Towards a conceptual framework for digitally supported communication, coordination, cooperation and collaboration in interprofessional healthcare: A scoping review

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Abstract

Background: Digital tools for interprofessional interaction (D4C), including electronic health records and specialised apps, are increasingly used in healthcare to ensure continuity of care across professional boundaries. Despite their growing adoption, there is not yet any comprehensive framework to guide the development, implementation and evaluation of D4C.

Objective: This study aims to provide such a conceptual framework as a foundation for their operationalisation.

Methods: A scoping review was conducted across Medline, CINAHL, Embase, PsycInfo and Scopus to identify studies on D4C. We included peer-reviewed studies in English, French, German, Portuguese and Spanish published since 2012. Definitions of the interaction mode (communication, coordination, cooperation and collaboration) and the digital tool supporting these interactions, along with their definitions in cited references, were extracted and analysed.

Results: Of the 407 identified articles addressing D4C, 6.1% defined the digital concept and 6.6% the interaction supported by the digital tool, with even fewer being backed by a reference (4.7% for digital concepts and 3.9% for interactions). The analysis of the definitions revealed a hierarchical framework, detailing dimensions, requisites and goal for each mode of interaction and the digital tool. It delineates progression from communication to collaboration: communication enables the exchange of information; coordination involves organising people, resources and activities; cooperation focuses on dividing tasks to achieve shared goals; and collaboration, at the apex, involves jointly addressing care needs. Each mode of interaction can be supported by digital tools.

Conclusions: The proposed D4C framework offers a structured approach to understanding, implementing and evaluating digital tools for interprofessional interactions in healthcare. As such, it can inform developers for creating appropriate tools, guide policy makers with regard to regulatory decisions and support stakeholders in their understanding of D4C, possibly improving workflows and patient care. Further research is needed to operationalize and validate the framework across healthcare settings. Clinical Trial: Protocol paper:

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Summary

Background: Digital tools for interprofessional interaction (D4C), including electronic health records and specialised apps, are increasingly used in healthcare to ensure continuity of care across professional boundaries. Despite their growing adoption, there is not yet any comprehensive framework to guide the development, implementation and evaluation of D4C. This study aims to provide such a conceptual framework as a foundation for their operationalisation.
Methods: A scoping review was conducted across Medline, CINAHL, Embase, PsycInfo and Scopus to identify studies on D4C. We included peer-reviewed studies in English, French, German, Portuguese and Spanish published since 2012. Definitions of the interaction mode (communication, coordination, cooperation and collaboration) and the digital tool supporting these interactions, along with their definitions in cited references, were extracted and analysed.
Findings: Of the 407 identified articles addressing D4C, 6.1% defined the digital concept and 6.6% the interaction supported by the digital tool, with even fewer being backed by a reference (4.7% for digital concepts and 3.9% for interactions). The analysis of the definitions revealed a hierarchical framework, detailing dimensions, requisites and goal for each mode of interaction and the digital tool. It delineates progression from communication to collaboration: communication enables the exchange of information; coordination involves organising people, resources and activities; cooperation focuses on dividing tasks to achieve shared goals; and collaboration, at the apex, involves jointly addressing care needs. Each mode of interaction can be supported by digital tools.
Interpretation: The proposed D4C framework offers a structured approach to understanding, implementing and evaluating digital tools for interprofessional interactions in healthcare. As such, it can inform developers for creating appropriate tools, guide policy makers with regard to regulatory decisions and support stakeholders in their understanding of D4C, possibly improving workflows and patient care. Further research is needed to operationalize and validate the framework across healthcare settings.
Funding: None.

Introduction

Digital health tools – encompassing amongst others telehealth, wearable devices and health information technology – are on the rise. As of 2022, the global digital health market was estimated at USD 211.0 billion, with projections suggesting an annual growth rate of 18.6% until 2030 [1]. These tools have become integral to healthcare services, being utilized in almost every aspect of healthcare routine, from prevention and detection to treatment and recovery, significantly improving patient outcomes [2]. Digital health tools can also facilitate interaction between healthcare stakeholders, enabling communication, coordination, cooperation and collaboration (hereafter referred to as D4C tools). Examples of such D4C tools include electronic medical records, telemonitoring systems and web-based resources [3]. Their adoption is widespread; e.g., 96% of general acute care clinics in the US have implemented electronic health records [4]. The application of D4C tools is critical in the interprofessional and intersectoral context to ensure continuity of care across professional boundaries.

Despite the increasing reliance on D4C tools in healthcare, a comprehensive D4C framework to guide development and implementation of D4C tools in this context is missing. Prior D4C models, such as the 3C collaboration model to guide the development of groupware and the collaboration space model to support the development of technology for collaboration purposes lack a nuanced framework on the distinctions and intersections of communication, coordination, cooperation and collaboration to enhance design and evaluation of D4C tools [5,6]. This study aims to address this gap by developing such a comprehensive framework for interprofessional D4C, underpinned by an extensive scoping review. Our objective is to provide a conceptual foundation for the operationalisation of D4C tools [2].

