… if the case is critical or involves medication, I will look into it right away…' (ENT, 30) Postponed: '…but if it's about inpatient that doesn't react to treatment in some spots, and at the same time, delay in treatment is not harmful, I'll look into it when the time comes…' (ENT, 30)
	Action evaluation	Relevance: '… I have a set of questions in my mind; once we search, we compare the results… and then we decide whether or not this is a related diagnosis or treatment, is it relevant to our inquiry or not…' (emergency medicine, 4) Credibility: '… I put my faith in the evidence-based sources to make these clinical judgements. But I undertake a critical assessment where this procedure is not replicated… How valid is it? How trustworthy is it, and who is the author? Which research institute do support? Has it a register code? These boost precision confidence. These are some general rules…' (women health/preventive medicine, 17) Updated: 'for treating the anticoagulants in 2014 Textbooks and earlier, such new drugs were not and the type of treatment was different, for example, it is the type of prothrombin concentrate for bleeding control, there was not such a thing at the time, the time of conducting the study is important, for example, the study was performed in 2012, but published in 2018…' (emergency medicine, 8)
	Action feasibility	Diagnostic and therapeutic procedures' cost-effectiveness: '…treatment or diagnosis you intend to undertake must have a cost-effective. Give the patient the cheapest treatment and the simplest diagnostic possible. A treatment that is more effective while putting less strain on the health-care system…' (pediatric nephrology, 23) Hospital equipment: '… I do some research and discover that this patient should be a PET, but we don't have a PET scan available, so we gave it up…' (gastroenterology, 6) Patient preferences: '… I'd like to transfuse blood into the patient or give him medication. It's good in my experience, and it's good according to scientific resources. But my patient refuses, claiming that I am, for example, a sect that does not accept blood transfusions or that I do not utilize a particular country's medicine…' (emergency medicine, 8) Patient financial ability: '… We must consider the patient's financial situation and a set of treatments, such as a very expensive therapy like a cochlear implant, which most of our people cannot afford…' (ENT, 27) Not involving the physician in legal disputes: '… A very major issue that occurs is legal discussions, which means that besides everything done for the patient, a sequence of things can happen, and you must be responsive… therefore not every reference can be used to make a decision; it must be defended… ' (emergency medicine, 10)
	Action selection	Information adequacy: '… does it rely on whether or not that information is sufficient for me? If I come across an article that has a low level of credibility but appears to be intriguing, I check to see if it has been covered elsewhere…' (ENT, 27) Insufficient information: '… If the texts and guidelines don't yield results, I'll turn to the databases. In this case, you'll see that the points made in this authoritative article have been reiterated in several other articles…' (endocrinology, 14)

Continued

Table 4 Continued

Themes	Subthemes	Example quotation
	Clinical decision	Alone: '… If I'm looking for a simple answer to a query like a drug's adverse effects, interaction, or dose, I'll decide and utilize it myself…' (ENT, 30) With consultation: 'but if the matter gets extremely intricate, I will undoubtedly consult with my colleagues who are experts in that subject, seek their advice, and then make choices based on collective expertise…' (ENT, 27)
	Action management	Save: '… Occasionally, if I find an article to be very valuable, I save it in my desktop or a flash or on Mendeley for future access…' (general surgery, 7) Share: '… If I get a good outcome when looking for information, I usually share it with my colleagues…' (emergency medicine, 10)
Theme 7: CISB consequences	Patient related	Patient recuperation: '…The patient benefits most, your scientific knowledge increases as well, and the patient will get better. The side effects will be less…' (Code 14). Patient Satisfaction: '… Aside from recovering faster, it lowers the patient's budget, making your patient happier and more satisfied…' (pediatric, 12)
	Physician related	Personal development: '…The physician will be up-to-date, takes more practical action that is more appropriate. He is aware of his flaws and strengths and works to overcome them… ' (women health/preventive medicine, 17) Be a professional: '… The main point is that you become more professional because of the information you uncover, and you also bridge the gaps that exist in that subject, leading to knowledge generation…' (gastroenterology, 6) Self-actualization: '… the physician's potential inner abilities and talents become active, he feels satisfied that the therapy he is providing is on time, and he is pleased with his patient's recovery…' (ENT, 30)
	Organisation related	Performance improvements: '…Both the physician's medical errors and the additional expenditures are minimized accordingly. The patient isn't operated on very frequently. The end consequence will undoubtedly be an improvement in the organization…' (general surgery, 7) Organization authority: '… Usually, when patients applaud their physician for their recovery, it generates a positive advertisement for the physician and the hospital, which gradually develops a brand…' (internal medicine, 8)

CISB, clinical information-seeking behaviour.

if they possess extensive experience or are older. When faced with less authentic information sources or when dealing with significant, critical or complex problems, physicians tend to seek information from multiple sources. In cases where the clinical question is straightforward, and the information source is highly reliable, physicians actively engage in ISB. Moreover, if there is a risk of patient harm due to a delay in finding an answer to a question, physicians promptly seek information. Additionally, when physicians are unable to gather sufficient information from available sources or when the question pertains to updating knowledge, they engage in postponed ISB.

