Review article

Digital health competencies for primary healthcare professionals: A scoping review

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ABSTRACT

Background: Despite digital health providing opportunities to enhance the quality, efficiency and safety of primary healthcare, the adoption of digital tools and technologies has been slow, partly because of poor digital health literacy. For primary healthcare systems to take full advantage of these technologies, a capable, digitally literate workforce is necessary. Still, the essential digital health competencies (DHCs) for primary healthcare have not been explored. This review aims to examine the broad literature on DHCs as it applies to Primary Care (PC) settings.

Methods: We performed a scoping review on all types of research linking DHCs to PC. We searched all major databases including Medline, Embase, CINAHL, and Cochrane Library in November 2019. Concurrently, a thorough grey literature search was performed through OpenGrey, ResearchGate, Google Scholar, and key government and relevant professional associations’ websites. Screening and selection of studies was performed in pairs, and data was analysed and presented using a narrative, descriptive approach. Thematic analysis was performed to identify key DHC domains.

Results: A total of 28 articles were included, most of them (54 %) published before 2005. These articles were primarily aimed at PC physicians or general practitioners, and focused on improving knowledge about information technologies and medical informatics, basic computer and information literacy, and optimal use of electronic medical records. We identified 17 DHC domains, and important knowledge gaps related to digital health education and curriculum integration, the need for evidence of the impact of services, and the importance of wider support for digital health.

Conclusions: Literature explicitly linking DHCs to PC was mostly published over a decade ago. There is a need for an updated and current set of DHCs for PC professionals to more consistently reap the benefits of digital technologies. This review identified key DHC domains and statements that may be used to guide on the development of a set of DHC for PC, and critical knowledge gaps and needs to be considered. Such a DHC set may be used for curricula development and for ensuring that the essential DHC for PC are met at a clinical or organizational level, and eventually improve health outcomes.

Abbreviations: AMIA, American Medical Informatics Association; BMHI, Biomedical and Health Informatics; CINAHL, Cumulative Index to Nursing and Allied Health Literature; DHC, Digital health competencies; EHR, Electronic health record; EMR, Electronic medical record; EPR, Electronic patient record; ERIC, Education Resources Information Center; GP, General Practitioner; HITCOMP, Health Information Technology Competencies; ICT, Information and Communications Technology; IMIA, International Medical Informatics Association; IT, Information Technology; PC, Primary Care; PCP, Primary Care Provider; PDA, Personal Digital Assistant; TIGER, Technology Informatics Guiding Education Reform.

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1. Introduction

Advances in digital technology provide an opportunity to enhance the quality, efficiency and safety of healthcare [1,2]. However, despite the numerous advantages offered through digitisation, appropriate and adequate training and competencies are required to improve rates of slow adoption. This scoping review assessed potential digital health competencies (DHCs) and gaps within primary care (PC) to highlight potential areas for improved digital literacy.

Digital health refers to a broad umbrella term encompassing eHealth, which could be broadly defined as “the use of information and communications technology in support of health and health-related fields”, as well as emerging areas of advance computing sciences in the fields of “big data”, genomics and artificial intelligence [3]. Digital health has numerous potential benefits including reducing turnaround times, medication errors, and adverse drug events; better resource allocation; advancing preventive care, and enabling greater adherence to clinical guidelines [4-6]. Furthermore, digital health has been considered a key contributor to attaining universal health coverage [7], an essential component for PC.

Despite the multiple advantages of digital health, the adoption of digital tools and technologies in healthcare has been slow in many countries [8], including the U.S. [9], Europe [10], and Australia [11]. Poor digital health literacy was found to be the most common barrier to the implementation of digital health services [10]. It has been emphasized that improving digital literacy could lead to improved adoption of new digital tools and technologies among health workers [8]. Therefore, there is a need for accessible, structured and comprehensive education of health workers to optimally use technology to realize their potential in terms of quality of care. Through digitisation, the roles and responsibilities of the health workforce will transform in an unprecedented manner, intensifying the need for capacity building and continuous professional development [12].

