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Digital technologies for health financing in low-income and middle-income countries: a scoping review protocol

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ABSTRACT

Introduction Universal health coverage (UHC) is a global priority, ensuring equitable access to quality healthcare services without financial hardship. Many countries face challenges in progressing towards UHC. Health financing is pivotal for advancing UHC by raising revenues, enabling risk-sharing through pooling of funds and allocating resources. Digital technologies in the healthcare sector offer promising opportunities for health systems. In low-income and middle-income countries (LMICs), digital technologies for health financing (DTHF) have gained traction, supporting these three main functions of health financing for UHC. As existing information on DTHF in LMICs is limited, our scoping review aims to provide a comprehensive overview of DTHF in LMICs. Our objectives include identifying and describing existing DTHF, exploring evaluation approaches, examining their positive and negative effects, and investigating facilitating factors and barriers to implementation at the national level.

Methods and analysis Our scoping review follows the six stages proposed by Arksey and O'Malley, further developed by Levac *et al* and the Joanna Briggs Institute. The reporting adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews framework. Eligibility criteria for studies reflect the three core elements of the search: (1) health financing, (2) digital technologies and (3) LMICs. We search multiple databases, including Medline via PubMed, EMBASE via Ovid, the Web of Science Core Collection, CENTRAL via Cochrane and the Global Index Medicus by the WHO. The extracted information is synthesised from both quantitative and qualitative studies.

Ethics and dissemination As our scoping review is based solely on information gathered from previously published studies, documents and publicly available scientific literature, ethical clearance is not required for its conduct. The findings are presented and discussed in a peer-reviewed article, as well as shared at conferences relevant to the topic.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Our scoping review provides an overview of digital technologies for health financing (DTHF) that have been introduced in low-income and middle-income countries (LMICs).
⇒ We include information on their characteristics, evaluation approaches, positive and negative effects of DTHF, and factors and barriers influencing implementation.
⇒ We synthesise information from observational and intervention studies, as well as expert opinions, descriptive case studies, case series, technical reports and reviews.
⇒ Our scoping review follows the methodology initially proposed by Arksey and O'Malley, further developed by Levac *et al* and the Joanna Briggs Institute.
⇒ We restrict our search to documents published in English, French, German or Spanish and focus specifically on LMIC settings.

INTRODUCTION

Achieving universal health coverage (UHC) is high up on international policy and research agendas. It is crucial for the attainment of the Sustainable Development Goal target 3.8 and means that all people have equal access to quality healthcare services without suffering financial hardship. While there has been significant progress in the coverage of essential healthcare services across the WHO Member States, some countries still encounter substantial obstacles in progressing towards UHC.[1] Health financing is a fundamental prerequisite for progressing towards UHC as without adequate financing, healthcare services cannot be effectively provided, leading to barriers in access, unaffordable out-of-pocket expenses and limited availability of essential healthcare services.[2] Health financing for UHC encompasses three basic functions, including (1) to collect sufficient resources, (2) to pool these resources to enable risk-sharing and (3) to ensure effective and equitable resource allocation through strategic purchasing.[2 3] Fulfilling these functions ensures that health services are accessible to all, including the most vulnerable and disadvantaged populations, without causing financial hardship.[2]

Since the early 2000s, a wide range of different digital technologies (see working definition under methods and analysis) have emerged that provide great opportunities for health financing,[4] and they have the potential to alter how health financing tasks are conducted by stewards, purchasers, providers, users and citizens.[5] These technologies include—among others—mobile phone-based technologies, such as mobile payment services (eg, digital health wallets like CarePay[6]), health insurance platforms (eg, BIMA[7]) or tools enabling remote data exchange and capture (eg, mobile beneficiary enrolment in Medstrat[8]), and data technologies, such as big data analytics and artificial intelligence, including machine learning.[4] Another example is the new electronic claims (eClaims) system developed to reduce financial barriers to access healthcare in Rwanda.[9] In fact, digital technologies for health financing (DTHF) are increasingly used in low-income and middle-income country (LMIC) to strengthen health financing[5 10 11] and they have the potential to support these countries at leapfrogging certain stages of development.[12]

