Development and validation of the clinical information literacy questionnaire

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Abstract:

BACKGROUND: Clinical Information Literacy (CIL) seems to be a prerequisite for physicians to implement Evidence-Based Medicine (EBM) effectively. This study endeavors to develop and validate a CIL questionnaire for medical residents of Isfahan University of Medical Sciences.

MATERIALS AND METHODS: This study employs sequential-exploratory mixed methods in 2019. The participants were 200 medical residents in different specialties; they are selected through the convenience sampling method. In the first (qualitative) phase, an early CIL questionnaire was designed by reviewing literature and performing complementary interviews with health professionals. In the second (validation) phase, the questionnaire's face validity and content validity were confirmed. In the third (quantitative) phase, the construct validity was examined via Item-Response Theory (IRT) model, and the factor loading was computed. The gathered data were analyzed using descriptive statistics, *t*-test, two-way ANOVA, as well as two-parameter IRT model in R software.

RESULTS: In the qualitative phase, the concept of CIL is initially described in seven main categories and 22 subcategories, and the items were formulated. An initial 125-item questionnaire was analyzed by the research team, leading to a 43-item. Through the content validity and face validity examination, we removed 11 and 4 items in the Content Validity Ratio (CVR) and Content Validity Index (CVI), respectively. Throughout the face validity analysis, none of the items were removed. According to the construct validity results, difficulty coefficient, discriminant coefficient, and factor loading were confirmed, most of the other questions achieved a proper factor loading value that is higher than 0.30, and a value of 0.66 was achieved for the reliability via the Kuder–Richardson method. Ultimately, the real-assessment 28-item CIL questionnaire was developed with four components.

CONCLUSIONS: The CIL questionnaire could be employed to examine the actual CIL basic knowledge. Because of using the real-assessment approach rather than self-assessment in the design, it can be claimed that this instrument can provide a more accurate assessment of the information literacy status of medical residents. This valid questionnaire is used to measure and train the skills needed by healthcare professionals in the effective implementation of EBM.

Keywords:
Clinical Information Literacy (CIL), Evidence-Based Medicine (EBM), Item Response Theory (IRT), medical residents, questionnaire

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Introduction

World Federation for Medical Education (WFME) has recently reported that lifelong learning is essential in medicine.[1] One of the crucial components of lifelong learning is Evidence-Based Medicine (EBM).[2] As a potent pedagogical instrument, EBM can fill the gap between research and clinical practices.[3] EBM was recognized as a five-step procedure: 1) formulating clinical questions based on the patient problem, 2) searching for the relative

evidence, 3) critically appraising the evidence, 4) applying evidence at the patient bedside, and 5) evaluating performance.[4] Through these steps, Clinical Information Literacy seems to be a prerequisite to the employment of EBM in clinical care[5-10] and one of the essential competencies throughout the EBM application.[11] According to the Institute of Medicine (IOM), one of the competencies of a medical education university is to become acquainted with informatics to combine the EBM principles with information literacy.[12]

Due to the existence of numerous publications in the field of healthcare information, individuals need to know information literacy skills, especially those for clinical settings. Otherwise, they will not have on-time access to and efficient use of information. In this regard, physicians should be familiar with basic information literacy, EBM applicable terms, the relative subjects on the patient's values, and the practice of evaluating the results of information used in the clinical settings[9,13]—altogether known as "Clinical Information Literacy (CIL)"—to retrieve evidence similar to their performance. The use of EBM requires promoted skills of the physicians' CIL. However, there is evidence that physicians typically have lower information literacy than what is necessary.[14,15] Besides, some physicians and assistants appear to have had relatively good knowledge about both EBM and the specialized sources and rarely benefit from such an approach.[16-19] Besides, some physicians fail to formulate clinical questions, critically appraise the evidence, and appropriately define the practical terms.[18,20] Accordingly, it is necessary to evaluate the current CIL of physicians to formulate a plan for the physicians' CIL improvement.

Two main methods to appraise CIL are self-assessment and real assessment. In the first approach, learners judge their performance and may view their abilities at a high or low level. In the latter, individuals were asked questions regarding their experiences[21] and their contributions to more precise results. In some studies, a variety of tools were employed to assess both EBM skills and information literacy. Nevertheless, most of these tools focus on specific aspects of the EBM employment, such as knowledge, attitude, barriers, and facilitators, and were developed to be a self-assessment technique.[18,19,22-24] Also, a review study concluded that most of the EBM tools assessment encompasses structural and functional limitations and set forth challenges to the process of their validation.[25] In this respect, Fernández used the Delphi technique to develop a questionnaire that assesses four aspects: attitude, scientific research results, professional performance development, and outcomes evaluation. While the questionnaire follows the design principles, the items fail to provide a real assessment.[26] The KACE questionnaire also addresses four aspects, including knowledge, attitude, accessibility, and evaluation. The

knowledge aspect, which has 10 items with a 4-point Likert scale, is only used in dentistry and appraises a few of the EBM stages.[26] To the best of the researchers' knowledge, no comprehensive instrument is available to offer adequate assessment in this area.