Digital health has already created opportunities in shaping the future of PC, by allowing people to manage their health more effectively, improving the diagnoses of diseases, and monitoring the impact of policies, among other benefits [13]. However, as mentioned above, for primary healthcare systems to be able to take full advantage of these digital health technologies, a capable, digitally literate workforce is necessary.

What is not fully understood is which DHCs are necessary for PC providers (PCP) and health workers to implement and utilize digital health in PC. This knowledge hinges on a variety of factors including the type of technologies used, the type of health worker, and how digitally advanced the PCP setting is.

2. Aim

This review aims to examine the broad literature on DHCs as it applies to PC settings. Our specific research questions include:

- What are the aims of the studies that explore DHCs in PC?
- What are the clinical specialties and settings related to the technologies described (if any) and which healthcare providers are they aimed at?
- Is it possible to identify a set of generic “PC DHCs”?
- What are the knowledge gaps and research needs identified for DHCs in PC?

In conducting this review, we created a summarized overview of the context, healthcare workers, and technologies wherein DHCs have been explored in PC. Moreover, while trying to identify a set of generic primary care DHCs that every PCP should have, we were able to obtain a broader picture of the DHC domains that seem to be important for PC and the most recurrent knowledge gaps and research needs in this field.

3. Methods

We performed a scoping review using the Joanna Briggs Institute’s (JBI) methodological guidance for scoping reviews [14]. The objectives, inclusion criteria and methods for this scoping review were specified in advance elsewhere [15].

3.1. Inclusion/exclusion criteria and search strategy

We included studies and reports published between 1st January 2000 and 6th November 2019. The identification of studies included two main steps:

1 First, we searched for articles focusing on DHCs for healthcare professionals according to the following criteria:

<table>
<thead>
<tr>
<th>Inclusion</th>
<th>Exclusion</th>
</tr>
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<tbody>
<tr>
<td>Definitions and conceptual frameworks on DHCs for pre- and in-service health professionals</td>
<td>Non-DHCs for both pre- and in-service health professionals</td>
</tr>
<tr>
<td>Work which identifies and enlists the key DHC/literacy domains, and/or specific competencies within the domains</td>
<td>Digital and non-digital competencies/literacy for patients (both generic and health specific)</td>
</tr>
<tr>
<td>Planning, design and assessment of programmes/courses for training/education of pre- and in-service health professionals on DHCs; may include literature on curriculum, course design, learning objectives, effectiveness/cost-effectiveness of specific interventions, etc.</td>
<td>Competencies/literacy for other population groups (e.g. students and professionals that do not work in healthcare, digital competencies of trainers except when training is provided by healthcare professionals on DHCs)</td>
</tr>
<tr>
<td>Assessment of competencies on digital health technologies; may include formative and/or summative assessments, development and validation of assessment tools, etc.</td>
<td>Literature on the applications of digital technologies or trends in healthcare, which does not include any discussion of competencies</td>
</tr>
<tr>
<td>All study types, including opinion pieces, frameworks, editorials on computer literacy competencies/training, etc.</td>
<td>Literature or discussions focused on policies/initiatives regarding implementation of digital health technology</td>
</tr>
<tr>
<td>standards of digital health, patient safety, Standards of digital health infrastructure, software, etc.</td>
<td>Acceptability, perceptions, attitudes, barriers, and facilitators related to the use of a technology for healthcare delivery</td>
</tr>
<tr>
<td>IT sophistication/capability/capacity of health systems/organizations</td>
<td>Technical descriptions/modifications/development of software used in the healthcare contexts</td>
</tr>
<tr>
<td>Effect of digitalisation on healthcare quality, patient safety</td>
<td>Effect of digitalisation on healthcare quality, patient safety</td>
</tr>
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</table>

2 Second, after identifying articles covering DHCs, we searched for those focusing on primary care, by selecting studies having any of the following terms in their titles or abstracts: “primary care”, “family practice”, “family medicine”, “general practice”, “GP” and “family physician”. In addition, articles focusing on physician assistants, and community-based healthcare providers (regardless of medical specialty) were also included as these imply work in the PC field. We excluded articles describing home and rural care, as these may or may not relate to PC.

