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## **An evidence-based framework for the implementation of digital health technologies in primary healthcare: what, where and for whom?**

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## CHAPTER 1 – GENERAL INTRODUCTION

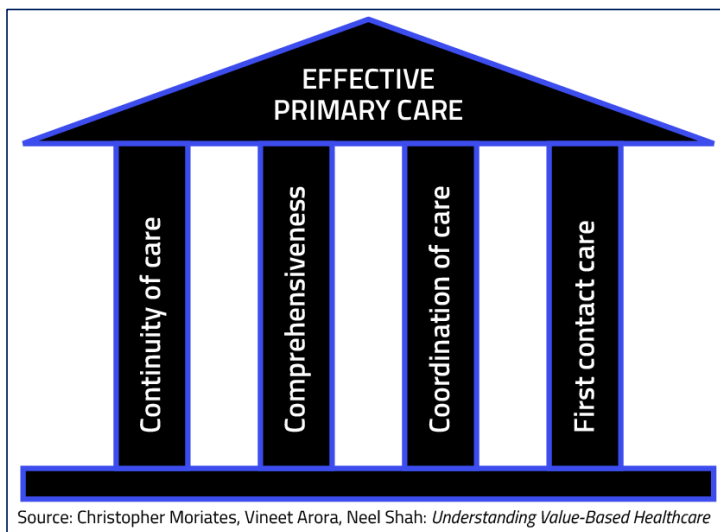
### 1.1. Primary healthcare as the cornerstone of effective health systems and society

Primary care (PC) has been defined widely as “the provision of integrated, accessible health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community”.<sup>1</sup> PC is often considered a cornerstone of health care systems: it promotes important societal values that are becoming central to modernizing societies, such as health equity, people-centered care and the key role of communities in health action.<sup>2</sup> International evidence suggests that health systems with strong primary health care (PHC) produce better and more equitable health outcomes; they are more efficient and can achieve higher user satisfaction in comparison to health systems with only a weak PC orientation.<sup>3</sup>

However, PC has been underfunded globally, and has not been able to fully contribute to the Sustainable Development Goal of “ensuring healthy lives and promote wellbeing for all at all ages”. This is mostly due to large-scale trends that PC has not been ready for, including: 1) the shift to non-communicable diseases (NCDs) as the main disease burden globally; 2) PC’s ability to tackle the main social determinants of health, and; 3) global health threats such as climate changes, migration and conflict, just to name a few.<sup>4</sup> Some reasons for this unreadiness have been identified and involve PC’s supply-side components, which are inadequately ready to address the growing NCD burden; restrictions on access to medicines and technology; unsustainable financial resources, and; lack of health systems’ internal and external coordination.<sup>5,6</sup>

There is widespread consensus about recognizing the central importance of strengthening PC by, for example, assessing current strengths and gaps in PHC delivery and identifying best practices to accelerate quality and effectiveness in PHC, to meet these evolving needs.<sup>7</sup> Following Starfield’s PC definition above, PC services have been measured along four main features or pillars (better known as the four “Cs” of PC): first-contact access for each need; longitudinal person-centered care [continuous care]; comprehensive care for most health needs; and coordinated care when it must be sought elsewhere. As a result, PC is assessed according to how well these four features are fulfilled.<sup>1</sup>

**Figure 1:** The 4 pillars of Primary Healthcare



1.2. The role of primary healthcare in the treatment and management of chronic conditions  
Chronic, non-communicable diseases (NCDs) are responsible for almost 74% of deaths worldwide, according to the WHO.<sup>8</sup> Given its characteristics, PHC stands out as the ideal level of healthcare for the treatment and management of chronic conditions (IOM, 1996).<sup>9</sup>

PHC has been proposed as a population-level framework to guide global chronic condition-related health promotion and policy,<sup>10</sup> due to its well-known strengths. Namely, its integrated approach to healthcare and prevention, its emphasis on community participation, its ability to foster inter-sectoral collaboration and private sector involvement, its focus on equity, and its use of appropriate technology.<sup>10</sup> If we shift the focus to patients themselves, PHC also presents advantages for the management of NCDs, because of its reliance on several key factors: opportunistic case finding for risk factor assessments; detection of the disease early on; combination of pharmacological and psychosocial interventions; and long-term follow up with regular monitoring and promotion of adherence to treatment.<sup>11</sup>