Although there has been one questionnaire that evaluates actual information literacy,[21] it does not specifically address physicians' particular literacy and has not been remarkably changed following the clinical setting to cover all subjects concerning them.

According to Ivanitskaya, it may typically be either a self-declaration or educational course task when evaluating students' skills in appraising health information, and standard tools were rarely employed.[27] In this respect, a review was conducted on the instruments for information literacy assessment in the healthcare fields, and nine instruments were found appropriate. After modifying the instrument to assess knowledge and skills, the Fresno test was eventually selected for the evaluation. Overall, information literacy tools include, but are not limited to,[28] the following groups of tools: The first tool is the K-REC instrument, which is mainly employed to assess the EBM skills, and was based on formulation, finding, and appraising aspects. The tool has nine items with a 5-point Likert scale formulated as clinical scenarios. However, it fails to assess knowledge under information literacy thoroughly.[29] Also, the RRSA questionnaire with 28 multiple-choice items was used to evaluate information literacy concepts.[30] However, its effectiveness in educational settings has not been proved.[28] Accordingly, without a proper instrument, an acceptable CIL of physicians is not possible, and designing intervention programs to promote the physicians' performance becomes difficult. Given this, there should be a valid measurement instrument to develop such an instrument. Besides, despite the presence of an investigation by Fung[13] that describes CIL general concepts, this study lacks a tool to assess such concepts.

Despite the necessity of promoting CIL among different caregivers, assessing the medical residents' CIL should be the priority. The reason is that they are the first group of caregivers who visit patients and were considered the important group to teach and learn and play a key role in clinical decisions.[23] Therefore, when CIL skills were trained, the idea of EBM will become popular and it leads to the promotion scientific thinking of students, and EBM will be considered by physicians as a way of thinking. Assessment and training of CIL to clinical professionals will play an important role in using EBM resources for clinical practice, which will lead to improvement of treatment quality and overcoming additional costs. Therefore, the purpose of this research is to "design and

validate the Clinical Information Literacy questionnaire," which contains questions that do not belong to only one clinical specialty; but at the same time, it can measure in a basic level and its implementation is also easy. So that medical librarians can accurately identify the information needs and skills needed by residents to implement EBM and provide more effective training.

Materials and Methods

Study design and setting
This study uses a sequential-exploratory mixed method to develop an instrument based on qualitative research and was piloted by a quantitative analysis.[31] In this approach, first qualitative data and then quantitative data were collected and analyzed, and usually, quantitative data were used to enhance qualitative data. This method was used to modify and test the theory, and design the tools.[32] This study was performed on medical residents at Isfahan University of Medical Sciences, in 2019. [Diagram 1].

Data collection tool and technique
This questionnaire was developed through three stages; in the first (qualitative) phase, an early CIL questionnaire was designed by reviewing literature and performing complementary interviews with health professionals. In the second (validation) phase, the questionnaire's face validity and content validity were confirmed. In the third (quantitative) phase, the construct validity was examined via IRT model, and the factor loading was computed.

Stage one: A qualitative study
To formulate early items of the questionnaire, two steps (i.e. a review of literature and complementary interviews) were taken. In the first step, a literature review technique was employed, including searching texts concerning the CIL concept. Works related to "Evidence-Based Medicine" or "information literacy" or a combination of both were looked up because the CIL notion is fresh, and no similar studies were found after performing searches. To select the keywords, we reviewed Medical Subject Headings (MeSH) and the opinions of healthcare professionals and medical librarians. In this regard, we used the articles from the databases of PubMed, Web of Science, Science Direct, Emerald, Scopus, Embase, and Persian databases including Magiran, SID, Iranmedex, and Noormags. Then, based on criteria such as English and Persian articles related to the research topic and without time limit, the selected articles were evaluated. First, 471 articles on CIL were reviewed, and 214 of the articles were not used due to having similar information. Then, the selected articles were examined according to the objectives of the research; after screening the title, abstract, and full text, 42 articles were selected to find the necessary components to develop a questionnaire.