A search strategy was developed collaboratively and iteratively by the reviewers with support from an experienced medical librarian. The final Medline search strategy was translated to other databases (Appendix 1). The following six databases were searched in November, 2019: Medline, Embase, Cumulative Index to Nursing and Allied Health...
Literature (CINAHL), Education Resources Information Center (ERIC), PsycINFO, and the Cochrane Library. Medline, Embase, ERIC and PsycINFO were accessed via the Ovid platform; and CINAHL was accessed via EBSCOhost. We expected that there would be substantial unpublished work in this area so we concurrently searched OpenGrey, ResearchGate, Google Scholar, first 10 pages of Google results, websites of relevant professional associations (e.g. International Medical Informatics Association and European Federation of Medical Informatics), accreditation councils (e.g. the US Accreditation Council for Graduate Medical Education or ACGME), key government websites (e.g. Digital Health Canada, NHS Digital, Health Informatics Society of Australia) and other organizations with the mandate of training and lifelong learning of healthcare professionals, using the terms listed in Appendix 2.

3.2. Selection of studies and data extraction

We selected articles by applying the pre-defined inclusion and exclusion criteria first to the title and abstracts, and later to full-text articles. For the title and abstract screening, we screened the articles in pairs on Covidence, a web-based software platform. Any discrepancies or disagreements between reviewers were resolved through discussion, and where required, a third reviewer was engaged as an arbiter. Full-text articles were screened following the same process using EndNote X8. A data extraction form in Microsoft Excel was used to extract and record information from the selected full-text studies (Appendix 3).

3.3. Data analysis and presentation of results

Analysis of the data followed a narrative, descriptive approach. Following the main objectives of this study, we explored publication date, origin and type of articles that studied DHC in PC and which PC healthcare fields and populations they were related to. Through thematic analysis of the included studies [16], we derived a preliminary set of DHC domains specifically relevant for PC. Knowledge and research gaps were extracted from the articles.

4. Results

The electronic databases searched identified 10,627 individual records after deduplication. The grey literature searches added 138 potentially relevant articles. Title and abstract screening resulted in 719 eligible articles, of which 691 were excluded after full text screening (666 were not about primary care; 25 were not related to DHC as described in our inclusion/exclusion criteria). Thus, 28 articles reporting on unique studies were included in the analysis (Fig. 1).

4.1. Studies characteristics

Over half of the included articles (57 %, n = 16) were published before 2005; all except one come from western, high-income countries; and three quarters are journal articles presenting original research (Table 1). The most common objectives of the articles were to explore the use, needs, or barriers and facilitators related to the use of digital or information technologies (IT) (36 %, n = 10), followed by those that described, reported the development of, or evaluated training programs for students and residents (29 %, n = 8), or for PC health professionals or faculty (21 %, n = 6). Studies mostly focused on PC physicians or general practitioners (GPs) (21 %, n = 6), followed by unspecified primary healthcare professionals, referred to as “staff” or PC “providers” (17 %, n = 5), and medical students during a PC or family medicine term/rotation (14 %, n = 4). (Table 1).

In terms of the technology-related setting or clinical speciality of the articles, the most common one related to knowledge about IT/Medical informatics broadly speaking (43 %, n = 13) [17–29], followed by those focusing on basic computer and information literacy skills (20 %, n = 6) [25,26,30–33], and on electronic medical/health records (20 %, n = 6) [34–39]. Three studies focused on specifically on telehealth (10 %) [40–42], and one study each focused on mobile health [43] and personal digital assistant use [44] (3%, respectively). For details of the characteristics of the included studies, see Appendix 4.
4.2. DHC themes

Through thematic analysis, we were able to identify the most prevalent DHC domains, as studied or presented in the articles. Table 2 includes these domains, along with their definitions and number of articles including the domain. Appendix 5 shows the details of the competencies or statements as they were presented in the articles.