Subtheme 3: action evaluation

After retrieving information, physicians evaluate their actions by assessing the relevance, credibility and updatability of the obtained data. Physicians described relevance as the extent to which the retrieved results aligned with their information needs, often gauged through comparison with their prior knowledge. Additionally, physicians scrutinised various factors such as the research content, journal, author and affiliations of research-supporting institutes to assess credibility. Using less authentic resources could potentially complicate patient care and expose physicians to legal liabilities. Furthermore, physicians considered the publication and research dates to evaluate the currency of the information, as lengthy printing and publishing processes could render the data obsolete.

Subtheme 4: action feasibility

Following the evaluation process, physicians assess the feasibility of their actions, considering various factors such as the cost-effectiveness of diagnostic and treatment procedures, availability of hospital equipment, patient preferences, financial constraints and potential legal implications. Physicians prioritise diagnostic and therapeutic approaches that are highly cost-effective for both the patient and the healthcare system. Adequate medical equipment is crucial for patient care in medical centres, facilitating diagnosis and treatment. Physicians emphasised the importance of recognising each patient's unique needs, abilities, values and beliefs. Moreover, they emphasised respecting patients' rights to choose services based on their preferences and financial circumstances. Finally, physicians assess their ability to deliver the prescribed care procedures, ensuring they will not encounter legal

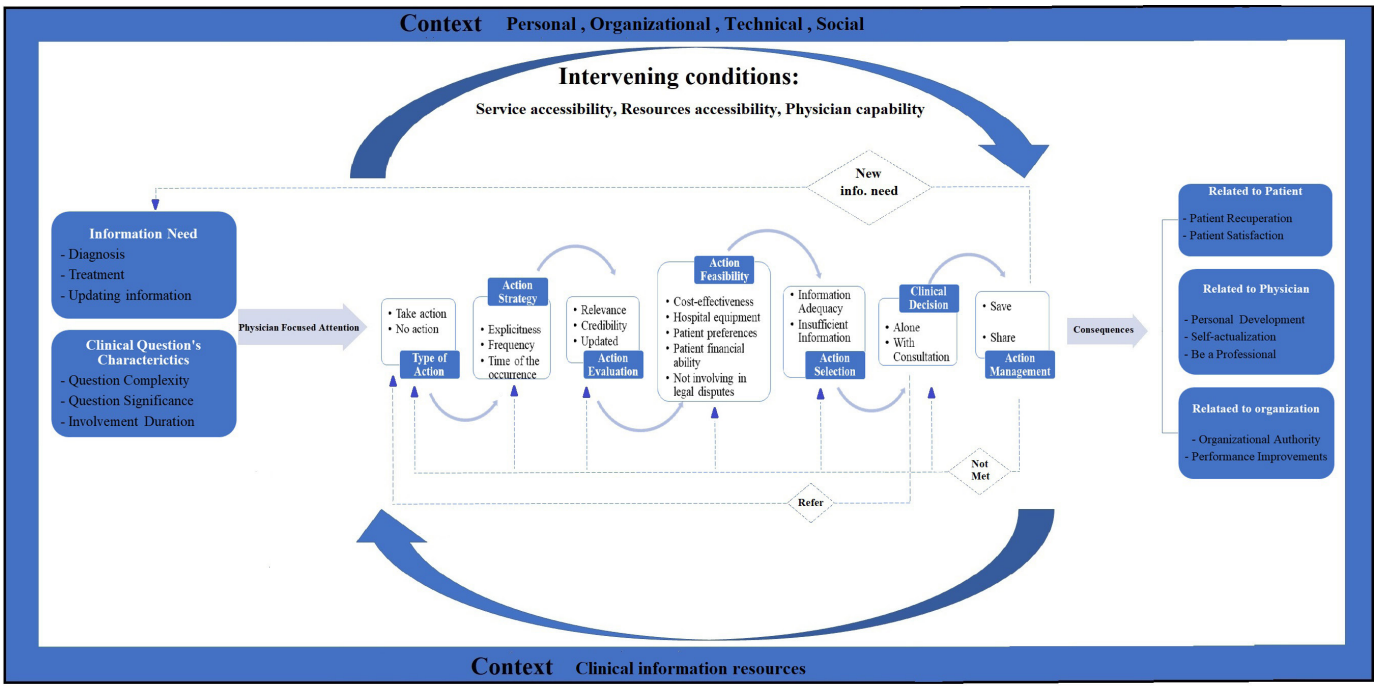

Figure 1 Clinical information seeking behaviour model.

challenges. Physicians need to be prepared to defend the chosen diagnostic or therapeutic approach in this regard.