Meessen provided an initial overview of how digital solutions advance UHC in LMICs, with a focus on the three main functions of health financing.[10] Additionally, digital health interventions have been classified according to the ways they are applied to meet the needs of health systems.[13] While the potential benefits of DTHF are evident, it is essential to consider the associated risks and challenges as these technologies reshape health financing functions and interactions among stakeholders.[5] Brikci et al[14] are the first to systematically identify DTFH. However, their review focused on the financing of primary healthcare and DTHF that have not undergone robust evaluation (eg, including an assessment of risk of bias and sensitivity analysis) were excluded. Furthermore, earlier research[5 10 11 14] might not capture recently developed and adopted DTHF which, however, is of relevance due to the rapid evolution in this field.[15] The limited information available on existing DTHF in LMICs is compounded by a lack of scientific evaluation, with much of the published data provided solely by DTHF developers or implementers.[5] This scarcity of comprehensive information underscores the importance to shed light on the potential of DTHF in strengthening health financing and advancing UHC in LMICs.

Our scoping review aims to provide a comprehensive overview of DTHF that have been introduced in LMICs. More specifically, the objectives include:

1. To provide an overview of the DTHF that have been introduced in LMICs.
2. To identify the geographical distribution and scope of DTHF implementation in LMICs, including the implementing organisations, their approaches and ambitions.
3. To categorise DTHF based on their targeted primary users and functionalities of DTHF and how they are integrated into health financing tasks, such as revenue generation, pooling of funds and purchasing.

4. To examine the evaluation methods and metrics that have been used to assess DTHF in LMICs.
5. To describe the positive and negative effects of DTHF on desirable health financing attributes with regard to UHC objectives.
6. To identify the facilitating factors and barriers to the adoption and utilisation of DTHF.

METHODS AND ANALYSIS

Our scoping review is carried out in accordance with the methodology initially proposed by Arksey and O'Malley[16] and further developed by Levac et al[17] and the Joanna Briggs Institute.[18] It includes a six-stage methodological framework which we apply in our scoping review: (1) identifying the research question; (2) identifying relevant studies; (3) study selection; (4) charting the data; (5) collating, summarising and reporting results and (6) consultation. The reporting follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA) Checklist.[19 20] The complete checklist can be found in online supplemental annex 1. The review protocol has been registered through the Open Science Framework[21] on 11 September 2023.

Stage 1: identifying the research question

In this review, we refer to digital technologies as electronic tools, systems and devices that are responsible for generating, storing, processing or transmitting data.[22] We focus on digital technologies that bring about substantial changes in the way health financing tasks are carried out by stewards, purchasers, providers, users and citizens.[5] These technologies encompass mobile phone-based technologies such as mobile payment services, health insurance platforms or tools enabling remote data exchange and capture, and data technologies, such as big data analytics and artificial intelligence, including machine learning.[4] Our aim is to provide a comprehensive overview of existing DTHF in LMICs and examine the diverse functions of DTHF in raising revenues, risk pooling and healthcare purchasing. In addition, we investigate the potential benefits associated with DTHF as they offer promising opportunities for strengthening health financing and contributing to the achievement of UHC objectives. DTHF can improve revenue generation through mobile health insurance contributions and enhance risk pooling by enabling interoperable information management systems. Moreover, purchasing-related DTHF have the potential to improve access to information, leading to greater transparency, accountability and trust. Overall, DTHF can lead to time savings, reduced administrative burdens, improved revenue raising and lower opportunity costs, thereby enhancing overall efficiency.[5] However, as relatively limited knowledge is available about the true effects of these interventions, we also analyse evaluation approaches that have been adopted to assess the effects of DTHF.

Furthermore, it is important to consider the potential risks associated with DTHF that may impact health financing. Therefore, we examine potential negative effects of DTHF as some may contribute to fragmentation of pooling arrangements thus decreasing the capacity for redistributing resources. This can exacerbate existing inequalities in financial protection, particularly affecting marginalised, vulnerable and disadvantaged populations.[5] Finally, we seek to identify facilitating factors and barriers to the implementation of DTHF. By providing an overview, our research aims to help LMICs maximise the benefits of DTHF while minimising the risks.

The following research questions guide our investigation:

RQ1: Which DTHF have been introduced in LMICs?

RQ2: Where and how have DTHF been implemented in LMICs, and what are the ambitions and approaches of the implementing organisations?

RQ3: How can the DTHF be classified based on their targeted primary user and key functionalities of DTHF in the context of health financing tasks, including revenue generation, pooling of funds and purchasing?