Methods

We conducted a scoping review to identify peer-reviewed articles on D4C used for interprofessional exchange among healthcare providers. The review followed the Joanna Briggs Institute methodology and a previously published review protocol [7,8]. The reporting adheres to the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) [9].

Literature sources and selection

We applied a three-step approach to identify and include relevant articles. First, we fine-tuned our search string in PubMed by screening the titles of the search results obtained. To capture the entire breadth of publications in this subject area as a base for the framework, we used a sensitive search string (Table 1). Then, we adapted the search string to CINAHL, Embase, PsycInfo and Scopus, checked for conclusiveness and extracted the search results (Appendix 1). After uploading all records to Covidence (Veritas Health Innovation, Melbourne, Australia), duplicates were eliminated. A preliminary screening of the first 50 records was conducted by all study authors. Screening results were discussed to ensure a uniform understanding of eligibility criteria. Each remaining abstract was screened independently by two researchers. Full text screening was conducted for all included abstracts, and the studies were either included in the synthesis or excluded with a reason for exclusion. Discrepancies between researchers' decisions were settled by an additional reviewer throughout all stages of the screening process. Lastly, KN manually screened the references of all included manuscripts to identify additional studies.

Table 1. Search strategy on MEDLINE via PubMed and SCOPUS

Participants, concept, context	#	Search string	Hits in PubMed (12/11/2022)	Hits in SCOPUS (12/11/2022)
Communication and collaboration among different healthcare provider groups	1	trans-disciplin*[a] OR transdisciplin*[a] OR cross-disciplinar*[a] OR crossdisciplinar*[a] OR inter-disciplin*[a] OR interdisciplin*[a] OR multi-disciplin*[a] OR multidisciplin*[a] OR multi-profession*[a] OR multiprofession*[a] OR inter-profession*[a] OR interprofession*[a]	185,543	392,636
	2	"knowledge transfer"[a] OR information*[a] OR Health Information Exchange[b] OR cooperat*[a] OR co-operat*[a] OR collaborat*[a] OR communicat*[a]	2,089,524	7,334,822
	3	“integrated care”[a] OR Intersectoral Collaboration[b] OR Interdisciplinary Communication[b]	26,343	33,558
	4	(# 1 AND #2) OR 3#	75,493	144,245
Digital tools	5	Health Information Systems[b] OR Ambulatory Care Information Systems[b] OR Information Technology[b] OR technolog*[a] OR socio-techni*[a] OR sociotechni*[a] OR mHealth[a] OR eHealth[a] OR digit*[a] OR Electronic Health Records[b] OR Public Health Informatics[b] OR messag*[a] OR messeng*[a] OR app[a] OR video*[a] OR phone[a] OR E-Mail*[a] OR "E Mails"[a] OR "E Mail"[a] OR Email*[a] OR "electronic mail"[a] OR "electronic mails"[a] OR "social media"[a] OR WhatsApp[a] OR Facebook[a] OR Viber[a] OR WeChat[a] OR Telegram[a] OR Kakotalk[a]	1,254,069	5,992,856
Healthcare setting	6	Health*[a] OR hospital*[a] OR care*[a] OR caring[a]	5,596,504	7,922,757
Combined	7	#4 AND #5 AND #6	7,261	11,056
Filters	8	#7 + English, French, Spanish, Portuguese, German, from 2012 onwards	5,694	8,216

[a]: title/abstract; [b]: Medical Subject Heading term for PubMed search string and title/abstract/keyword for SCOPUS search string

Eligibility criteria

The eligibility criteria encompassed formal attributes and aspects related to the content. In terms of

formal attributes, we included any type of primary research approach and study design, opinion pieces, guidelines, reviews, meta-analyses and meta-syntheses if they were published in a peer-reviewed journal and written in English, French, German, Portuguese or Spanish. Conference abstracts, book chapters and any records without access to the full text were excluded, as was anything published prior to 2012 due to the rapid development of digital technologies.
Regarding content, we included publications in any geographic and demographic healthcare setting focusing on D4C among at least two distinct groups of healthcare professionals or among healthcare professionals in similar roles but situated in different healthcare settings. We excluded studies that primarily investigated D4C between patient groups and healthcare practitioners, those examining the same healthcare profession within identical settings, and any focusing on students of healthcare professions. We further excluded articles with a focus on telemedicine – primarily facilitating interaction between healthcare providers and patients.