The conventional content analysis was carried out in the second step. Accordingly, a complimentary interview was performed for items and components of the questionnaire to become rich. This semi-structural interview was conducted on 10 medical librarians and healthcare specialists with experience in teaching or researching EBM or caregiving under EBM. These experts were initially selected purposefully based on their sufficient knowledge and experience in answering the researcher's questions and research objectives (according to inclusion criteria). Then, snowball sampling was used to identify the qualified samples. In other words,
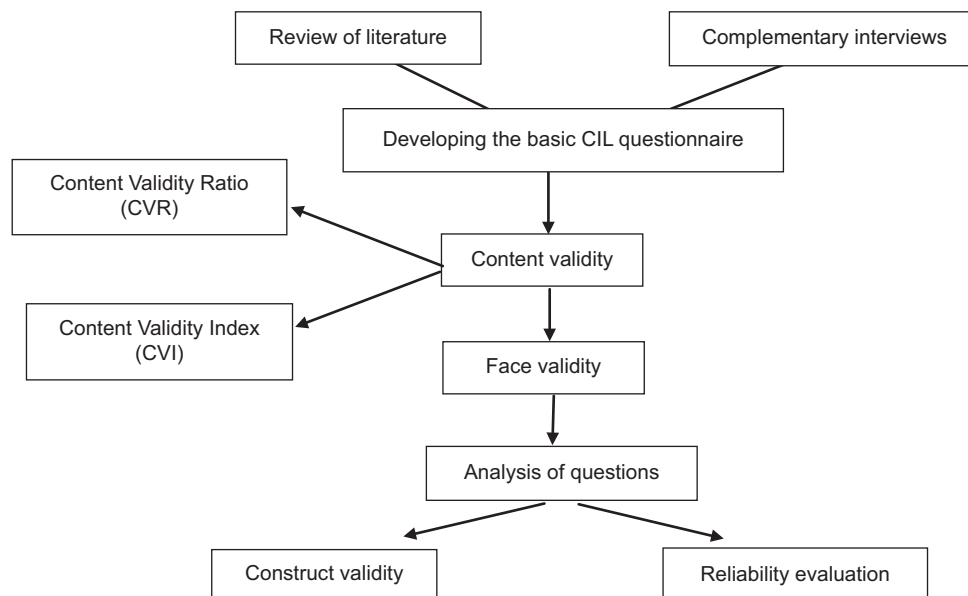
Diagram 1: Diagram of sequential-exploratory mixed method

experts were asked to recommend other individuals they thought as suitable for the study. Before performing the interview by the researcher, informed consent was obtained from all the participants, and they were ensured about information confidentiality. Data collection was continued until data saturation.

The participants consented to record the interview, with each lasting 30–50 minutes. The interview was transcribed and reviewed multiple times, and the essential explanations were highlighted. Then, major and minor themes were identified, extracted, and coded. In this process, concepts from each interview transcript related to the medical residents' CIL that could be changed into a question sentence were numbered as a code. After reviewing these codes, the identical, combined, and similar ones were eliminated. Accordingly, both major and minor components were identified. Among them, those items that seemed proper to become questions were specified. After the transcripts and recorded interviews, the CIL questionnaire items were extracted and the questions formulated. In this way, a draft of the instrument consisting of 125 questions was prepared. The research team then analyzed the items. After removing the repeated, similar, and unrelated items, 43 questions remained. This instrument underwent the next stage, namely developing the basic CIL questionnaire.

Lincoln and Guba's four criteria (i.e., credibility, dependability, confirmability, and transferability) were employed in this step.[33] The research team exchanged ideas and presented the obtained conclusions to the participants to achieve the data credibility. Afterward, to reach dependability, a thorough and detailed report concerning the research data collection, decision-making, and the method of interpretation was composed. A detailed description of the research subject was provided, and procedures were explained to improve data transferability. To obtain confirmability, we considered confirmation and complementary opinions and corrective supervision conducted by other researchers.

Stage two: Validation

Both Content Validity Ratio (CVR) and Content Validity Index (CVI) were used to confirm the content validity quantitatively. To this end, 16 experts (8 clinical specialists and 8 expert librarians and medical librarians) were demanded to assess all the items rated on a 3-point Likert scale, namely necessary, useful, unnecessary, and unnecessary. The responses were then calculated using the formula CVR= (ne-N/2)/N/2. The ratios determined for the items were compared with those illustrated at the Lawshe Table.[34] Finally, the content validity of the items with a score equal to or more than 0.48 was confirmed. CVI assessment was carried out based on Waltz and

