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Usability as a feature of an information system for health status measures: the DataCIF concept

Usabilidade como atributo de um sistema de informação para medidas do estado de saúde: o conceito DataCIF

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ABSTRACT

Objective: To evaluate the perceived usability of DataCIF 2.0, a health information system based on the International Classification of Functioning, Disability and Health. **Method:** Ten healthcare professionals with expertise in the ICF and/or health information systems explored DataCIF 2.0 for 15 days and subsequently completed the System Usability Scale (SUS), scored from 0 to 100. **Results:** Nine participants obtained SUS scores of 50 or higher. The overall SUS score was 71.25 (95% CI: 62.5–87.5), indicating good perceived usability. Items related to system integration and willingness to use the software were positively rated, whereas the need for technical support and confidence in using the system indicated opportunities for improvement. **Conclusion:** DataCIF 2.0 demonstrated good perceived usability among experts. Further evaluation involving users without previous contact with the system is recommended.

Keywords: Health Information Systems; usability; International Classification of Functioning; Disability and Health.

RESUMO

Objetivo: Avaliar a usabilidade percebida do DataCIF 2.0, um sistema de informação em saúde baseado na Classificação Internacional de Funcionalidade, Incapacidade e Saúde. **Método:** Dez profissionais de saúde com experiência na CIF e/ou em sistemas de informação em saúde exploraram o DataCIF 2.0 durante 15 dias e, posteriormente, responderam à Escala de Usabilidade do Sistema (System Usability Scale, SUS), cuja pontuação varia de 0 a 100. **Resultados:** Nove participantes obtiveram pontuações iguais ou superiores a 50 na SUS. A pontuação geral da SUS foi de 71,25 (IC 95%: 62,5–87,5), indicando boa usabilidade percebida. Os itens relacionados à integração do sistema e à disposição para utilizar o software foram avaliados positivamente, enquanto aqueles referentes à necessidade de suporte técnico e à confiança no uso do sistema indicaram oportunidades de aprimoramento. **Conclusão:** O DataCIF 2.0 demonstrou boa usabilidade percebida entre os especialistas. Recomenda-se a realização de avaliações adicionais com usuários sem contato prévio com o sistema.

Descritores: Sistemas de Informação em Saúde; usabilidade; Classificação Internacional de Funcionalidade; Incapacidade e Saúde.

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1 INTRODUCTION

In 2001, the World Health Organization (WHO) published the International Classification of Functioning, Disability and Health (ICF), a classification of health and health-related domains based on the biopsychosocial model. The ICF provides a framework for describing and measuring health and disability at both individual and population levels and has become an important theoretical framework for healthcare. Its taxonomy organizes information into body functions, body structures, activities and participation, and contextual factors, including environmental and personal factors. It comprises more than one thousand health-related categories and provides a standardized language for describing functioning, disability, and health-related states [1,2].

One advantage of the ICF for health information system development is that its categories and qualifiers can describe both functioning and disability from biological, individual, and social perspectives. However, the large volume and complexity of coded information may require extensive training, time-consuming data-entry procedures, data management skills, and statistical expertise to generate useful reports [1,3]. An ICF-based health information system may help address these challenges by facilitating data classification and supporting healthcare quality assessment, decision-making, cost management, and public policy development.

There is broad agreement that good perceived usability is essential to the successful adoption of a health information system. Graphical interfaces should guide users intuitively, support efficient task completion, and minimize unnecessary effort [1,4-6]. Considering the potential of the ICF to support health information systems, our research team developed DataCIF 2.0 to facilitate the recording, classification, and interpretation of functioning information in healthcare services. DataCIF 2.0 is an open-source system available in Brazilian Portuguese.

The computational system would work as a tool to convert health information into qualified codes continually feeding a database able to supply a great variety of health reports, measures, and indicators to guide decision-making processes. A first immature idea of the DataCIF modeled information and simulated processes, paving the way for maturing the operational version achieved at the end of the validation, intending to make the ICF an easy tool with broader access to health services [4].

Previous studies have demonstrated that poor usability in e-health technologies may contribute to unfavorable healthcare outcomes [4,5,7]. Therefore, the DataCIF 2.0 interface was designed according to cognitive ergonomics principles to reduce unnecessary cognitive workload and support task completion. Buttons and color-coded elements were based on visual conventions familiar to healthcare professionals, such as those used in the Manchester Triage System [4,8-10]. Prompts were included to guide users through the workflow, and ICF categories were hierarchically grouped so that information not required at a given stage could be hidden during data entry [11] (Figure 1).