Subtheme 5: action selection

The physician assesses whether the obtained information adequately meets the information needs. If deemed insufficient, the information-seeking process is repeated until sufficient information is acquired. Evaluation of information is reiterated at this stage, given the significance of the issue for the patient and the potential legal implications for the physician.

Subtheme 6: clinical decision

Clinical decision-making is paramount during the information-seeking stage, as physicians bear responsibility for care-related outcomes. In this context, physicians make clinical decisions either at once or continuously. Immediate decisions typically address simple and less urgent questions or the need for information renewal. Conversely, continuous decision-making is common in cases involving patients with complex, multisystemic or rare diseases. The decision-making process may be revisited and altered based on the physician's acquired information and consultation received.

Subtheme 7: action management

At the conclusion of the strategy, physicians save and share data acquired during the information-seeking process. If relevant and appropriate information is obtained, physicians store it for future reference using information management software. Moreover, sharing information serves to enhance knowledge and raise awareness among colleagues and students (refer to table 4 for supporting quotes).

Theme 7: CISB consequences

Subtheme 1: patient-related consequences

The most significant achievement of CISB for a physician lies in the concepts of patient recovery and satisfaction. Patient recovery stands as the ultimate goal of any physician, while patient satisfaction is intertwined with the process of recovery. It hinges not only on the successful resolution of the disease but also on minimising financial and time burdens for the patient.

Subtheme 2: physician-related consequences

Personal development is a direct outcome of information-seeking for physicians. Through this process, physicians can discern and enhance their strengths and weaknesses, talents, abilities and skills. Moreover, physicians attain professional growth by acquiring knowledge, identifying gaps in knowledge and actively seeking to expand their expertise. Engaging in CISB facilitates self-actualisation, enabling physicians to achieve happiness and self-satisfaction. Furthermore, successfully completing tasks through CISB enhances physicians' self-confidence.

Subtheme 3: organisation-related consequences

Organisational achievement through the effective utilisation of CISB fosters synergy and promotes the organisation's growth and development. It contributes to reducing medical errors and avoiding financial waste, ultimately leading to financial benefits. Moreover, organisational credibility encourages the regular and continuous referral of patients, giving the organisation a competitive edge. Establishing a strong organisational reputation and brand identity further enhances organisational authority

in medical centres, attracting more customers (refer to table 4 for supporting quotes).

DISCUSSION

This paper aimed to investigate the clinical information-seeking process at the point of care, identifying seven key themes: clinical information needs and characteristics of clinical questions (causal conditions), information usability (interfering conditions), clinical information resources as factors influencing information-seeking (context conditions), action/interaction when encountering clinical questions (strategies) and consequences of CISB (consequences). The CISB model depicted in figure 1 reflects an interactive, dynamic and non-linear process.

As outlined by Foster,[35] non-linear models deviate from linear information-seeking models. Similarly, in the physician's CISB model, the starting and ending points are not fixed, and the information-seeking process may persist by addressing causal, contextual and intervening conditions. This process can be iterated with a feedback loop or transition to another process altogether.

In the present study, the theoretical explanation revealed that CISB occurred in demanding clinical scenarios encompassing diagnosis, treatment and information updating. Previous studies have acknowledged diagnosis and treatment as primary or secondary types of information needs in clinical settings.[23 29 36–43] Unlike findings from Cook's research,[15] patient education did not emerge as a motive for information-seeking in the present study. This discrepancy may be attributed to the physicians' heavy workload.

The physician's causal factors shaping the CISB process include characteristics of complexity, the significance of the question and the duration of the physician's involvement with the patient. Moreover, variations in mental analysis and focused attention on solving clinical problems (core category) influence changes in the CISB process. Physicians encounter the most significant changes when confronted with urgent, complicated and critical questions for which they have access to information to provide answers. Some studies have highlighted low significance as a reason for unanswered questions in clinical practice,[42 44–46] while the urgency of the question has been identified as a motivation for seeking information.[19 47] These findings align with the outcomes of the present study.