Bausell's Content Validity Index.[35] Accordingly, using a four-point Likert scale, all 16 experts considered relevancy, clarity, and simplicity criteria to study the instrument's items. The formula used to assess CVI was presented below. Similar to the identical works, the items with a score of more than 0.79 appeared to have an acceptable CVI.[36]

$$CVI = \frac{\text{The sum of scores for each item in accordance with a three - and four - point Likert Scale}}{\text{Total number of specialists}}$$

The face validity was quantitatively assessed through the method of impact factor. In this process, 30 randomly selected medical residents were asked to express the importance of every item on a five-point Likert scale. The face validity was obtained after calculating the impact factor of the item (impact factor = (frequency %) × importance). The items with an impact score higher than 1.5 were deemed appropriate for further analysis.[36]

Final stage: A quantitative study

The instrument's reliability and construct validity were determined in this stage. Item-Response Theory (IRT) is a method for the analysis of the test structure. IRT emphasizes the responses given to the test questions rather than different scores obtained from the test. With IRT highlighting the individual responses to the questions, abilities of individuals and specific features of the question will emerge. Various aspects of a question vary depending on the different IRT models. Generally, IRT includes a group of models, each devoted to serving a role for a particular test item.[37,38] IRT models vary in classification depending on the parameters estimated, like the tested parameter (i.e., ability parameter) and the item parameters (i.e., difficulty coefficient, discriminant coefficient, and conjecture coefficient). Different models employ different question parameters, categorizing them as one parameter model or two or three parameters model.[39] Because the questionnaire answers were two-valued, the question–answer model with two variables (difficulty coefficient and discriminant coefficient) was taken into account throughout performing analysis by the R software. The question difficulty parameter plays a role in the person's ability scale as the correct responses of a person with superior skills were supposed to take a score of 0.5 for such a parameter.[40] Here, the item discriminant coefficient refers to the item's potential in distinguishing different group's skills. The proper values for discriminant coefficient are as follows[41]: ≥ 0.4 implies very good value, 0.3–0.39: a good value, 0.2–0.29: the need for revise, and <0.19 shows that the items are weak and need to be revised or eliminated. A single-factor model was used through the R software

to compute the factor loading. Based on this model, questions in every component were added to the software, and their factor loading was calculated. The report generated by the factor loading for a particular item indicates the importance of that item within the component. Overall, this report helps decide whether the item should be kept in or removed from that component. However, the elimination of such an item is optional and not necessary.

Eventually, the CIL questionnaire, which contains 28 items, was based on a review of the literature and the complementary interviews. It includes four components, including EBM basic concept, finding clinical evidence, critical appraisal of clinical evidence, evidence application, and dissemination of results. The questions were scored in 0–1, with four choices per question. A high score obtained in a component shows the great ability of the resident in that CIL component. The questionnaire includes demographic characteristics like gender, age, specialty, and semester and asks respondents whether they attend any EBM courses and know the EBM concept.

Study participants and sampling

The construct validity was evaluated by giving the questionnaire to 200 medical residents in different specialties at Isfahan University of Medical Sciences. Sampling was done according to availability sampling method, and samples were selected from different specialties to have miscellaneous samples. The samples were estimated to be 5–10 times of the designed tool items.[42] Therefore, considering that the CIL questionnaire has 28 items, sample size included 200 medical residents, and so the ratio of the sample to the variable was 7 to 1, indicating the adequate sample size.

Inclusion criteria were willingness to participate and meeting population requirements. Unwillingness to attend the study and delivering an unfinished questionnaire were the exclusion criteria. Because the medical residents were busy and did not spend enough time to complete the questionnaire, it may affect the accuracy of their answers. Therefore, in order to collect quality data, incomplete questionnaires were not used and another resident was replaced the previous sample. Medical residents were also selected from different specialties in order to have miscellaneous samples. Therefore, the replacement was done because some persons were not qualified, and we wanted to observe ethical considerations of the research and there was no bias.

Reliability

Kuder–Richardson was employed to compute the reliability of the instrument components and the

questionnaire because the method was for responses assigned a 0–1 point value.[43] The SPSS software version 22 was employed for the data analysis. In this process, both descriptive statistics (including frequency, frequency percentage, mean, standard deviation) and inferential statistics (including one-sample *t*-test, two-way ANOVA) were considered, and the content validity was calculated. The R software was used to compute the factor loading (with single-factor model) and IRT.

Ethical consideration

Ethical considerations in this study included: permission from the Ethics Committee of the Isfahan University of Medical Sciences, with the code of ethics: IR.MUI. REC.1397.398, obtaining informed consent from participants and interviewees, and ensuring the confidentiality of the information of them.