To evaluate whether the DataCIF 2.0 interface was perceived as easy to use, we adopted the usability framework described by Sousa and Lopez [5], which integrates effectiveness, efficiency, satisfaction, learnability, memorability, error rate, and recovery within a specific context of use. Perceived usability was assessed using the European Portuguese version of the System Usability Scale (SUS), a brief and widely used questionnaire for identifying usability issues in e-health technologies [5,12,13].

Therefore, this study aimed to evaluate the perceived usability of DataCIF 2.0, a health information system based on the International Classification of Functioning, Disability and Health, using the System Usability Scale.

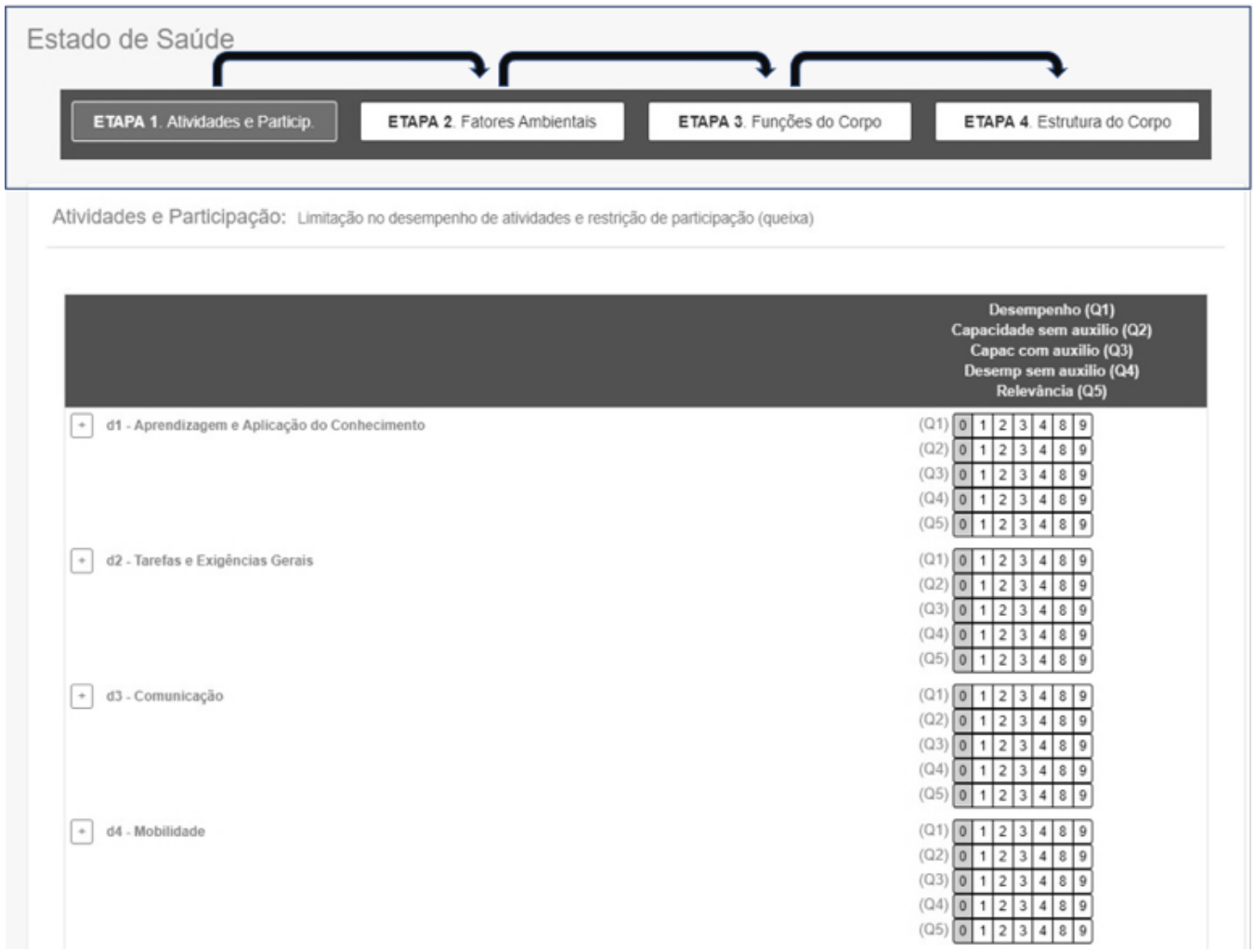
2 METHODS

The present article reports the quantitative, cross-sectional usability component of a broader research project comprising quantitative and qualitative approaches to the development and validation of DataCIF 2.0. The qualitative component consisted of individual semi-structured interviews addressing participants' experiences with the system and its potential clinical and research applications. In-person interviews were audio-recorded, whereas online interviews were video-recorded. All interviews were transcribed verbatim and analyzed separately using Bardin's content analysis. Because the present article focuses specifically on perceived usability assessed using the System Usability Scale (SUS), the qualitative findings are not reported here and will be presented separately.

2.1 DataCIF 2.0 and interface design

The interface was designed according to cognitive ergonomics and established human-computer interaction criteria, including consistency, visibility of system status, reduction of cognitive workload, hierarchical organization of information, user guidance, error prevention, and correspondence between system elements and concepts familiar to healthcare professionals [8-11]. ICF categories were hierarchically grouped, prompts guided data entry, and color-coded elements supported the interpretation of qualifier values.

Figure 1. User interface for managing the classification system workflow in DataCIF



Source: Prepared by the authors (2026).

DataCIF 2.0 is a functional, web-based, open-source health information system developed by the research team; the version evaluated in this study was operational rather than simulated. It was implemented using PHP, JavaScript, Bootstrap, and the SHA-512 hashing algorithm and was available in Brazilian Portuguese.

2.2 Subjects

A convenience sample was selected to include potential users with substantial knowledge of and experience with the ICF and/or health information systems. Potential participants were identified by searching academic résumés for terms related to these areas. Geographic stratification was used to increase sample diversity rather than to establish regional representativeness.

2.3 Search, eligibility, and recruitment