Twenty-two of the 28 included articles allowed for the identification of DHCs or competency domains; the remaining six articles were descriptions or evaluations which did not provide competency-like statements or domains (Appendix 4, column 9). Competencies related to the optimal use of EMRs was the most common domain and mentioned in 11 articles (Fig. 2). After that, the most common domains involved skills related to basic computer and internet use (n = 9), practice management or administration (n = 8), and knowledge about health information systems, including clinical decision support systems, and health data management (n = 7), and information literacy (n = 7). Conversely, DHCs related to data analysis skills, knowledge about legal and regulatory issues, and privacy and security of the data, were mentioned in only one article, respectively. Digital health skills related to remote care,
including telehealth, and to provider education and teaching were mentioned in two articles each (Fig. 2).

4.3. Knowledge gaps and research needs, as presented in the included studies

In terms of knowledge gaps and research needs identified, these can be classified into three main areas:

1 Digital health education and curriculum integration: Studies stated that the success of implementing medical informatics curricula should start with faculty development [26], and on contextualizing learning objectives to support educators [18]. Additionally, they stressed the importance of including and advancing training in health informatics and telemedicine to raise awareness of information and communications technologies (ICT), better prepare family medicine residents and students for the 21st century, and to ensure the growth of the field [22, 32, 42]. Another set of challenges within this area involved when and how to integrate medical informatics into the curriculum [24]. Studies mentioned that there is little research about the most effective way or whether quality or quantity should be prioritized [33]. For instance, there is a need for evaluating the effectiveness of EMR teaching curriculum [39], and to use those results to design advanced training plans for this technology [35]. The incorporation of medical education should take into account the implementation of new technologies in the field [36], and the needs and requirements of the PC professionals’ working practice [29], keeping in mind adult learning styles and computer literacy levels [31].

2 Improving services and work conditions: Studies also mentioned the need for strong evidence regarding the role of EMR systems in improving the provision of services [37], about how mHealth translates into better coordination or improved patient outcomes [43], and about how the introduction of technologies can impact on the patient-computer-doctor interaction [30]. There is a need for involving nursing staff into the implementation of IT services so that they are more efficient at using IT, which should improve their working conditions [17], and to support their engagement with technologies to improve care [20].

3 Importance of wider support for digital health (beyond just training and education): Studies stress the need of a supportive environment created by policymakers to identify the right indicators representing improvements in care, as well as by digital technology developers to make systems more clinician friendly [34]. Additionally, to broaden the use of technologies such as EMRs, there needs to be an emphasis on IT management and best practices dissemination at the moment of implementation [38].

5. Discussion

Through this scoping review we uncovered that most articles about DHCs focusing on PC were published before 2005, that they detailed studies performed in western high-income countries, and focused on GPs and PC physicians, family medicine residents and medical students. One of the main aims of this review was to directly derive a set of generic PC DHCs. However, this was not possible due to the format and wording in which the included articles described their programs and interventions (i.e. not as competency statements). They did mention specific features or characteristics of digital health that were included in training programs or needs coming from the studied interventions, which allowed us to identify the most prevalent DHC domains instead of the competencies

Table 2 (continued)

<table>
<thead>
<tr>
<th>Domain</th>
<th>Definition</th>
<th>Number of articles including domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 Telecommunications, data exchange</td>
<td>Skills related to using data and implementing informatics research</td>
<td>4</td>
</tr>
</tbody>
</table>

Fig. 2. Number of articles featuring digital health competency domains.
Although surprising that the bulk of articles included here was published over a decade ago, this might be due to a shift of focus related to how digital health is envisioned. For example, more recently, comprehensive international initiatives for enhancing digital health capacities have focused more on specific healthcare roles rather than on healthcare fields, as seen by the Technology Informatics Guiding Education Reform (TIGER) initiative, originally developed for nurses [45], or the Health Information Technology Competencies (HITCOMP) [46], which lists competencies for different professional workforces, regardless of the medical field they practice in. Similarly, most of the articles included here were aimed at medical students, family medicine residents and GPs, while more recently the emphasis of DHC training has shifted towards nursing [45,47,48].