Data extraction and analysis

All included records were imported into MAXQDA (version 2022; VERBI GmbH), and definitions pertaining to communication, coordination, cooperation, collaboration and digital application were coded and extracted into an MS Word file. Two researchers (MCR and KN) double-checked the coding and compiled a definitive list of definitions and their corresponding references, using Microsoft Excel (Microsoft Office 2021). All references for each definition were read and – if available – their definition of communication, coordination, cooperation, collaboration and digital application extracted into the same sheet. If the cited references did not provide a definition, the definition of the article was excluded. If we were unable to access or find the references, the definition was similarly excluded from the analysis. Common themes and dimensions across definitions of the original record and the reference were inductively identified using thematic analysis by KN with an initial experimental summary using ChatGPT V.3.5 (Open AI, California, USA) .

Ethics

No ethics approval was needed to conduct this scoping review of articles existing in the public domain.

Results

Search results

Through the database search, 27 074 articles were identified. The removal of 11 767 duplicates yielded 15 307 unique articles, of which 14 633 (95.6%) were excluded after title and abstract screening. Full text review yielded a total of 188 (1.2%) included articles. Manually searching the 12 331 references led to the inclusion of 219 additional articles. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram summarizes the process of inclusion and selection of articles, and was extended by manual addition of references (Figure 1) [9]. For screening, the weighted average of two researchers' Cohen's Kappa at the abstract stage resulted in 0.22 and for the full text screening in 0.53, indicating a fair interrater agreement for abstract screening and moderate for full text screening [10].

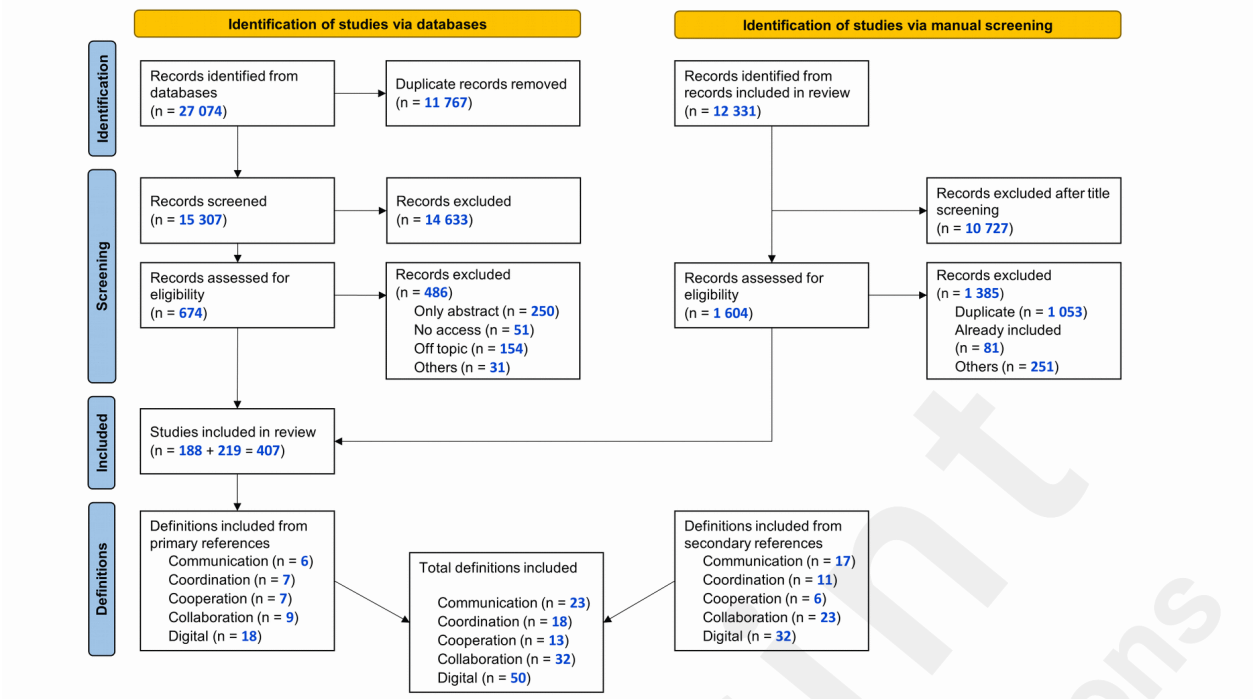
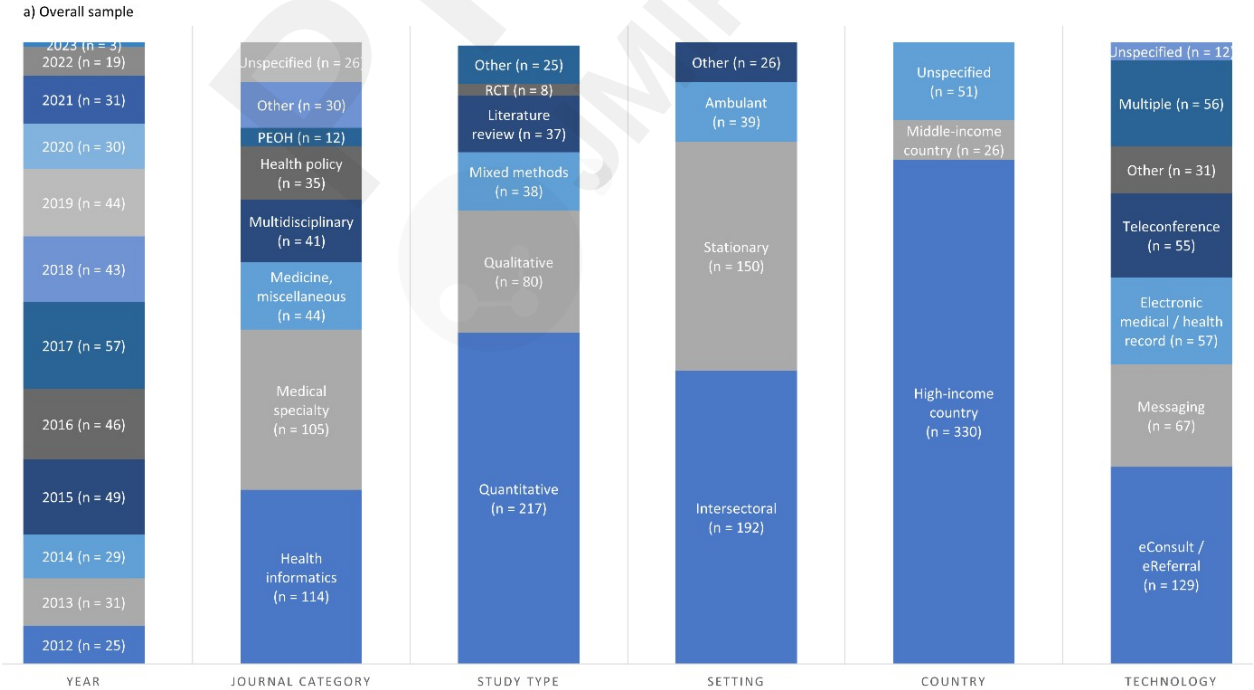