Potential participants were identified through Plataforma Lattes, a Brazilian database of academic and professional résumés. Searches combined the terms "International Classification of Functioning, Disability and Health" and "Health Information System" using the Boolean operators AND and OR. The retrieved curricula of the potential participants were analyzed to evaluate their expertise. The curricula without a contact e-mail available were excluded from the contact list. Once eligible, the experts were invited by e-mail to participate in our study. To increase geographic diversity, we organized the contact list according to the five Brazilian geographic regions (North, Northeast, Central-West, Southeast, and South) and sought to include at least one participant from each region. In addition to this recruitment strategy, we adopted the snowball sampling method, expanding the sample to candidates indicated by the initial participants added to the contact list.

Participants were eligible if they: (1) had completed higher education in a health-related field; (2) had substantial theoretical or practical knowledge of the ICF and/or health information systems; (3) had academic or professional experience related to the application of the ICF and/or health information systems; and (4) agreed to participate in the study. Once participants were included, we sent the invitation e-mail, instructions on the study protocol, explanations about the computer program and its scope, and

information about the development process. Candidates were excluded when they: (1) did not agree to participate in all the steps described by the protocol; (2) did not respond adequately to the questionnaire items; (3) did not agree to respect the confidentiality and secrecy of the computer program development process; or (4) did not have access to the Internet or to a computer to explore the DataCIF.

The research procedures were approved by the Research Ethics Committee of the Faculty of Health Sciences of the University of Brasilia (approval number 1,312,780). Sociodemographic and professional information (including sex, age, profession, academic degree, teaching activity, geographic region, and years of professional, research, teaching, and ICF-related experience) was collected exclusively for sample characterization and was kept confidential. All subjects signed the Free and Informed Consent Form, and the Confidentiality and Secrecy Term.

2.4 Data collection and usability analysis: System Usability Scale

After the 15-day period of unguided system exploration and immediately before the individual interviews conducted as part of the broader research project, participants completed the European Portuguese version of the System Usability Scale (SUS). The SUS comprises 10 statements rated on a five-point Likert agreement scale and generates an overall perceived usability score ranging from 0 to 100.

Participants received no instructions regarding specific tasks to be performed during the 15-day exploration period. They were informed only that DataCIF 2.0 was a health information system designed to support the classification of functioning information. At the end of this period, perceived usability was assessed using the SUS.