Results

An initial 125-item questionnaire was designed based on the concepts and data of 42 studies gathered by reviewing literature and performing interviews in the first step (i.e. the qualitative research). The number of questions was further reduced to 43 by eliminating unnecessary and similar ones. After meeting inclusion criteria, 11 specialists (including caregivers and medical librarians) attended the interview sessions. Most of the interviewees were males (54.5%) with a professional doctorate (90.9%) and work experience of 10–20 years (54.5%). Also, a high number of experts (54.5%) had graduated from the medical library science. Data obtained from the interviews were manually analyzed using a qualitative content analysis method. As a result, 7 major categories and 22 subcategories emerged with the following main themes: 1) the basic EBM concept, 2) clinical question formulation, 3) finding clinical evidence, 4) critical appraisal of evidence, 5) evidence application, 6) appraisal of undertaken actions, and 7) dissemination of results.

Based on the second stage results (i.e. validation), 11 with a CVR lower than 0.48 and 4 items with a CVI lower than 0.79 were eliminated. The CVI mean was calculated at 0.87 for the remaining 28 items. Based on the face validity assessment, a score of 1.5 was obtained for all instrument items. The items eliminated in this step were presented in Table 1.

The place of every item within the questionnaire components was discussed and decided by evaluating the instrument validity and taking into account the opinions of experts and the research team. The items with similar concepts were combined since several components lacked sufficient questions, and some of

Table 1: Search strategy in literature review

Database	Search Strategy
PubMed	(«Evidence based medic*»[Title/Abstract] OR «Evidence based Pract*»[Title/Abstract] OR «Evidence based Health care*»[Title/Abstract] OR «Evidence Based Emergency Medicine»[Title/Abstract] OR «EBM»[Title/Abstract] OR «EBP»[Title/Abstract]) AND «Information Literacy»[Title/Abstract]
Science Direct	(«Evidence based medicine» OR «Evidence based Practice» OR «Evidence based Health care» OR «Evidence Based Emergency Medicine» OR «EBM» OR «EBP») AND «Information Literacy»
Scopus	(TITLE-ABS-KEY («Evidence based medic*» OR «Evidence based Pract*» OR «Evidence based Health care*» OR «Evidence Based Emergency Medicine» OR «EBM» OR «EBP») AND TITLE-ABS-KEY («Information Literac*»))
Web Of Science	TITLE:(«Evidence based medic*» OR «Evidence based Pract*» OR «Evidence based Health care*» OR «Evidence Based Emergency Medicine» OR «EBM» OR «EBP») AND TITLE: («Information Literac*»)
Embase	('evidence based medic*':ti, ab, kw OR 'evidence based pract*':ti, ab, kw OR 'evidence based health care*':ti, ab, kw OR 'evidence based emergency medicine':ti, ab, kw OR 'ebm':ti, ab, kw OR 'ebp':ti, ab, kw) AND 'information literac*':ti, ab, kw
Emerald	[[Anywhere: «evidence based medic*»] OR [Anywhere: «evidence based pract*»] OR [Anywhere: «evidence based health care*»] OR [Anywhere: «evidence based emergency medicine»] OR [Anywhere: «ebm»] OR [Anywhere: «ebp»]] AND [Anywhere: «information literacy»]

the items share conceptual similarities. Accordingly, the early version of the questionnaire was prepared with four components and 28 items.

Based on the demographic characteristics obtained from the study participants in the third stage of the research, the mean age of respondents is 33.16 years old with a standard deviation of ± 6.571, of which 57% were females. Most residents (49%) had average knowledge about EBM. Also, a considerable number of them (68.5%) experienced attending the EBM courses either at workshops or academic classes.

The results [Table 2] show that the discriminant coefficient ranges between 0.25 and 1.99, and the difficulty coefficient of -1.33–2.14 was achieved. Questions 5 and 24 have the highest difficulty level, while questions 4, 13, and 16 have the lowest. Question 10 has the lowest discriminant coefficient, while items 18, 28, 6, 12, and 3 possess the highest discriminant coefficient. The calculated factor load of the questions in each component is available in Table 2.

One sample *t*-test was employed to assess the mean of questionnaire components to compare it with an assumed value (the average of the scores equals 0.5). The results showed that the mean value of the second component

is slightly higher than the assumed value, while the overall mean and the average values of other features are equal to that value. According to Friedman's test results, a significant difference was observed between the components ranks as the second component achieve the highest average rank, followed by the third, fourth, and first components, in the order of their appearance.