Figure 1. Prisma flow diagram for study selection and derivation of definitions. Adapted from: Page et al (2021).[11]

Most articles were published in journals in the subject area of medicine (n = 349), with the main subject categories being health informatics (n = 114) and related to medical specialities (n = 105) (Fig. 2, a). In all, 217 studies employed a quantitative research approach, 80 studies a qualitative research approach, and 38 studies were mixed-method studies. With regard to the settings in which digital health tools are used, 39 studies were ambulant, 150 examined hospitals, 192 were intersectoral, while the remaining 26 studies were not specific. Precisely 81.1% came from high-income countries, with the majority being from the US (n = 137) and Canada (n = 72) (Fig. 3). The other studies were from middle-income countries (n = 26), spanned over multiple countries (n = 41) or did not specify a country (n =10). The main technologies reported were eConsultations / eReferrals (n = 129), messaging tools (n = 67), electronic medical / health records (n = 57) and teleconferences (n = 55). More details for all articles are provided in Appendix 2.



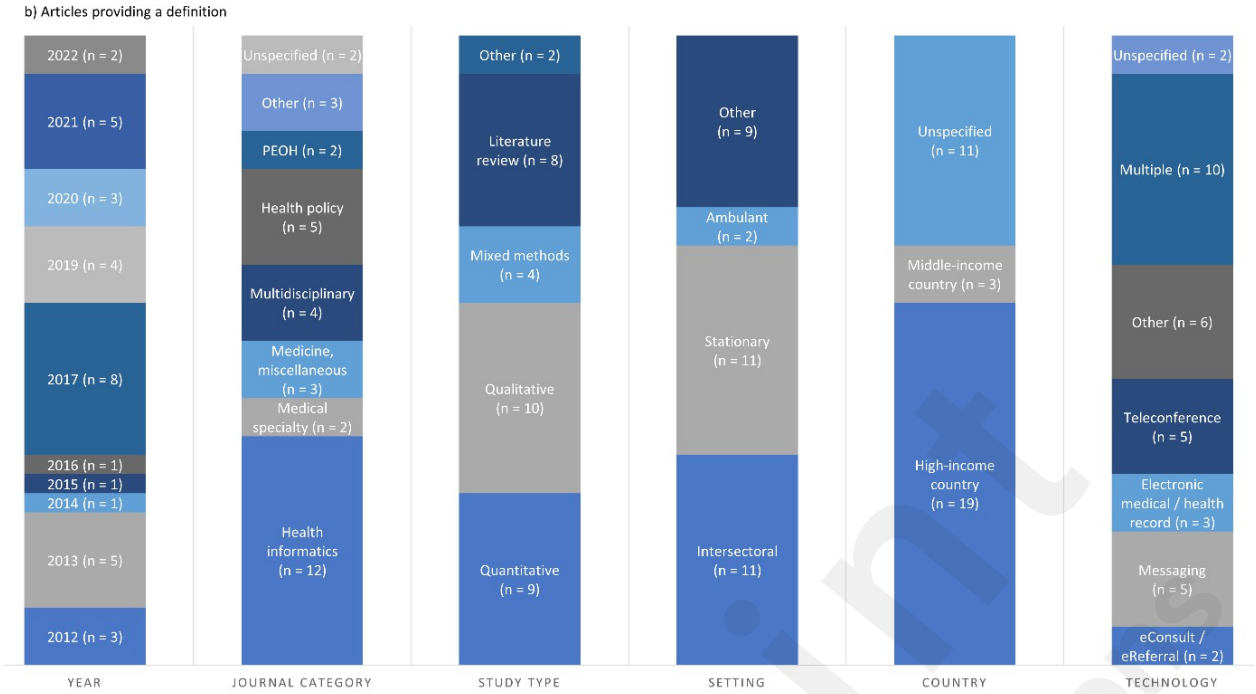


Fig. 2. Comparison of overall sample and those articles which provided a definition. The unspecified group in countries comprises the articles naming multiple countries, as well as those that did not specify a country. Messaging comprises instant messenger tools, email, pager and text messaging. Teleconference refers to hands-free communication devices, phone calls, teleconferences and videoconferences. Multiple refers to reporting about various technologies. The other group in technology encompasses digital care pathways, virtual reality, health information exchange, social media and medication management. PEOH = Public Health, Environmental and Occupational Health; RCT = randomized controlled trial.

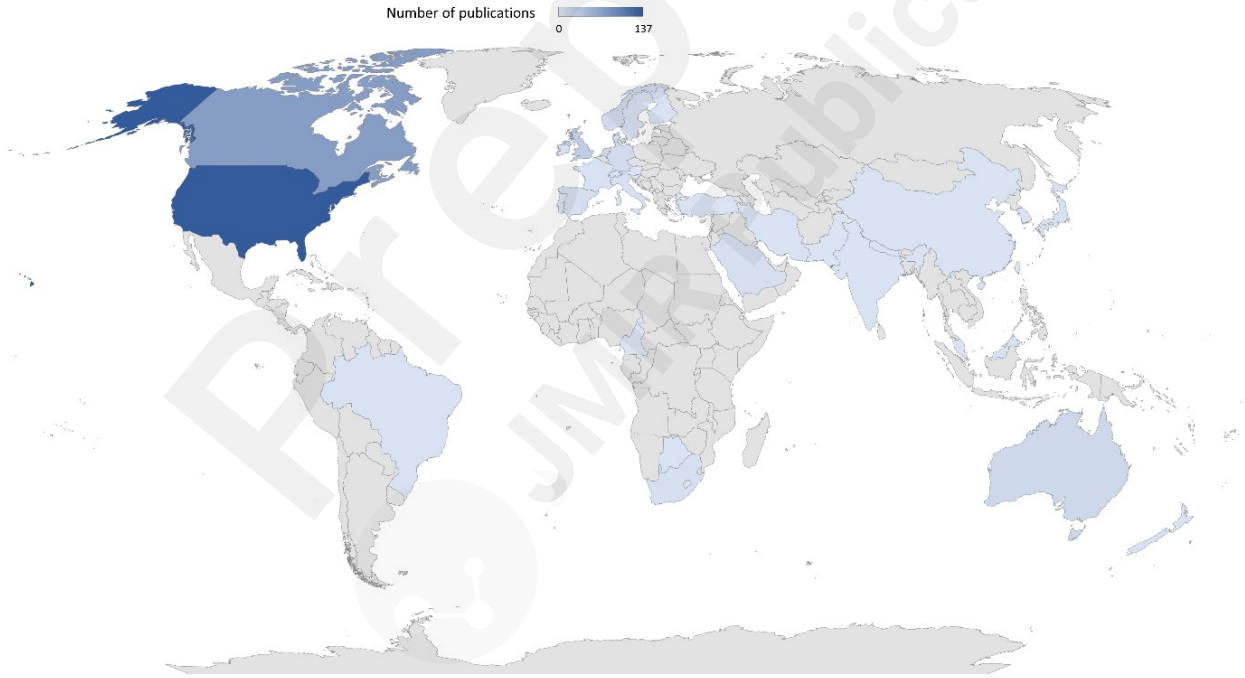


Fig. 3. Country allocation of studies (n = 407); studies with multiple countries (n = 41) or without a country specification (n = 10) are excluded.