RQ4: What evaluation methods and metrics have been used to assess DTHF in LMICs?

RQ5: What positive and negative effects of DTHF on desirable health financing attributes and UHC objectives have been described?

RQ6: What are the facilitating factors and barriers to the adoption and utilisation of DTHF?

Stage 2: identifying relevant studies

We conduct literature searches using the following electronic databases: (1) Medline via PubMed, (2) EMBASE via Ovid, (3) the Web of Science Core Collection, (4) CENTRAL via Cochrane and (5) Global Index Medicus by the WHO. Additionally, we screen the first 300 references from Google Scholar.[23] To identify further documents of interest, we review the reference lists of relevant papers and use the Grey Matters tool[24] for grey literature. We also conduct a general Google search and screen the first 300 references. Furthermore, we reach out to leading digital health financing experts to find more relevant documents. To retrieve more detailed information on the DTHF identified in this review, we will search specifically for each DTHF in addition with a specific focus on positive and negative effects as well as factors influencing the adoption and utilisation. We include all documents published in English, French, German or Spanish published between 1 January 2000 and 20 September 2023.

In line with our research questions, our search strategy combines terms from three topics: (1) health financing, (2) digital technologies and (3) low-income and middle-income countries. Terms have to appear as keywords in the title and/or abstract in order to be considered. Our search strategy is adapted according to previous work by Brikci *et al*[14] for topics (1) and (2), and by Petitfour *et al*[25] for topic (3) who developed the search strategy in collaboration with librarians. To ensure its relevance to our objectives, we further adapt and refine the search strategy with the support of a librarian. We make adjustments as needed to meet the specific requirements of each database. The complete search strategies are presented in online supplemental annex 2.

Stage 3: study selection

We import all search results into Covidence software[26] and remove any duplicates before proceeding to the screening phase. Inclusion and exclusion criteria have been adapted based on Brikci *et al*[14] as outlined in table 1. Two independent reviewers conduct a pilot screening of the titles and abstracts of a random sample of 10% of the search results. The results of the pilot screening are compared and discussed by the two independent reviewers to ensure consistency. In case of conflicts, a third reviewer resolves the disagreement. If agreement is sufficiently high (>85%), one reviewer proceeds alone with the remaining titles. Otherwise, inclusion and exclusion criteria are further refined and specified to provide better guidance. Subsequently, another random 10% sample is screened by both reviewers and agreement is assessed using the same threshold (ie, 85%). This process continues until sufficient agreement is reached.

The full-text articles are assessed independently by two researchers, following the predefined criteria for inclusion and exclusion. Covidence software is used to conduct the screening process and track agreement between the reviewers. Again, any discrepancies between the two researchers are resolved by consulting the third researcher, who makes the final decision on including the paper. The study selection process is presented in a PRISMA flow chart.

Stage 4: charting the data

We have created an initial version of the data extraction template, which can be found in online supplemental annex 3. Each section of the template provides either general information about the study or pertains to a specific research question. The process of data extraction is performed iteratively, starting with a random sample of 10% of the selected studies. Two researchers independently extract data from this sample and compare the results. Any discrepancies are discussed to ensure consistency. Also, the data extraction items are refined as necessary. Following this preliminary phase, the two reviewers extract the data from the remaining studies. If any discrepancies arise, consensus is reached through discussion within the research team. It is possible that additional items may emerge during the data extraction process. These are discussed and potentially incorporated into the template.

Stage 5: collating, summarising and reporting the results

The collected data are analysed using qualitative methods and simple descriptive statistics. We provide a summary of the types of studies identified, for example, the numbers