The technique of the Kuder–Richardson coefficient was employed to assess the questionnaire reliability. Obtaining a score of 0.66 for a total of 200 samples indicates the acceptable reliability of the questionnaire. In this method, the test or instrument was accepted when Kuder–Richardson's reliability coefficient is 0.64, but in standard tests this value should be higher than 0.80.[44,45] External reliability has also been qualitatively evaluated. Thus, both the validity and reliability of this 28-item CIL questionnaire with four components were confirmed. [Table 3].

Discussion

The CIL questionnaire was designed and validated to assess the CIL among medical residents in this study. As a key facilitator, the CIL's responsibility is to apply EBM in clinical care as the CIL skills are a prerequisite to delivering effective clinical care, which requires putting the study results into practice. Accordingly, this multi-aspect 28-item CIL questionnaire with acceptable validity and reliability is the first-ever instrument to examine the medical residents' CIL. This instrument includes two parts, namely demographic characteristics and the CIL items within four components, as presented below. The questions contain one correct answer with four choices per question.

1. *The EBM Basic Concepts:* Having knowledge about the goal, practicing the goal, and knowing the EBM implementation procedures are the basic concepts of EBM. Accordingly, the first CIL component, which includes three items, involves the concepts of "the goal and importance of EBM," "EBM procedures," and "EBM components." These concepts are in line with the questionnaires designed by Kalavan,[22] Raya,[16] and Capras,[46] suggesting the responsibility of a good understanding of the basic concepts of a subject in creating a better perception of that subject.

2. *Finding Clinical Evidence:* The process of finding clinical evidence involves formulating a structured clinical question and using the techniques of search to look for the best evidence that meets the required information. Accordingly, this 11-item component includes two phases, including "formulation of clinical question" and "finding clinical evidence," in the findings obtained in a qualitative investigation. These phases were integrated since the formulation of a clinical question is the first

Table 2: CVI, CVR, and impact factor values obtained for the CIL questionnaire

Questions	CVR	CVI	Impact factor
1	0.5	0.81	4.37
2	1	0.94	4.30
3	0.88	0.90	4.33
4	0.75	0.90	3.70
5	0.75	0.94	3.80
6	0.75	0.96	3.83
7	0/88	0.88	4.57
8	0/88	1	4.33
9	0.5	0.92	3.87
10	1	0.83	4.20
11	0.75	0.88	3.67
12	0.5	1	4.07
13	0.75	0.88	4.23
14	0.88	0.88	4.40
15	0.5	0.73	4.23
16	0.88	0.77	4.57
17	0.63	0.92	4.60
18	0.63	0.92	4.43
19	0.5	0.81	4.37
20	0.63	0.79	3.57
21	0.5	0.71	4.70
22	0.63	0.90	4.20
23	0.5	0.81	4.90
24	0.88	0.90	4.37
25	0.75	0.81	4.50
26	0.63	0.79	3.53
27	0.63	0.79	3.83
28	0.87	0.90	4.20

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step in searching. The items within this component are in line with the idea of the studies by Capras,[46] Alshehri,[47] Kaknjo,[19] and Lavizeh,[48] who propose "an introduction to PICO," "Thesaurus," "searching," "EBM databases," "operators and search technique," and "developing search strategy techniques" as the main components of their tools. This result sheds light on the importance of learning essential skills to discover the latest scientific findings to overcome clinical specialists' daily problems.

3. *Critical appraisal of the evidence:* This component encompasses an appraisal of articles gathered by searching to examine their content validity, accuracy, practicality, and effectiveness. The concepts included in this 8-item component are "clinical evidence pyramid," "hallmark and usage of different types of the clinical evidence," "different clinical studies following different clinical questions," and "EBM applicable terms." Such concepts have been indicated in the work of Walsh and Diaz,[49] Bednarczyk,[50] Kaknjo,[19] Abu-Gharbieh,[51] Alshehri,[47] and Sharif Moghadam.[10] Accordingly, one of the CIL purposes is to decide how much the obtained articles would be useful in answering the clinical questions.

4. *Evidence application and dissemination of results:* This component determines whether evidence is applicable and focuses on the values and preferences of patients. Also, it provides the awareness of how to save and share the results for further uses. Accordingly, such a component with six items brings two major phases, including "clinical evidence application" and "dissemination of results," in the qualitative study results. Since the evidence application involves high practical aspects and the number of items was insufficient, the phases were merged into one. One central concept of evidence application is taking into account patients' preferences and values, which aligns with one aspect of the questionnaires by Ebrahimi[52] and Bednarczyk.[50] The items of "dissemination of results" component cover "the concept of dissemination of results," "citing credible sources," and "the methods of dissemination of results" to either officially or unofficially share a brief of the process undertaken to improve quality in therapies. This component has received much less attention in research than other CIL components. As a result, there is a gap between clinical specialists and the outcomes obtained from the practice of evidence at the bedside. In studies by Jameson,[11] Sharif Moghadam,[10] and Kersten,[53] dissemination of results is described as one step in EBM, as well as the last step of the standard information literacy.[14] Therefore, it is necessary to create a circumstance where clinical specialists use the best evidence to choose the patients' care procedures and save and share the outcomes. However, this issue is typically receiving little attention.