The publications explored digital health initiatives or training programs involving knowledge of ICT and medical Informatics in general, teaching basic computer and online literacy skills, and use of EMR. Accordingly, the DHC domains that were more prominent related to optimal use of EMR, basic computer and internet skills, and practice management and administration. Part of the technologies covered in the articles, and the corresponding DHC domains identified, matched the most critical and current digital health aspects of PC. The importance of EMRs, i.e. their potential impact on quality of care, cost reductions and improved health [2,49], as well as their positive perception in PC [50], was reflected in that optimal use of EMR was the domain most addressed by training programs and interventions. Similarly, the importance of basic knowledge of IT, ICT, and medical Informatics, as well as the possession of basic computer and internet skills for PC, mirrors the current interest of relevant organizations, such as the Primary Care Informatics Working Groups from the International Medical Informatics Association (IMIA) and the American Medical Informatics Association (AMIA), advocating for this knowledge in PC [51,52]. Additionally, our results emphasize the importance of DHCs for practice administration and management technologies, as these can mainly facilitate administrative tasks such as scheduling, practice organization, and finances [53].

In contrast, the current importance of DHCs involving the ethical and legal aspects of the use of technology in healthcare, as well as knowledge of security and privacy of digital health data, was highlighted in two recent scoping reviews on DHCs and innovation ecosystems [54,55], but was not reflected in the included studies here. This signals that these aspects have gained importance in recent years but were not emphasized earlier in PC-related studies. Additionally, other currently topical aspects of DHCs such as risk management, quality and safety issues, along with commonly used technologies such as wearable, artificial intelligence and machine learning were not mentioned. Moreover, DHCs regarding mobile applications was mentioned in only one article, while another article described the use of PDAs, which have since been replaced with smartphones. This also reflects that literature linking DHCs to PC is somewhat outdated or that the focus in which DHCs are studied has shifted, as mentioned above.

The studies included provided essential knowledge gaps in the DHC field and highlighted research needs for strengthening training and improving digital health use in PC. A key aspect related to improving education and training of PC students and professionals, is the need to figure out how to include DHC in the current curricula [56]. At first, it is vital to develop the skills of faculty and to keep raising awareness about the importance of educating PC professionals on ICT and medical informatics. This should be backed up by evidence linking the use of digital technologies to health, cost, and satisfaction outcomes. Additionally, there needs to be strong support from outside the training and education field, and involve other stakeholders such as policymakers and technology developers to ensure digital health is positioned in a prominent role, and supported by easy-to-use, ready-to-implement technologies [10,57].

Although not strictly related to PC, two important bodies of work involving health informatics competencies show relevant similarities and may be complemented with the DHC domains identified here, specifically for PC. One is the IMIA recommendations on Education in Biomedical and Health Informatics (BMHI), which is described as a framework for national initiatives on BMHI education and for assembling international programmes, and exchange of students and teachers in the field [58,59]. These recommendations are phrased as learning outcomes classified in four domains (1) BMHI core knowledge and skills; (2) Medicine, health and biosciences, health system organization; (3) Informatics/computer science, mathematics, biometry; (4) Optional Modules, and targeted at two types of users (IT user and BMHI specialist). Each learning outcome is then labelled as an introductory, intermediate or advanced knowledge/skill [59]. Most of the competency domains identified in our review do correspond with the learning outcomes presented by the IMIA, and are interspersed through all the four domains, such as knowledge of informatics as a discipline and management of IT systems (domain 1 above); decision making and health administration (domain 2); ability to use personal computers and newer technologies (domain 3); and biomedical imaging and public health informatics (domain 4). This is to be expected given that a PCP should be knowledgeable and have skills, at least at a basic level, related to all these domains. Also as expected, there are several learning outcomes that are more specialized and maybe not required from a PCP, especially when thinking about clinical care, such as evaluation and assessment of information systems, and usability engineering, just to name a few. Considering the learning outcomes coming from AMIA under the umbrella of the DHC domains for PC, could provide further details and specific requirements for a digitally literate PC workforce.