Table 1	Inclusion and exclusion criteria	
Attribute	**Inclusion criteria**	**Exclusion criteria**
Population	▶ Documents involving human beings irrespective of whether they were users or providers of DTHF.	▶ Documents involving non-human populations.
Concept	▶ Documents involving digital technologies designed to enhance the raising of revenues, pooling of funds or purchasing of health services. ▶ Documents describing the piloting or implementation process of DTHF. ▶ Documents describing the evaluation methods and metrics used to assess DTHF. ▶ Documents describing the positive and negative effects of DTHF on health financing and UHC objectives. ▶ Documents describing the facilitating factors or barriers to the adoption and utilisation of DTHF.	▶ Documents involving digital technologies designed for a different purpose, which could enhance health financing components, such as electronic health records, electronic prescribing or robotic dispensation machines. Documents involving digital technologies used only for service delivery, data reporting or communication. ▶ Documents involving digital technologies not used in healthcare financing.
Context	▶ Documents involving LMICs.	▶ Documents involving high-income countries.
Study designs	▶ Observational and intervention studies. Expert opinion, descriptive case studies and case series, and technical reports and reviews of DTHF.	▶ Editorials, letters to the editor, commentaries, conference abstracts, conference proceedings.
Setting	▶ Documents conducted or implemented related to healthcare financing.	▶ Documents not related to healthcare financing.
Language	▶ Documents reported in English, French, German or Spanish.	▶ Documents not available in English, French, German or Spanish translation.
Time	▶ Documents published between the first of January 2000 and 20 September 2023.	▶ Documents published before the first of January 2000 and after 20 September 2023.

DTHF, digital technologies for health financing; LMICs, low-income and middle-income countries; UHC, universal health coverage.

and proportion of studies from different regions, using quantitative, qualitative or mixed methods and the different types of technologies used.

Subsequently, the results are presented in tabular format, that is, using summary tables that correspond to each research question. We provide information on which DTHF have been introduced, on the scope of DTHF implementation, detailing where, by whom, how and with what ambition these interventions have been deployed. Moreover, we categorise the identified studies based on the three key functions of DTHF, namely raising of revenues, pooling of funds and purchasing of health services, if these functions are described. To further classify the different types of technologies, we follow the classification of digital health interventions.[13] Additionally, we present the various evaluation approaches employed in the studies, including qualitative, quantitative and mixed-methods methodologies. Furthermore, we examine and categorise the reported effects of DTHF, encompassing both the benefits and challenges associated with their implementation as well as facilitating factors and barriers. During the data extraction process, we use an extraction template and a coding template, with the possibility of assigning further codes if deemed necessary.

The findings are summarised narratively, highlighting the main themes and providing examples of the positive and negative effects identified. By providing this comprehensive overview of DTHF in LMICs, our research can facilitate the adoption and adaptation of DTHF across LMICs, thereby contributing to progressing towards UHC.

Stage 6: consultation exercise

The findings of this scoping review are presented at international conferences, such as the African or European Public Health conference.[27 28] Also, we actively engage key informants throughout the entire review process. Their expertise is sought to discuss our strategy and share early results, allowing us to benefit from their insights and make any necessary adjustments if needed.

Limitations

Scoping reviews, while valuable for providing a broad overview of available literature, have limitations. They do not formally assess the quality of evidence in primary research reports, potentially leading to the inclusion of studies of varying reliability. The considerable amount of data generated can present challenges in decision-making regarding breadth vs depth of coverage. Furthermore, scoping reviews lack formal synthesis of evidence, providing only descriptive accounts of available research. Despite these limitations, scoping reviews serve as useful tools for identifying gaps in the literature and informing further research or policy decisions.[16]

Current study status

The scoping review started in April 2023 and is expected to be completed in July 2024. The search strategy was collaboratively developed with a librarian from the Technical University of Berlin and adjusted to align with the requirements of each database. The database searches are ongoing (stage 2).

Patient and public involvement

There was no patient or public involvement in the design or conduct of this research. However, we plan to share the results of the review with experts in the field to gather their feedback and insights.

Ethics and dissemination

Ethical approval was not required for this scoping review as it solely relies on data from previously published studies and publicly available scientific literature. The review protocol is registered on Open Science Framework (doi: 10.17605/OSF.IO/WCRXG), providing access to the complete protocol. The findings of this review will be synthesised and shared through articles that will be submitted to a peer-reviewed journal and presented at relevant scientific conferences. Our objective is to offer a comprehensive overview of DTHF in LMICs, enabling the transfer of knowledge and contributing to the advancement of UHC in other LMICs.