Although different studies attempted to design either a CIL or EBM questionnaire, no researcher has obtained such an instrument, even while conducting the present study. It is of note that despite the availability of many EBM assessment tools,[16,18,19,22,23,26,54,55] they typically lack one or more stages of EBM and were designed as self-assessment that do not offer the needed efficiency.[25] Besides, the questionnaires do not often use a mixed-methods design that would abandon the experiences of many individuals gained in clinical settings. According to the study by Shaneyfelt *et al.*,[56] the Fresno test[57] and Berlin questionnaire[58] are the only instruments that examine the four stages of EBM. However, the Fresno test is a time-taking instrument that uses both open-ended and close-ended questions. Also, respondents were expected to possess the required skills.

Besides, the Berlin questionnaire contains multiple-choice questions in the form of some clinical scenarios. It encompasses two parts to examine individuals' knowledge changes caused by the intervention before and after the course. In this tool, a score was assigned to every scenario. Neither of the instruments was used widely since they require unique teachings before being

Table 3: Number and percentage of the correct answers, as well as difficulty and discriminant coefficient, and factor loading

Components	Questions	The number of correct answers	The percentage of correct answers	Difficulty coefficient	Discriminant coefficient	Factor loading
The EBM basic concepts	1	117	58.5	-0.4	1.06	0.53
	2	82	41	0.61	0.65	0.36
	3	86	43	0.30	1.19	0.57
Finding clinical evidence	4	138	69	-1.33	0.65	0.36
	5	92	46	2.14	0.75	0.40
	6	99	49/5	0.02	1.44	0.64
	7	96	48	0.18	0.48	0.37
	8	83	41.5	0.67	0.54	0.30
	9	84	42	0.41	0.94	0.48
	10	99	49.5	0.08	0.25	0.15
	11	90	45	0.36	0.60	0.33
	12	135	67.5	-0.71	1.37	0.63
	13	124	62	-0.92	0.57	0.32
	14	101	50.5	0.31	0.90	0.36
Critical appraisal of evidence	15	88	44	0.70	0.33	0.25
	16	111	55.5	-0.95	0.34	0.13
	17	119	59.5	-0.47	0.97	0.50
	18	107	53.5	-0.11	1.99	0.76
	19	103	51.5	-0.31	0.37	0.21
	20	94	47	0.19	0.73	0.40
	21	117	58.5	-0.63	0.58	0.32
	22	122	61	-0.79	0.61	0.33
Evidence application and dissemination of results	23	96	48	0.14	0.60	0.33
	24	76	38	1.47	0.34	0.30
	25	93	46.5	0.17	1.02	0.51
	26	81	40.5	0.44	1.08	0.53
	27	104	52	-0.09	0.98	0.50
	28	137	68.5	-0.74	1.50	0.64

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answered. Unlike the Fresno test and Berlin questionnaire, the present CIL questionnaire requires less time to be completed. Also, it assesses the basic knowledge of the four CIL components in individuals performing clinical practices. These features are consistent with the fact that CIL is a fundamental skill for physicians that effectively implement EBM. Accordingly, it is worth mentioning that along with residents, every person involved in the clinical profession would benefit from this CIL questionnaire. However, the study population includes medical residents because they have already learned the minimum EBM skills throughout training as a general practitioner and gained the EBM lowest basic knowledge level. Yet, the instrument capacity goes beyond the current usage for medical residents.

The present research employs two-valued questions for the CIL instrument, with 0 assigned to the incorrect answers and 1 to the correct ones. Accordingly, the research uses the full-information factor analysis technique to analyze two-valued questions, which is also applicable to IRT.[59] The reason is that IRT assesses each question without depending on another question.[37]

Therefore, IRT was used to examine the construct validity and then calculate the difficulty parameter, discriminant coefficient, and factor loading.

According to the study results, an appropriate discriminant coefficient was obtained based on the spectrum of discriminant coefficients.[41] Such a finding may be due to a wide variety of component items with a range of good to very good discriminant coefficients. Thus, the questions would distinguish between examinees with different skill levels. Also, simple and difficult questions were arranged with a reasonable space as one component includes both easy and hard items. However, it is reasonable that some questions do not convey the proper difficulty level and discriminant coefficient as the CIL questionnaire has been developed for the first time.