Resource usability serves as an intervening condition that either facilitates or constrains CISB. The following factors are identified as enhancing physicians' accessibility to information: access to technical services,[48 49] optimal internet speed in clinical settings,[12 50–52] completeness of information,[53] immediate access to resources[15 54] and considerations regarding information resource costs.[39 55]

Various factors influence the contextual formation of the CISB process among physicians, encompassing clinical information resources as well as personal, organisational, technical and social factors. These factors can either strengthen or detract from the focus on resolving clinical issues. Textbooks[3 42 45 49 56–67] and guidelines[64 66 68 69] are frequently used due to their high credibility. Additionally, Google is employed for its accessibility to a wide range of information resources.[62 70] However, physicians typically do not rely on Google for clinical judgement; instead, they use Google as an initial step in the CISB process to verify the accuracy of information obtained from other sources.

In general, causal, intervening and contextual conditions enable physicians to focus on resolving clinical problems and guide them in selecting appropriate information-seeking strategies. The strategies adopted by physicians in CISB form the core of the theory. The model developed by Cook *et al*[15] aligns well with the model extracted in the present study. This study categorises some of these factors into barriers and enablers. However, the weakness of these classifications lies in their broadness and the lack of classification of factors as contextual or intervening. Indeed, many of these factors contribute to the contexts and conditions for information-seeking, while others directly facilitate or limit the strategy in question.

When physicians encounter challenging clinical problems, focused attention enables them to decide whether to engage in ISB. If they choose not to seek information directly, they may opt to refer the patient to a colleague, using deferral as a decision-making strategy.[56 71] However, if physicians decide to seek information, their action strategy is determined by factors such as explicitness, frequency and timing. Following the retrieval of information, physicians evaluate their actions through a process of action evaluation. During this phase, physicians assess the obtained information for relevance, credibility and updatability. Veinot *et al*[72] demonstrated that information evaluation encompasses considerations such as usefulness, relevance, validity and value.

When physicians access highly valid information, they consider the feasibility of action, which is determined by the physician's reflection on the cost-effectiveness of diagnostic and therapeutic methods, availability of hospital equipment, patient preferences and financial resources, with no potential legal complications. In the action selection stage, physicians initially assess the sufficiency of information and, if necessary, make clinical decisions. Subsequently, physicians manage the action by sharing and saving information. If physicians find that their mental standards are not met, they may revisit previous stages or even the beginning of the process to start anew. The strategies employed in this process are inherently recursive, allowing for the creation of new information-seeking paths after addressing the initial need. Furthermore, the nature of feedback is inherent at each stage of the process.

Numerous studies have highlighted that CISB among physicians leads to improvements in patient care.[37 73 74] In the present study, physicians' adoption of CISB strategies

not only facilitated personal and professional growth and self-actualisation but also contributed to enhanced organisational performance and authority. Moreover, these strategies positively impacted patient satisfaction and recovery.

Study strengths and limitations

In the present study, data analysis was conducted using a rigorous theoretical approach, resulting in an interactive, dynamic and non-linear model. Furthermore, all strategies identified are inherently recursive. This model offers a theoretical foundation that enhances understanding of CISB during patient care, achieved through the classification of causal, contextual and intervening factors and strategies. This research contributes to the development of a formal and comprehensive theory by advancing interdisciplinary understanding. Like many qualitative studies, the generalisability of the findings may be limited. However, adherence to conditions ensuring data accuracy can enhance the generalisability of the results to related contexts.

CONCLUSIONS

The information-seeking process commences with the identification of an information need and is directed towards resolving clinical issues. The CISB process follows an IF-THEN sequence when addressing clinical problems. In the presence of stimuli such as information needs and suitable characteristics of the clinical question, and under facilitating contextual and intervening conditions, physicians are directed towards professional and organisational growth. Additionally, they enhance patient satisfaction by adopting information-seeking strategies and focusing on resolving clinical issues. Conversely, if the necessary stimuli are insufficient, physicians are directed towards a failure to seek information. Consequently, the rhythm of the physician's CISB process aligns with variations in the characteristics of the clinical problem and contextual conditions, encompassing individual, organisational, technical, social and resource usability factors.

The findings highlight that CISB is a multidimensional phenomenon. Understanding CISB aids managers, policy-makers, clinical librarians and information system designers in effectively implementing various interventions, such as appropriate training methods and the enhancement of monitoring and evaluation systems, to promote focused attention on clinical problems and CISB among physicians. Additionally, the CISB model can serve as a theoretical foundation for the development of clinical decision support systems, electronic health record and EMR systems.