Several interventions involving PHC have led to favorable changes in health outcomes and have the characteristic of being cost effective, allowing their implementation across a range of resource settings. Some of these include tobacco control, health promotion at the PC level, pharmacological interventions for people at high risk of cardiovascular disease and diabetes, prevention of diabetes, treatment of mental disorders at the PC level, and integration of care for comorbidities.<sup>11</sup> Nonetheless, PHC needs to keep evolving to meet the needs of the ever-growing number of people affected with NCDs. Part of the challenges and opportunities, in addition to scarce resources and health system reconfiguration, include encouraging self-management support, decision support, delivery-system

design (e.g., moving towards multidisciplinary teams), and improved utilization of clinical information systems and digital technologies.<sup>11,12</sup>

### 1.3. Innovations in primary care

The 30-year mark after the Alma Ata declaration on Primary Health Care was used to recognize that, although some progress has been achieved, there is still much more that needs to be done to secure the WHO's Millennium Development Goal (MDG) of "health for all", for which PC is one of the main drivers.<sup>13</sup> Given the changes the world has experienced during these decades, especially in terms of changing demographics, the rise of chronic conditions and the way healthcare is delivered, PC had to be renewed and reimagined to meet the needs of this changing world population.<sup>14</sup>

For example, a seminal study on high-performing PC practices identified 10 building-blocks which included data driven improvement using computer-based technologies, empanelment, team-based care, patient-team partnership and patient self-management, and of course, the four pillars.<sup>15</sup> Consequently, innovations in PC have sought to achieve these blocks, and some widely implemented ones include reforms or innovations in PC teams, advanced access, PC models' restructuring (such as the chronic care model, the primary care medical home model, etc.), moving towards collaborative care, and group medical visits, just to name a few.<sup>16</sup> Additional innovation areas include stratifying the patient population, which also entails changes in responsibilities in teams, new roles for different team members, and payment reforms such as performance-based revenue.<sup>17</sup>

#### 1.3.1. *Digital technologies for improving primary care*

An important subset of innovations in PC lie in the field of digital technologies, although more is needed. Especially in the development of health information systems fit for new digital technologies and enabled for big data analytics, as well as the capacity to develop, test, and scale up innovations in varied areas, such as workforce education and systems management.<sup>4</sup>

**Figure 2:** Different digital technologies transforming the way healthcare is provided



**Source:** Personal Connected Health Alliance, Patient generated health data. 2017. Available at: <https://www.pchalliance.org/news/patient-generated-health-data-ehr-integration-continua-design-guidelines-fhir>.

Many digital health innovations have been available in PC settings for some time, although the extent to which they are used still varies widely, both between and within nations.<sup>18</sup> These include innovations in technologies that have been already in use like electronic medical record (EMR), which integrate data coming from coding systems, clinical decision support, e-prescribing and e-referral, just to name a few; and digital platforms or portals that allow patients to view their health data and help PC personnel to more easily interact with patients.<sup>18</sup> All of these have led to changes in big data analytics (which may help understand PC service needs and priorities), patient access to health records, and virtual care or tele-consultations.<sup>16, 18, 19</sup>

Additionally, commonplace technologies such as smartphones and tablets allow people to manage their health more effectively, while other technologies have had a profound effect on how healthcare services are delivered or how health systems are run.<sup>20</sup> Patient-facing technologies are changing the way patients interact with their health and with the health system. On the one hand, monitoring and wearable technologies and apps can improve people's behaviors, such as increased exercise and medication adherence; online sources of health information and access to records can help patients be better informed about their health, while online targeted interventions provide additional support for mental and sexual health, for example.<sup>21</sup> On the other hand, online triage, online appointment booking and remote consultations facilitate the interaction of patients with the health system and more closely connect the healthcare personnel with patients.<sup>21</sup> For example, a Cochrane review of PHC workers'

perceptions of the use of tablets and mobile phones, revealed that mHealth changed how they worked with each other and how they delivered care, while leading to new forms of engagement and relationships with clients and communities.<sup>22</sup>

Looking into the future, there are emerging technologies which also may have an important role if implemented in PC settings. Some of these include automated triage systems, with or without Artificial Intelligence (AI), which may direct patients to self-care advice or refer them to a clinician, depending on the interaction and answers provided by the patient. Wearables and the influx of tremendous amounts of data, will enable distance care but will also pose challenges such as careful monitoring, requiring useful dashboards with well-organized data ready for effective decision-making. The integration of machine learning and AI into clinical software, decision support and apps, has the potential to optimize and personalize treatments; the introduction of speech recognition technologies may also aid the PC consultation; and novel diagnostic devices and more sophisticated imaging capabilities incorporated into mobile devices, can have an important impact in the context of PC and community medicine.<sup>18</sup>