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REFERENCES

1 World Health Organization, World Bank. Tracking universal health coverage. In: *World Health Organization. Tracking Universal Health Coverage: 2021 Global Monitoring Report*. Geneva: World Health Organization and World Bank, Available: http://elibrary.worldbank.org/doi/book/10.1596/36724 [accessed 13 Dec 2021].
2 World Health Organization. The World Health Report 2010: Health Systems Financing: The Path to Universal Coverage. Geneva: World Health Organization, 2010.
3 Kutzin J. Health financing for universal coverage and health system performance: concepts and implications for policy. *Bull World Health Organ* 2013;91:602–11.
4 World Health Organization. Global Strategy on Digital Health 2020-2025. Geneva: World Health Organization, 2021.
5 World Health Organization. Digital Technologies for Health Financing: What Are the Benefits and Risks for UHC? Some Initial Reflections. Geneva: World Health Organization, 2021.
6 CarePay. Giving Everyone the Power to Care: A mobile and cloud-based platform to benefit the individual, 2023. Available: https://www.carepay.com/ [Accessed 3 Aug 2023].
7 Bima Milvik. High-quality proactive healthcare made affordable and accessible, 2023. Available: https://bimamilvik.com/ [Accessed 3 Aug 2023].
8 Okuzu O, Malaga R, Okereafor K, *et al*. Role of Digital health insurance management systems in Scaling health insurance coverage in Low- and middle-income countries: A case study from Nigeria. *Front Digit Health* 2022;4:1008458.
9 Hakiba S. USAID Rwanda integrated health systems activity (RIHSA): annual report. 2021.
10 Meessen B. The role of Digital strategies in financing health care for universal health coverage in Low- and middle-income countries. *Glob Health Sci Pract* 2018;6:S29–40.
11 Mangone E, Riley P, Datari K. Digital financial services for health: A global evidence review. 2021.
12 Brezis ES, Krugman PR, Tsiddon D. Leapfrogging in international competition: A theory of cycles in national technological leadership. *Am Econ Rev* 1993;83:1211–9.
13 World Health Organization. Classification of Digital health interventions V1.0: a shared language to describe the uses of Digital technology for health. 2018.
14 Brikci N, Njefi-Pene K, Erlangga D, *et al*. Digital Technologies supporting health financing: a systematic review and expert discussion. 2023.
15 World Health Organization. The Implications of Artificial Intelligence and Machine Learning in Health Financing for Achieving Universal Health Coverage: Findings from a Rapid Literature Review. Geneva: World Health Organization, 2022.
16 Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology* 2005;8:19–32.
17 Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implement Sci* 2010;5:69.
18 Peters MD, Godfrey C, McInerney P, *et al*. Chapter 11: Scoping reviews. In: Aromataris E, Munn Z, eds. *JBI manual for evidence synthesis*. Adelaide, Australia: Joanna Briggs Institute, 2020.
19 Tricco AC, Lillie E, Zarin W, *et al*. PRISMA extension for Scoping reviews (PRISMA-SCR): checklist and explanation. *Ann Intern Med* 2018;169:467–73.

20 Peters MDJ, Godfrey C, McInerney P, *et al*. Best practice guidance and reporting items for the development of Scoping review protocols. *JBI Evid Synth* 2022;20:953–68.

21 Pioch C, Struckmann V, De Brikci N, *et al*. Digital Technologies for health financing in Low- and middle-income countries: a Scoping review protocol. *Open Science Framework* 2023.

22 Berger S, Denner MS, Röglinger M. The nature of Digital Technologies – development of a Multilayer Taxonomy. Proceedings of the 26th European Conference on Information Systems (ECIS.1–18.

23 Haddaway NR, Collins AM, Coughlin D, *et al*. The role of Google scholar in evidence reviews and its applicability to grey literature searching. *PLoS One* 2015;10:e0138237.

24 Grey matters: A tool for searching health-related grey literature, 2023. Available: https://greymatters.cadth.ca/ [Accessed 14 Jun 2023].

25 Petitfour L, Srivastava S, Shah-Rohlfs R, *et al*. Protocol for a Scoping review of measures and definitions of gender-based discrimination linked to health outcomes in low and middle-income countries. *BMJ Open* 2022;12:e061533.

26 Covidence. Better systematic review management, 2023. Available: https://www.covidence.org/ [Accessed 14 Jun 2023].

27 CPHIA. 3rd International Conference on Public Health in Africa, 2023. Available: https://cphia2023.com/ [Accessed 14 Jun 2023].

28 EPH. 16th European Public Health Conference, 2023. Available: https://ephconference.eu/ [Accessed 14 Jun 2023].