The R software and a single-factor model were used to perform the questions loading factor calculation. The latter was used regarding the differences existing among the purpose of each question. Since each component of the instrument contains several minor concepts, only 1 to

2 questions were formulated due to the limitation in the total number of questions of the instrument. The items were then analyzed separately. Also, a confirmatory factor analysis (CFA) was performed to compute the factor loading. The analysis was based on the research team's decision on each component's accurate position of items. Here, the importance of an item within a component was based on the factor loading value— and perhaps a significant value—as the question of a component with a higher factor loading than others within the same component gets a larger slice. Although factor loading is less than 0.3 for four of the instrument items, most of the other questions achieved a factor loading value higher than 0.30. Nevertheless, those four questions remained since they obtained an appropriate difficulty and discriminant coefficient. Furthermore, they are based on the concepts of "MeSH," "clinical evidence pyramid," "different types of clinical evidence," and "selection of information sources related to the type of clinical question," which all play an important role in CIL profession.

According to the results of the sample *t*-test and the Friedman test, the mean value of the second component (i.e. finding clinical evidence) is slightly higher than the average value and achieved the highest overall mean. This difference may be due to the increased attendance of Isfahan University of Medical Sciences residents, either optionally or compulsory, at the educational workshops "searching a database." However, such an obtained average value is not "considerably" higher than the average of the scores. Besides, the residents' skills within the related component should not be deemed as remarkable, and attempts are now needed for teaching residents the skills within that component to increase their knowledge. Also, at the end of the questionnaire, there was a section for comments so that residents could express their opinions about the questionnaire. Most of the medical residents considered the content appropriate and suggested that an educational file should be available, and they wanted to be trained.

This tool was regarded as the first clinical information medical literacy questionnaire with relatively accurate design steps. It is also appropriate and efficient for measuring the CIL of residents and even physicians. Because of using the real-assessment approach rather than self-assessment in the design, it can be claimed that this instrument can provide a more accurate assessment of the information literacy status of medical residents. Furthermore, by designing this questionnaire, the theoretical literature on this subject was enhanced such that other researchers can also use it in real-world applications. Physicians will also have a reliable instrument to assess the CIL of medical residents.

However, given that this instrument is not complete and perfect yet, it should be examined by other researchers in other statistical populations to help its evolution. The population sample (n = 200) is one of the study limitations as the due to the conditions caused by the corona disease, the medical residents were busy and attended less, and the study participants were from one geographical area. Another limitation is the literature search in only the Persian and English languages, but not in other languages. As a result, the generalization of the results should be made cautiously. External reliability should have done quantitatively. Also, since the designed tool measures at a basic level, it should be developed in terms of all dimensions of CIL, and it was considered a potential limitation in this project. Ultimately, this CIL questionnaire with 28 items and 4 components was validated and confirmed. Considering that this research was conducted for the first time, the findings of this study can be a basis for conducting further studies in the field of CIL. It can also be used for educational needs assessment and evaluation of EBM educational programs

Conclusions

Physicians and clinicians should know CIL skills to successfully implement the EBM process in clinical practice. In fact, physicians who their practice were based on scientific evidence can make more effective decisions and provide patients with higher quality care. Therefore, the difference between CIL and other literacy is that CIL was related to people's health and is effective in clinical decision making. In other words, clinical decisions that were based on evidence and use the best evidence will allow specialists to act with more information. Accordingly, the present research designed a questionnaire with acceptable validity and reliability to assess CIL levels regarding this issue. This instrument examines actual CIL basic knowledge in residents. The CIL questionnaire can lead to the awareness of health policy makers about the real level of basic knowledge of clinical experts in the field of CIL and lay the foundation for better EBM establishment. Because one of the important issues for the policy-makers of the health system is the use of the best research evidence in clinical decisions, which will ultimately lead to the improvement of the performance of the health system. Considering the importance of this issue, this research has designed a tool to measure the skills needed by clinical professionals in using valid evidence, and at the same time, it can provide a clear state of educational practices and policies to improve their skills. For medical librarians, it will be useful in improving educational processes. In the end, testing the questionnaire in other regions and conducting further CIL studies based on the present research findings were suggested.

Data availability statement

Acknowledgement

Abbreviation

Clinical Information Literacy (CIL); Evidence-Based Medicine (EBM); Item-Response Theory (IRT), Content Validity Ratio (CVR), and Content Validity Index (CVI)

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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