Definitions

Of the 407 articles, 27 (6.6%) provided in total 41 definitions of communication, coordination, cooperation and/or collaboration. However, 12 (29.3%) definitions were excluded due to the lack of definition in the reference, resulting in six definitions for communication [12–17], seven each for coordination [14,15,17–21] and cooperation [14,15,17,20–23], and nine for collaboration [16,17,21,23–28]. While many articles explained the D4C tool used in their study in detail, the overarching technology was defined in only 25 articles (6.1%), of which seven were excluded. Definitions were provided for digital health [29] (n = 1), eHealth [17,30–32] (n = 4), health

information exchange [33,34] (n = 2), information and communication technologies [16,35,36] (n = 3), mHealth [37,38] (n = 2), telehealth [39] (n = 1) and telemedicine [40–44] (n = 5). Two references [16,17] gave definitions of i) at least one concept of 4C and ii) at least one type of technology. Two articles[14,17] cited the 3C collaboration model and the collaboration space model. Originally established by Ellis et al. in 1991 and modified by Fuks et al. in 2008, the 3C collaboration model addresses aspects of communication, coordination, cooperation and collaboration in the context of developing groupware applications (such as chat platforms) [6]. The collaboration space model was designed to help researchers study the technology for collaboration purposes in healthcare [5].

Most studies providing a definition were published in journals in the subject area of medicine (n = 29), with the main subject categories being health informatics (n = 12), health policy (n = 5) and multidisciplinary (n = 4) (Fig. 2, b). Relative to the number of articles in medical specialities, few articles in this category provided a definition. Approximately every fifth literature review provided a definition, in contrast to every 24th study using quantitative research methods. The provision of definitions across settings was relatively even, except for those papers classified as others, which defined more. Papers from Canada (n = 2) and the US (n = 3) provided few definitions. Only every 65th study about eConsults / eReferrals provided a definition.

The following paragraphs detail key aspects extracted from the definitions provided in the articles and references. Definitions for technology, such as mHealth, telehealth and health information exchange were analysed together to inductively identify common themes and dimensions. An overview of the key aspects with their references are provided in Appendix 3.

Digital support

The definitions acknowledged a broad variety of digital tools, ranging from smartphone applications to desktop-based communication systems, applied to various healthcare contexts and settings. A key requisite for the effective use of technological tools is a good technological infrastructure, including standards and interoperability, particularly concerning the possibility of different tools sharing and using accurate data in compliance with data protection laws. Digital tools are recognized for improving the accessibility of healthcare services and patient data through prompt and in some cases real-time exchange of data across geographical and institutional boundaries, providing information ‘whenever and wherever needed’ [33]. Some definitions suggest that digital tools induce ‘global thinking’ [16,45,46] among users. Moreover, these digital tools create a ‘networked’ [16] environment and lead to an ‘expansion and cultural transformation of traditional healthcare’ [29]. The primary objective of employing digital tools in healthcare is to enhance patient care by providing ‘the right care in the right place at the right time’ [47]. Definitions focus on the empowerment aspect of digital tools by ‘making the knowledge bases (…) accessible’ [48] and simultaneously stress the enhanced efficiency by ‘avoiding duplicative and unnecessary diagnostic or therapeutic interventions’ [48]. Despite the possibilities of digital tools, Eysenbach (2001) emphasized that care must be taken to address the digital divide and ensure that all people can benefit from the technology employed [48].

Communication

Communication is defined as the exchange of information in a two-way interactive process between the sender and the receiver. Sharma (2013) specifies that communication, according to Lasswell’s communication theory, is ‘who says what to whom in what channel with what effect’ [49]. Essential to all communication processes is an established common ground; sender and receiver must use a common ‘system of symbols, signs, or behavior’ [50] to ensure that information is conveyed in a ‘meaningful way’ [13] and understood correctly. To achieve high-quality and effective communication, four dimensions are highlighted: 1) openness, characterized by the ability to express information ‘without fear of repercussions or misunderstanding’ [12,51], 2) accuracy of the information and message, 3) timeliness of the information exchange, as delays might lead to redundant work, and 4) satisfaction with the communication. The goal of communication extends

beyond mere information exchange. Its purpose is to elicit an ‘effect’ [13,52], such as specific action, an improved understanding about a patient’s health status or to ‘establish and maintain relationships’ [5].

Coordination

Coordination is described as the management of individuals, activities and resources, based on mutual respect and shared values. Specific to coordination is, that tasks performed by separate agents are interdependent, requiring a constant update of ‘mutual knowledge, mutual beliefs and mutual assumptions […] moment by moment’ [53] and structured management in order to jointly achieve goals. In healthcare, the aim of coordination activities is to integrate care processes in order to ensure ‘appropriate delivery of healthcare services’ [18] and a continuity of care across ‘all of a patient’s conditions, needs, clinicians and settings’ [19,54].

Cooperation

Cooperation is characterized as ‘multiple individuals working together in a conscious way’ [55] , entailing the conscious integration of tasks, knowledge and skills among individuals. The agents strive towards a shared goal and are motivated to work together as a team. Tasks are not merely interconnected but intentionally distributed among the participants, who often share a common workspace. The distribution of tasks means that each person ‘has only a partial vision of the entire situation’ [22]. The tasks are subsequently amalgamated to contribute towards the shared goal: problem-solving and decision-making, incorporating the diverse views and competencies of all those involved.