Author affiliations
[1]Department of Medical Library and Information Science, School of Management and Medical Informatics, Tabriz University of Medical Sciences, Tabriz, Iran
[2]Health Information Technology Research Center, Isfahan University of Medical Sciences, Isfahan, Iran
[3]Nursing and Midwifery Care Research Center, Faculty of Nursing and Midwifery, Isfahan University of Medical Sciences, Isfahan, Iran
[4]Department of Pediatrics, Child Growth and Development Research Center, Research Institute for Primordial Prevention of Non-communicable Diseases, Isfahan University of Medical Sciences, Isfahan, Iran

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Contributors All authors are in agreement with the content of the manuscript and study design. AD conducted interviews, interpreted the data and wrote the manuscript. AD, HA, MS, AZ and RK contributed to the data analysis and interpretation. AD, HA, MS and AZ conceptualised and designed the modeling framework. RK advised regarding clinical relevance and edited the manuscript. HA supervised the study. HA accepts full responsibility for this article as guarantor.

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ORCID iDs
Azra Daei http://orcid.org/0000-0001-5112-8790
Hasan Ashrafi-rizi http://orcid.org/0000-0001-6052-2087

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Supplement 1- Interview guide

Participant's code: ……..… Date of interview: …….. **Start time for interview …….. End time for interview ……..**
Demographic information – **Age:** – **Gender:** – **Specialty:** – **Experience:** – **Academic medical centers:**
– **In which cases do you usually feel you need clinical information? Explain more, please.**
– **Consider what you were looking for clinical information, recently. Please remember and explain all the levels step by step.**
– **What was your next activity after finding the information you needed?**
– **What are the main sources for your work? what are their characteristics and what are their uses for your clinical decisions? Please mention the databases you are searching for clinical information need? and what are their strengths and weaknesses?**
– **In your opinion, what are the influencing factors and intervening factors on the search for clinical information by physicians?**
– **What challenges have you encountered in searching for clinical information? What was your strategy in dealing with these challenges? How do you measure your success?**
– **To what extent and how do you use evidence-based medicine in the treatment of patients? Does this method help your patients' treatment? What challenges have you experienced along this way?**
– **In your opinion, what are the consequences of clinical information seeking by physicians, reaching appropriate information and using them in the treatment**

and diagnosis?

Supplement 2 –COREQ checklist

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. International Journal for Quality in Health Care. 2007;19 (6):349 – 357.

No. Item	Guide questions/description	Reported on Page #
Domain 1: Research team and reflexivity		
Personal Characteristics		
1. Interviewer/facilitator	Which author/s conducted the interview or focus group?	Page 6
2. Credentials	What were the researcher's credentials? E.g. PhD, MD	PhD Page 1
3. Occupation	What was their occupation at the time of the study?	Page 1
4. Gender	Was the researcher male or female?	male & female
5. Experience and training	What experience or training did the researcher have?	Page 1 & 7
Relationship with participants		
6. Relationship established	Was a relationship established prior to study commencement?	Not reported on page **Yes**
7. Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	Page 21
8. Interviewer characteristics	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Page 7 Expert in qualitative researches
Domain 2: study design		
Theoretical framework		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Page 5
Participant selection		
10. Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	Page 6

11. Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	Page 6
12. Sample size	How many participants were in the study?	Page 6
13. Non-participation	How many people refused to participate or dropped out? Reasons?	**None**
Setting		
14. Setting of data collection	Where was the data collected? e.g. home, clinic, workplace	Page 6
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	**No**
16. Description of sample	What are the important characteristics of the sample? e.g. demographic data, date	Page 27 Table 1
Data collection		
17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Page 6 and Supp1
18. Repeat interviews	Were repeat inter views carried out? If yes, how many?	**No**
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	Page 6
20. Field notes	Were field notes made during and/or after the interview or focus group?	Page 7
21. Duration	What was the duration of the interviews or focus group?	Page 6
22. Data saturation	Was data saturation discussed?	Page 6
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	Page 7
Domain 3: analysis and findings		
Data analysis		
24. Number of data coders	How many data coders coded the data?	Page 7
25. Description of the coding tree	Did authors provide a description of the coding tree?	Page 7 and 8
26. Derivation of themes	Were themes identified in advance or derived from the data?	Page 7 and 8 **Themes were derived from the data**
27. Software	What software, if applicable, was used to manage the data?	Page 7
28. Participant checking	Did participants provide feedback on the findings?	Page 7
Reporting		
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	Page 28-33

30. Data and findings consistent	Was there consistency between the data presented and the findings?	Page 17-19 **Yes**
31. Clarity of major themes	Were major themes clearly presented in the findings?	Page 17-19 **Yes**
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Page 17-19 **Yes**