The other one is a recent multidisciplinary study on universal health informatics competency domains in the UK [60], which also draws from the IMIA recommendations for BMHI education described above. In this study, the research team mapped 50 health informatics competency domains (coming from the IMIA recommendations) to postgraduate medical curricula in 71 specialties. The GP specialty ranked among the highest ones in terms of proportion of competencies present for GP curricula, which was not surprising as pointed out by the authors, given that the GP/family medicine field has tended to embrace digitalisation [60]. The end result of this work was a set of six universal health informatics competency domains: 1) Information governance and security; 2) System use and clinician safety; 3) Digital communication; 4) Information and knowledge management; 5) Patient empowerment, and; 6) Emerging technologies, all of which were also identified in our scoping review. This set of universal health informatics domains may serve as a base for digital literacy knowledge and skills for medical specialties in general, to which other competencies and/or domains may be added depending on the particularities of a specific medical specialty. As such, in addition to the domains developed by Jidkov et al., the PCP should also possess digital competencies related to practice administration/management, medication management/ePrescribing and digital imaging, just to name a few, in order to fulfill the requirements of the family medicine/GP field. This study has some limitations. Given the nature of scoping reviews, we were not able to appraise or analyse the outcomes presented in the included studies. Therefore, we could not identify whether the interventions or training programs related to DHCs had an impact or were effective for improving PC. However, we did analyse the context and focus of these studies, which allowed us to identify the most important aspects of the technology and the stakeholders these were aimed at. Additionally, most of the identified studies did not provide explicit competency statements in a way that they could be directly transferred to an, e.g., digital health medical curriculum. Nonetheless, the identification of DHC domains for PC and the specific highlighted skills within them (Appendix 5), do provide an initial step for the development of such a set. Additional work for this would require wording the statements so that they represent clear and specific DHCs, and then validate this potentially relevant DHC list with
PC and digital health experts. A set of DHC for PC would have the potential to be included as an Entrustable Professional Activity in medical education [61], such as the Accreditation Council for Graduate Medical Education’s competencies [62], to ensure an adequate computer/digital literacy level for PC professionals.

6. Conclusion

The provision of PC has arguably improved with the use and implementation of digital health technologies. Given the current and future trends, digital health will continue to become more widespread and potentially transform the way PC, and healthcare in general, is provided. To fulfill this potential and make the best use of these technologies, a digitally literate and competent PC workforce is required, which calls for adequate training in the most relevant areas of PC, as well as in the most current and useful technologies. The DHC domains and technologies, as well as the knowledge gaps and research needs identified here, could provide an important first step in the development of a clear set of DHCs for PC. This could then be used and integrated into the development of family medicine curricula, to enhance the training for students and health professionals, enhance digital health utilization, and ultimately improve health outcomes.

Authors’ contributions

GJ wrote the protocol, screened articles, undertook data extraction and analysis and wrote the paper. FS screened articles, provided interpretation and analysis of the results and helped write the paper. DM and GK participated in interpretation of the results and provided critical review of the paper. RMUvdK, NHIC and JC participated in critical review of the paper. GJ confirms that the manuscript is an honest, accurate, and transparent account of the study being reported, that no important aspects of the study have been omitted, and that any discrepancies from the review as planned have been explained. All authors read and approved the final manuscript.

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Declaration of Competing Interest

The authors report no declarations of interest.

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Appendix A. Supplementary data

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