However, these benefits come from preliminary evidence, signaling an important need for more robust studies confirming them. This evidence is also linked to several challenges related to the use of digital technologies in health, such as the lack of regulation for health apps, more rigorous evaluations of the technologies themselves, difficulties of patients utilizing digital technologies, and system- and policy-level support.<sup>21</sup> In fact, for the future of digital care to be fully realized in PC, there are key elements that need to be addressed. Some of these include the need to involve PHC professionals and patients in the co-design of digital solutions; better infrastructure, support and training; data sharing, clear regulations and best practice standards; ensuring patient safety and privacy, and; making sure that digital care is inclusive and leaves no one behind.<sup>19</sup>

#### 1.4. Primary care providers' digital health literacy needs for successful implementation of digital health technologies

Essentially, to take full advantage of digital technologies in PC, there needs to be a PC workforce capable of using and managing these technologies. In other words, they need to be “digitally literate”. In general, there seems to be broad agreement on what skills might be needed for digital literacy. Digital health literacy has been defined as “the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem”, where a set of six fundamental skills are included: traditional literacy, health literacy, information literacy, scientific literacy, media literacy, and computer literacy.<sup>23</sup>

Nevertheless, it is not well understood as yet what the impact of the use of more elaborate eHealth technologies and the corresponding digital literacy skills needed would be. This in primary healthcare holds true for a variety of outcomes, including population health outcomes and health inequities, for example. There is a need for appropriate and up-to-date competencies and digital literacy among PC providers.<sup>24</sup> The majority of today's physicians has not received sufficient training on digital competencies, from principles of data processing and analytics or knowledge about basic characteristics of clinical information systems.<sup>25</sup> Digital health and information systems competencies must be updated to train mature digital health professionals.<sup>26</sup>

### 1.5. Research needs and knowledge gaps

Taking all of the above into consideration, there are three research lines this thesis will focus on. The first one would involve a conceptual revision of the definitions of PC, to identify and pinpoint the operational elements of the current pillars conforming a PC system. Then, a revision of a variety of PC enhancements, with a focus on digital health innovations, would help clarify how each technology may impact the PC pillars and the management of health conditions at the PC level. With this, one could identify the most effective and scalable technologies for this level of care. Finally, the implementation and use of these digital technologies require a specific set of (digital health) skills or competencies for them to be fully exploited. Therefore, delving into current approaches to digital health competencies in PC would help identify the skills needed from PC providers to make the most of digital technologies to improve care.

#### **(i) Exploration of the four core elements of primary care: operational definitions, complexities, and interactions.**

Innovations in PC are usually linked to improving its main core functions: first contact, continuity, comprehensiveness and coordination. These are normally considered the main building blocks of PC, and are seen as separate, compartmentalized aspects. To have clarity on which of these four core elements would be impacted by a particular innovation (or set of innovations), it would be necessary to have a clear, operationalized definition for each, and establish the links these have between each other. An exploration of these aspects will provide an underlying understanding of the functions that will be impacted when implementing innovations aimed at enhancing PC. This includes the impact of innovations using digital technologies.

#### **(ii) Exploration of the most common programs implemented to enhance primary care, focusing on identifying current digital health solutions**

A vast amount of innovations have been implemented in the quest for enhancing PC. Many of these innovations include multicomponent programs, which try to tackle several issues at once. Therefore, these efforts include several features, for example, related to changing how providers receive payment, introducing new accountability processes (i.e., empanelment), adding new roles or enhancing the roles of existing PC providers, expanding the access to services and coverage, just to name a few. A look at the most important, multicomponent efforts to improve PC will provide a clearer picture of which sets of innovations have had an impact on population health, healthcare costs and utilization, and/or patient and provider satisfaction outcomes.

Within these multicomponent programs, we will identify the role that the digital technology components have had in their efforts to improve PC, and explore the type of technologies and the areas of PC where these have been implemented. Moreover, given the important role that PC can have in the treatment and management of chronic conditions, we will explore how some patient-facing digital technologies may impact the treatment and management of diabetes, as an example of the potential impact these may have on the management of chronic conditions.