Collaboration

Collaboration is portrayed as ‘collective action’ [56] by interprofessional healthcare workers. Engaging in such collective action requires true partnership based on respect, mutual recognition of and trust in one another’s abilities, knowledge and skills. These requisites enable agents to ‘pool and share’ [57] planning and decision-making, responsibilities and challenges. Collaboration is characterized by 1) shared power (based on professional equality and a pronounced understanding of professional roles), 2) organisational factors (such as administrative and organisational support for collaboration, clearly defined organisational structures, a shared budget, an open and respectful environment, a culture and mindset facilitating collaboration, and established mechanisms to deal with conflicts), 3) team characteristics (including the size and composition of the team, and clear leadership), and 4) individual characteristics (such as the willingness, time and resources to engage in collaborative efforts, the individuals’ age, gender and educational background). The aim of collaboration is to collectively address ‘the complexities of patient needs’ [16] in order to provide the highest quality of care.

Synthesis

Communication, coordination, cooperation and collaboration are interrelated concepts that progressively build upon each other (Fig. 4). At the base of this conceptual framework is communication, which allows for an exchange of information. This enables the coordination of people, activities and resources. Coordination, in turn, lays the groundwork for cooperation, which involves the division of labour and subsequent unification to achieve a shared goal. Ultimately, cooperation fosters collaboration in which agents collectively address complex care needs. While exchanging information is a rather simple, achieving effective collaboration is a complex undertaking. All elements of this framework can be supported by a variety of digital tools.

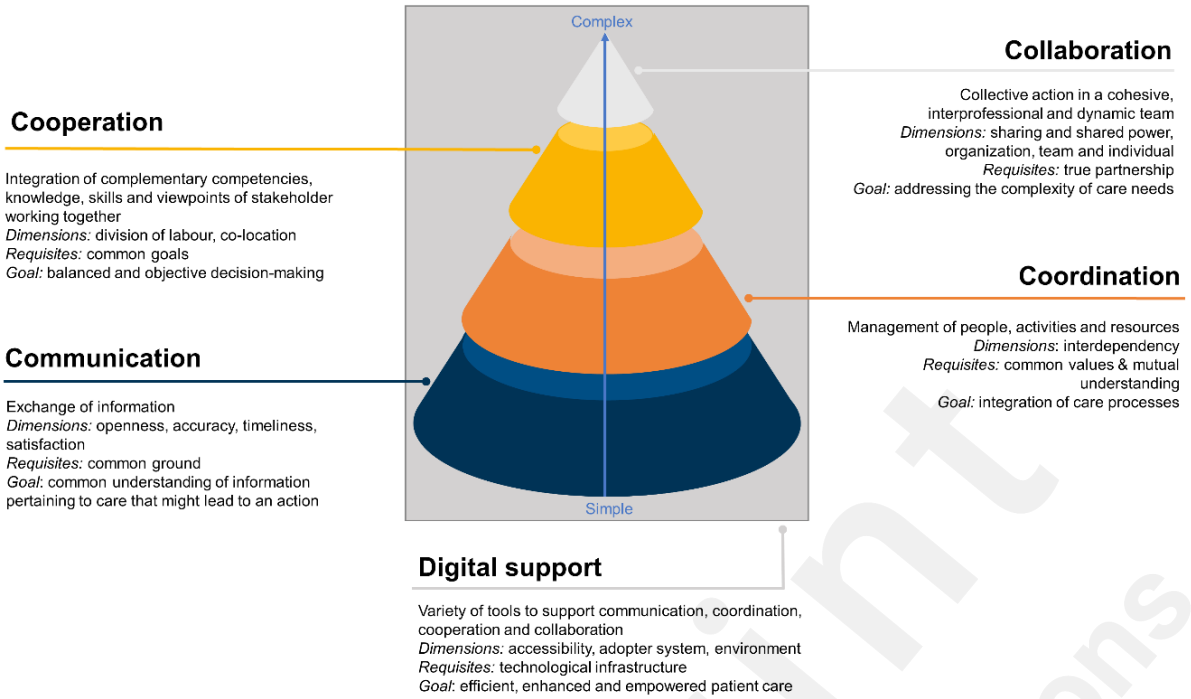


Fig. 4. Main attributes of digitally supported communication, coordination, cooperation and collaboration, as defined in scientific records extracted through a scoping review and their corresponding sources.

Discussion

This scoping review identified 407 articles addressing interprofessional D4C in healthcare. While all articles portray D4C, only a small fraction define the digital concept (6.1%) or the mode of interaction supported by the digital tool (6.6%). Even fewer provide definitions backed by a reference (digital: 4.7%, interaction: 3.9%). In most articles, the digital tool itself and its integration into the context are portrayed and evaluated. The scarcity of definitions within the literature underscores a reliance on implicit understandings of D4C concepts in the healthcare sector.