2.5 Sample characterization and statistical analysis

To characterize the sample, nominal categorical variables included sex, profession, and teaching activity; ordinal variables included academic degree and SUS scores categorized as ≥50 or <50 points. Quantitative variables were also considered, such as time since graduation, time of knowing and using the ICF, time spent on healthcare, research, and lecturing experience, all distributed by Macro-Regions of Brazil, named as Central-North, which integrates the North, Northeast, and Central-West Regions, and South, which is formed by the Southeastern and Southern Regions of the country.

Qualitative variables were described by absolute and relative frequencies, while quantitative variables were presented by median and 95% confidence interval. Fisher's Exact Test and Mann-Whitney Test were used to compare macro-regions ($p<0.05$). Statistical analyses were performed using GraphPad Prism 8.0.

The results of the System Usability Scale were obtained by adding the individual portions of the ten items that make up the scale. SUS scores were calculated according to the original method proposed for the instrument, generating values from 0 to 100. Scores ≥50 were considered acceptable usability, and classification intervals followed Bangor *et al.* [14,15]. Spearman's correlation coefficient was used to assess the association between each individual SUS item score and the total SUS score.

For the graphical presentation, participants were ordered according to their total SUS scores, from lowest to highest. The adjusted scores for the ten individual SUS items, ranging from 0 to 4, were grouped into less favorable ratings (scores 0–2) and more favorable ratings (scores 3–4). A grayscale scheme inspired by the Manchester Triage System was used as a visual aid to distinguish rating levels and highlight items requiring greater attention [16].

Correlation strength was interpreted as negligible ($r < 0.30$), weak (0.30–0.49), moderate (0.50–0.69), strong (0.70–0.89), or very strong ($r \geq 0.90$).

3 RESULTS

3.1 Subjects

The final sample comprised ten healthcare professionals with expertise in the ICF and/or health information systems. Nine were physiotherapists and one was a physician. All five Brazilian geographic regions were represented in the sample. After applying the eligibility criteria allied to the snowball method, 10 experts used the DataCIF and assessed its usability. Each Brazilian geographic region was represented, increasing the geographic diversity of the sample. However, the distribution was uneven, with a predominance of participants from the Central-West (n=3) and Southeast (n=4) regions.

The sample predominantly comprised women (60%), physiotherapists (90%), lecturers (60%), and participants holding a PhD degree (80%) (Table 1). No statistically significant differences in categorical participant characteristics were observed between the Central-North and South macro-regions.

The sample predominantly comprised women (60%), physiotherapists (90%), lecturers (60%), and participants holding a PhD degree (80%). These characteristics were analyzed independently and should not be interpreted as necessarily referring to the same participants.

The median age was 36.5 years. Participants had a median of 14 years since graduation, 12.5 years of clinical experience, 10 years of research experience, 7.5 years of lecturing experience, and 9.5 years of contact with the ICF (Table 2).

Table 1. Qualitative characterization of the experts

Distribution			Sex		Profession		Teaching activity		Academic degree		SUS	
Expert	Region	Macro-Region	Male	Female	PT	Physician	Yes	No	PhD	Master	≥50	<50
E1	N	Central-North	0%	10%	10%	0%	10%	0%	10%	0%	10%	0%
E2	NE		10%	0%	10%	0%	10%	0%	10%	0%	0%	10%
E3	CW		10%	20%	30%	0%	10%	20%	20%	10%	30%	0%
E4												
E5												
E6	SE	South	10%	30%	30%	10%	20%	20%	40%	0%	40%	0%
E7												
E8												
E9												
E10	S		10%	0%	10%	0%	10%	0%	0%	10%	10%	0%
Total sample (n=10)			40%	60%	90%	10%	60%	40%	80%	20%	90%	10%

PT – physiotherapist; SUS – System Usability Scale.

Source: Prepared by the authors (2026).