#### **(iii) Exploration of the digital health literacy needs and requirements for PC professionals for the successful use of digital health technologies**

In order for digital technologies to be fully exploited, and for the results of their implementation to be as successful as possible, a set of key digital technology skills for PC healthcare professionals needs to be available. A thorough exploration needs to be undertaken to identify the most important digital health literacy competencies required for digital technologies to improve PC.

#### 1.6.Aims and outline of this thesis

Building on the three aspects described above, a framework will be developed. Such a framework will describe the most suitable functions of PC that may be enhanced by digital technologies, and will map the type and role of digital technologies for each of these areas. In addition, a “New Primary Care consultation model” will be presented. This model explains how digital technologies may transform the PC consultation, and, as a result, how a patient relates to the whole healthcare system. Finally, a set of digital healthcare competency domains is developed, which could be used to build a set of digital health competencies required for PC providers.

**Main objective: Development of an evidence-based framework to identify (1) the functions of primary care, (2) the type and role of digital health technologies, especially in relation to the management of chronic conditions, and (3) the digital health literacy needs, for the successful implementation of digital technologies in primary care.**

Therefore, main research questions include:

- (1) what are the areas of primary care that will benefit the most from digital health technologies;
- (2) which digital health technologies are the most adequate to implement at the primary care level, and;
- (3) what is needed from providers in terms of digital health literacy to successfully implement digital technologies in primary care.

This thesis explores the 4 pillars of PC, the innovations that have been implemented to improve them, and the role digital technologies may have had as part of these innovations, with a focus on their impact in the management of chronic conditions. This thesis seeks to identify the optimal way to incorporate digital technologies in PC and how they could improve the PC consultation, in particular, and the PC field in general. It is composed of three parts: the first revises the concept of PC and explores interventions to improve it; the second part, delves into the role digital technologies have had in improving PC and looks at how apps may impact the treatment of chronic conditions. And the third, explores the digital competencies required for PC professionals to use these technologies.



## Chapter 1 References

1. Starfield B, Shi L, Macinko J. Contribution of primary care to health systems and health. *Milbank Q.* 2005;83(3):457-502. doi: 10.1111/j.1468-0009.2005.00409.x.
2. Agarwal, R., Jain, P., Ghosh, M., & Parihar, K.S. (2017). Importance of Primary Health Care in the Society. *International journal of health sciences*, 1, 6-11.
3. Macinko J, Starfield B, Shi L. The contribution of primary care systems to health outcomes within Organization for Economic Cooperation and Development (OECD) countries, 1970-1998. *Health Serv Res.* 2003 Jun;38(3):831-65
4. Binagwaho A, Adhanom Ghebreyesus T. Primary healthcare is cornerstone of universal health coverage *BMJ* 2019; 365:l2391 doi:10.1136/bmj.l2391
5. Hadian M, Mozafari M, Mazaheri E, Jabbari A. Challenges of the Health System in Preventing Non-Communicable Diseases; Systematized Review. *International Journal of Preventive Medicine.* 2021. 12. 71. 10.4103/ijpvm.IJPVM\_487\_20.
6. Kabir A, Karim MN, Islam RM, Romero L, Billah B. Health system readiness for non-communicable diseases at the primary care level: a systematic review. *BMJ Open.* 2022 Feb 9;12(2):e060387. doi: 10.1136/bmjopen-2021-060387.
7. Bitton A, Ratcliffe HL, Veillard JH, Kress DH, Barkley S, Kimball M, Secci F, Wong E, Basu L, Taylor C, Bayona J, Wang H, Lagomarsino G, Hirschhorn LR. Primary Health Care as a Foundation for Strengthening Health Systems in Low- and Middle-Income Countries. *J Gen Intern Med.* 2017 May;32(5):566-571. doi: 10.1007/s11606-016-3898-5. Epub 2016 Dec 9.
8. WHO. Noncommunicable diseases – Key facts. World Health Organization website, September 16, 2022. Available at: <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases> [Accessed: April 22, 2023]
9. Institute of Medicine. 1996. *Primary Care: America's Health in a New Era.* Washington, DC: The National Academies Press. doi: 10.17226/5152.
10. Demaio AR, Kragelund Nielsen K, Pinkowski Tersbøl B, Kallestrup P, Meyrowitsch DW. Primary Health Care: a strategic framework for the prevention and control of chronic non-communicable disease. *Glob Health Action.* 2014 Aug 4;7:24504. doi: 10.3402/gha.v7.24504.
11. Beaglehole R, Epping-Jordan J, Patel V, Chopra M, Ebrahim S, Kidd M, Haines A. Improving the prevention and management of chronic disease in low-income and middle-income countries: a priority for primary health care. *Lancet.* 2008 Sep 13;372(9642):940-9. doi: 10.1016/S0140-6736(08)61404-X.
12. Hossain MM, Tasnim S, Sharma R, Sultana A, Shaik AF, Faizah F, Kaur R, Uppuluri M, Sribhashyam M, Bhattacharya S. Digital interventions for people living with non-communicable diseases in India: A systematic review of intervention studies and recommendations for future research and development. *Digit Health.* 2019 Dec 16;5:2055207619896153. doi: 10.1177/2055207619896153.
13. Rohde J, Cousens S, Chopra M, Tangcharoensathien V, Black R, Bhutta ZA, Lawn JE. 30 years after Alma-Ata: has primary health care worked in countries? *Lancet.* 2008 Sep 13;372(9642):950-61. doi: 10.1016/S0140-6736(08)61405-1.
14. Macinko J, Montenegro H, Nebot Adell C, Etienne C; Grupo de Trabajo de Atención Primaria de Salud de la Organización Panamericana de la Salud. La renovación de la atención primaria de