Given the relative void of explicit D4C definitions in articles, the surge of D4C tools in recent years and their challenging integration into standard practice, we developed a comprehensive D4C framework by analysing the extracted definitions from the articles and their references. The D4C framework is structured as a pyramid, with communication as the foundational layer for coordination, which enables cooperation, positioning collaboration at the apex. This hierarchy – although reflecting a common understanding of the concepts – is not uncontested. Some authors debate the order of cooperation and coordination, or that of coordination and collaboration, proposing that collaboration might enable coordinated care [20,58,59]. For instance, Fuks et al. (2008) define collaboration as the ‘interplay between communication, coordination, and cooperation’ [6]. Others view collaboration as a spectrum, ranging from mere information exchange to complex interactional efforts, as understood by collaboration in this paper [24,26,27,60,61]. The concept of collaboration remains thus one of the most debated concepts [5,16,56,61,62]. This suggests that even though communication, coordination, cooperation and collaboration are depicted as separate concepts in our framework, their boundaries are fluid and intertwined.

The effectiveness of each layer within the D4C framework depends on the extent to which the dimensions (such as openness, accuracy, timeliness and satisfaction for communication) and the requisites (such as common values and mutual understanding for coordination) are fulfilled. It further depends on external factors, including the political conditions and the overarching context in which the D4C tools are deployed, which influence the dynamics and outcomes of D4C processes [63]. The lack of clear definitions within the literature currently presents a challenge to operationalization, i.e., the efficient, transparent and standardized evaluation and comparison of D4C tools.

The development of the D4C framework was driven by the need to address differing implicit

definitions. While many studies identified in the review described the technology exhaustively, they lacked an equally exhaustive analysis of the underlying modes of interaction that the technology was supposed to support. The value of our framework lies in its capacity to structure concepts pertaining to a D4C, allowing for improved stakeholder engagement and possibly enabling operationalisation of these concepts [64,65].

As such, the D4C framework that we propose can inform technology suppliers and policy makers, research and practice, fostering a comprehensive understanding of D4C definitions used in a given project and the intended interaction enabled through a specific D4C tool. Such clarity could guide technology providers in developing adequate tools for the intended interaction, be it communication, coordination, cooperation or collaboration. Policy makers can utilize the framework to formulate or revise guidelines and regulations that support effective integration of D4C tools into healthcare settings, ensuring that they contribute to improved interprofessional interaction and workflow, possibly enhancing patient care.

Limitations

Despite our comprehensive search strategy, which included databases from different disciplines such as health sciences, social sciences and life sciences, we may not have identified all relevant literature as technological databases such as IEEE Xplore and ACM Digital Library were not searched. To mitigate this limitation, we conducted a manual search of the references cited in the included articles. Although we believe that the identified studies provide a robust foundation for the D4C framework, future research should aim to include other sources such as grey literature and industry reports. Another limitation is that we did not perform a comprehensive search of interprofessional interaction without digital tools and deliberately only included explicit definitions of D4C concepts. While a more in-depth analysis of implicit definitions could have provided a more nuanced D4C framework, only including explicit definitions showcases how authors understand the concepts and underscore their importance. Basing the D4C framework on definitions included or referenced in the literature further enhances the likelihood of successfully translating the conceptual framework into practical application.

Conclusion

Our review is the first to present a comprehensive D4C framework derived from scientific literature. By providing a structured approach to D4C tools and the supported communication, coordination, cooperation and collaboration, our framework can assist stakeholders in their understanding of D4C tools and guide development and deployment. Further research is needed to operationalize the D4C framework and to establish a maturity model in order to efficiently measure the impact of D4C tools across diverse healthcare settings.

Author's contributions: KN, SS, MCR, MS and FF conceptualized the study. KN, SS, MCR, MS and FF contributed to data collection. KN, SS, MCR, MS and FF analyzed the data. KN drafted the manuscript; SS, MCR, MS and FF revised the draft critically and provided important intellectual content. All authors had full access to all the data in the study, read and approved the final manuscript and had final responsibility for the decision to submit for publication.

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Supplementary Files

Multimedia Appendixes

Search strategy in detail for PubMed search.
URL: http://asset.jmir.pub/assets/0b3a9b4c40b1f1bd746ebd7c48ac882d.docx

In-detail overview of included studies.
URL: http://asset.jmir.pub/assets/3c346e9cb28a3044f37d9b9c8e93f7f3.xlsx

Attributes of digitally supported communication, coordination, cooperation and collaboration as defined through the scoping review and their corresponding sources.
URL: http://asset.jmir.pub/assets/8d1abad62cfcf64b2c9b3ab55cc02bad.docx