Table 2. Quantitative characterization of the experts

Variables	Unit	Central-North (n=5)		South (n=5)		Sample (n=10)	
		Median	95% CI	Median	95% CI	Median	95% CI
Age	years	33	[28, 39]	44	[34, 64]*	36.5	[33, 59]
Time of experience							
Graduation	years	11	[8, 15]	19	[13, 40]*	14	[10, 22]
Contact with ICF		7	[2, 12]	11	[8, 18]*	9.5	[6, 14]
Clinical experience		11	[6, 15]	18	[0, 22]	12.5	[6, 19]
Research experience		9	[5, 11]	10	[8, 18]	10	[7, 14]
Lecturing time		6	[4, 8]	13	[0, 39]	7.5	[4, 16]
SUS	total score	70	[47.5, 82.5]	80	[62.5, 100]	71.25	[62.5, 87.5]

n – number of participants; 95% CI – 95% confidence interval; ICF – International Classification of Functioning, Disability and Health; SUS – System Usability Scale. *p < 0.05.

Source: Prepared by the authors (2026).

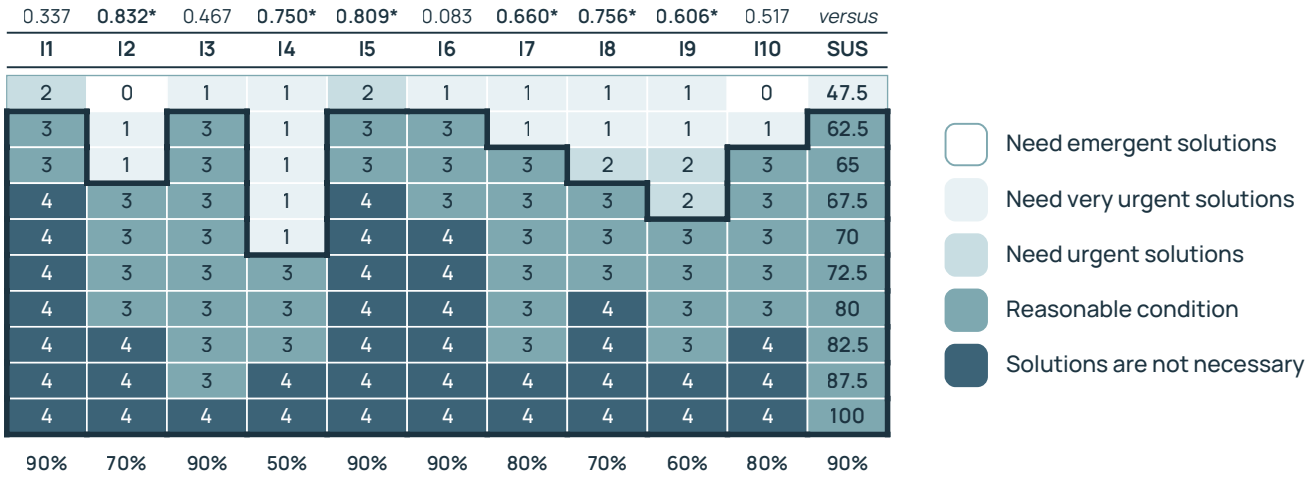
Participants from the Central-North macro-region had lower median age, fewer years since graduation, and fewer years of contact with the ICF than participants from the South macro-region ($p < 0.05$). No statistically significant differences were observed for clinical, research, or lecturing experience. Given the small number of participants in each macro-region, these comparisons should be interpreted as descriptive and exploratory rather than representative of regional differences.

DataCIF 2.0 achieved an overall SUS score of 71.25 (95% CI: 62.5–87.5), corresponding to good perceived usability. The median SUS scores were 70 in the Central-North macro-region and 80 in the South macro-region. Nine of the ten participants obtained SUS scores of 50 or higher.

3.2 Usability

Figure 2 shows the distribution of the adjusted scores for the ten SUS items. More favorable ratings predominated across the instrument. Items I1, I3, I5, and I6 received the highest proportion of favorable ratings, indicating positive perceptions regarding willingness to use the system, ease of use, integration of functions, and consistency.

Figure 2. Distribution of participants' adjusted scores across the SUS items.



Source: Prepared by the authors (2026).

Less favorable ratings were more frequent for I4, which addresses the need for technical support, and I9, which addresses confidence in using the system. Five participants provided less favorable ratings for I4, and four provided less favorable ratings for I9.

Significant associations with the total SUS score were observed for I2 (r = 0.832), I4 (r = 0.750), I5 (r = 0.809), I7 (r = 0.660), I8 (r = 0.756), and I9 (r = 0.606). Associations were strong for I2, I4, I5, and I8 and moderate for I7 and I9.