- salud en las Américas [Renewing primary health care in the Americas]. *Rev Panam Salud Publica*. 2007 Feb-Mar;21(2-3):73-84. Spanish.
15. Bodenheimer T, Ghorob A, Willard-Grace R, Grumbach K. The 10 building blocks of high-performing primary care. *Ann Fam Med*. 2014 Mar-Apr;12(2):166-71. doi: 10.1370/afm.1616
  16. Bodenheimer T. Primary care in the United States. Innovations in primary care in the United States. *BMJ*. 2003 Apr 12;326(7393):796-9. doi: 10.1136/bmj.326.7393.796.
  17. Margolius D, and Bodenheimer T. Transforming Primary Care: From Past Practice to The Practice of The Future. *Health Affairs*, 29, no.5 (2010):779-784. doi: 10.1377/hlthaff.2010.0045
  18. Pagliari C. Digital health and primary care: Past, pandemic and prospects. *J Glob Health* 2021; 11:01005.
  19. Neves AL, Burgers J. Digital technologies in primary care: Implications for patient care and future research. *Eur J Gen Pract*. 2022 Dec;28(1):203-208. doi: 10.1080/13814788.2022.2052041.
  20. World Health Organization. (2018). *Digital technologies: shaping the future of primary health care*. World Health Organization. Available at: <https://apps.who.int/iris/handle/10665/326573>. License: CC BY-NC-SA 3.0 IGO [Accessed: 22 April, 2023]
  21. Imison C, Castle-Clarke S, Watson R and Edwards N (2016). *Delivering the benefits of digital health care*. Nuffield Trust.
  22. Odendaal WA, Anstey Watkins J, Leon N, Goudge J, Griffiths F, Tomlinson M, Daniels K. Health workers' perceptions and experiences of using mHealth technologies to deliver primary healthcare services: a qualitative evidence synthesis. *Cochrane Database Syst Rev*. 2020 Mar 26;3(3):CD011942. doi: 10.1002/14651858.CD011942.pub2.
  23. Klecun E, Lichtner V, Cornford T. e-Literacy in health care. *Stud Health Technol Inform*. 2014;205:843-7.
  24. Blasi F, Caiani EG, Cereda MG, Donetti D, Montorsi M, Panella V, Panina G, Pelagalli F, Speroni E. Six Drivers to Face the XXI Century Challenges and Build the New Healthcare System: "La Salute in Movimento" Manifesto. *Front Public Health*. 2022 Jun 29;10:876625. doi: 10.3389/fpubh.2022.876625.
  25. Foadi N, Varghese J. Digital competence - A Key Competence for Today's and Future Physicians. *J Eur CME*. 2022 Jan 2;11(1):2015200. doi: 10.1080/21614083.2021.2015200.
  26. Liaw ST, Georgiou A, Marin H. Evaluation of Digital Health & Information Technology in Primary Care. *Int J Med Inform*. 2020 Dec;144:104285. doi: 10.1016/j.ijmedinf.2020.104285. Epub 2020 Sep 23.