4 DISCUSSION

Usability assessment is an important component of health information system development because interface-related difficulties may increase cognitive workload, hinder task completion, and contribute to information-processing errors [5,7-10]. The SUS is widely used to assess perceived usability across different technologies and provides a standardized measure of users' overall experience with a system [5, 12-15]. However, because the instrument primarily captures subjective perceptions, it does not directly assess other relevant usability dimensions, such as task completion time, error frequency, task success, memorability, and actual user performance.

The favorable ratings for items related to willingness to use the system, ease of use, functional integration, and consistency suggest that the organizational structure of the DataCIF 2.0 interface supported participants' interaction with the system. These findings are consistent with the design strategies adopted during its development, including the hierarchical grouping of ICF categories, guided prompts, color-coded elements, and the use of concepts familiar to healthcare professionals. Such strategies were intended to reduce cognitive workload and facilitate the conversion of health information into qualified ICF codes [4,8-11].

Despite the overall positive evaluation, the ratings related to the need for technical support and confidence in system use indicate that DataCIF 2.0 may still present barriers to independent use. These difficulties cannot necessarily be attributed solely to the graphical interface. They may also reflect the inherent complexity of the ICF, which comprises more than one thousand hierarchically organized categories and requires users to understand its conceptual model and coding rules [2,3]. Therefore, future versions of DataCIF should prioritize clearer user guidance, simplified workflows, more intuitive data-entry processes, and contextual support for the selection and interpretation of ICF categories.

The findings related to complexity, consistency, and learnability further suggest that perceived usability is influenced by the interaction between interface characteristics and users' previous knowledge. Participants with substantial experience in the ICF and/or health information systems may have been better able to understand the terminology, information structure, prompts, and workflow stages than novice users. Conversely, uncertainty regarding the classification process or limited familiarity with digital systems may increase the perceived need for support, even when the interface operates consistently. Resistance to the adoption of new information systems and expectations derived from previous experiences may also affect user acceptance and perceived usability [18,19].

The favorable assessment of items related to learnability suggests that DataCIF 2.0 may also contribute to users' understanding of the logic underlying the ICF. By requiring users to organize information and select qualified codes, interaction with the system may reinforce concepts and coding rules that can subsequently support clinical reasoning and decision-making. Nevertheless, this potential educational effect was not directly evaluated in the present study and should be examined in future

research using specific learning and performance measures [17,20].

Usability evaluation should be understood as a constructive component of system development rather than as a definitive judgment that a product is either usable or unusable [21]. In this context, the present findings provide evidence to guide the continued development of DataCIF 2.0. Improvements should focus on reducing the perceived need for technical support, increasing user confidence, simplifying interaction with the ICF structure, and ensuring that the system can be used effectively by professionals with different levels of experience. Future evaluations should combine perceived usability measures with standardized tasks and objective indicators, such as task completion time, error rate, and task success.

This study has several limitations. The sample was small and selected through convenience and snowball sampling, which may have introduced selection bias and may limit the generalizability of the findings. Stratification by macro-region was used to increase sample diversity rather than to establish regional representativeness; therefore, comparisons based on five participants per macro-region should be interpreted cautiously. In addition, the inclusion of experts in the ICF and/or health information systems may have resulted in more favorable usability perceptions than those that would be observed among novice users. Participants performed no standardized tasks, and objective usability measures, such as task completion time, error rate, and task success, were not collected. Finally, perceived usability may have been influenced not only by interface characteristics but also by participants' familiarity with the ICF, previous experience with health information systems, interpretation of the information presented, navigation strategies, and perceptions of interface elements such as colors, prompts, and workflow stages.

5 CONCLUSION

DataCIF 2.0 demonstrated good perceived usability among healthcare professionals with expertise in the ICF and/or health information systems. The system's integrated functionalities and graphical organization may support the recording, classification, and interpretation of functioning information for decision-making. However, the perceived need for technical support and lower confidence reported by some participants indicate opportunities for interface improvement. Further studies with larger and more diverse samples, particularly users without previous contact with DataCIF 2.0, are recommended before broader implementation.

Author contributions. The authors contributed equally to all stages of the article: conception and design of the study; data collection, analysis, and interpretation; drafting and critical revision of the manuscript; and approval of the final version.

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EDITORIAL NOTES

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