OXFORD

Oxford Open Digital Health, 2024, **2**, oqae013
https://doi.org/10.1093/oodh/oqae013
Advance access publication date 20 May 2024
Rapid Communication

Is it better to bring digital health tools together? Where Burkina Faso is going with a minimal digital ecosystem (MDE)

Joël Arthur Kiendrébéogo[1,2,3,4*], Charlemagne Tapsoba[5,6], Orokia Sory[2], Issa Kaboré[7], Yamba Kafando[7], Simon Tiendrébéogo[2,8], David Zombré[9], Rémi Kaboré[2,10], Noellie Konsebo[6,11], Nacanabo Relwendé[2,8], Jean Serge Dimitri Ouattara[12], Guillaume Foutry[13], Sara Hyde[14], Dylan Green[15], Michael Chaitkin[16], André Lin Ouédraogo[17] and S. Pierre Yaméogo[18]

[1]Department of Public Health, University Joseph Ki-Zerbo, 03 BP 8398 Ouagadougou 03, Burkina Faso
[2]Research, Expertise and Training Department, Recherche Pour la Santé et le Développement (RESADE), 04 BP 8398 Ouagadougou 04, Burkina Faso
[3]Heidelberg Institute of Global Health, Medical Faculty and University Hospital, Heidelberg University, Im Neuenheimer Feld 130.3, 69120 Heidelberg, Germany
[4]Department of Public Health, Institute of Tropical Medicine, Kronenburgstraat 43, 2000, Belgium
[5]Department of Health Promotion and Prevention, Nouna Health Research Centre (CRSN), BP 02 Nouna, Burkina Faso
[6]Partnership, Management and Knowledge Transfer Department, Recherche Pour la Santé et le Développement (RESADE), 04 BP 8398 Ouagadougou 04, Burkina Faso
[7]Operations Division, Recherche Pour la Santé et le Développement (RESADE), 04 BP 8398 Ouagadougou 04, Burkina Faso
[8]Biomedical and Public Health Department, Research Institute of Health Sciences (IRSS), Ouagadougou, 03 BP 7192 Ouagadougou 03, Burkina Faso
[9]Evaluation and Programme Implementation Support Department, Recherche Pour la Santé et le Développement (RESADE), 04 BP 8398 Ouagadougou 04, Burkina Faso
[10]Bordeaux School of Public Health (ISPED), University of Bordeaux, 146 Rue Léo Saignat, 33000 Bordeaux, France
[11]Primary Care Management Agency, Ministry of Health and Public Hygiene, 03 BP 7009 Ouagadougou 04, Burkina Faso
[12]Information Systems Department, Ministry of Health and Public Hygiene, 03 BP 7009 Ouagadougou 04, Burkina Faso
[13]Cooper/Smith, Baltimore, MA, USA
[14]Cooper/Smith, Salt Lake City, UT, USA
[15]Cooper/Smith, Seattle, WA, USA
[16]Global Development Division, Bill and Melinda Gates Foundation (BMGF), 500 5th Ave N, Seattle, WA 98109, USA
[17]Institute for Disease Modeling (IDM), Bill and Melinda Gates Foundation (BMGF), 500 5th Ave N, Seattle, WA 98109, USA
[18]Technical Secretariat for Health Financing Reforms, Ministry of Health and Public Hygiene, 03 BP 7009 Ouagadougou 04, Burkina Faso
*Correspondence address. 04 BP 8398 Ouagadougou 04, Burkina Faso. Tel: 00226 25 30 70 64/65; E-mail: jkiendre@gmail.com

Abstract

Digital health technologies are proliferating in low-income countries. However, they are not always optimally integrated and focused on health system priorities. To improve the performance of primary health care and accelerate progress toward universal health coverage, Burkina Faso aims to bring together eight digital health tools in two health districts as a pilot project, an initiative known as the 'Minimal Digital Ecosystem'. A co-creation approach is used to develop and implement these tools, involving the Ministry of Health, international nongovernmental organizations that promote the tools, donors and researchers. Despite the many challenges in developing and deploying it, the minimal digital ecosystem (MDE) is a promising experiment that deserves special attention to reap its full benefits.

Key words: digital ecosystem; digital health; digital health solutions; digital health tools; primary healthcare performance; Burkina Faso

INTRODUCTION

Several World Health Assembly (WHA) resolutions, including WHA58.28 on eHealth adopted in 2005 [1], WHA66.24 on eHealth standardization and interoperability adopted in 2013 [2] and WHA71.7 on Digital Health adopted in 2018 [3], strongly encourage Member States to develop and implement digital health strategies. The WHA58.28 defines digital health or eHealth as 'the cost-effective and secure use of information and communications technologies in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research' [1]. There are many types of digital solutions in terms of their technological features, functionalities and target users [4]. Digital health technologies have been shown to significantly improve the performance of the healthcare system, whether in terms of care delivery, activity and resource planning, data management or administration [5–9].

Digital health technologies have proliferated in low- and middle income countries in recent decades [10, 11]. However, the conditions for implementing digital solutions in these countries

Received: October 2, 2023. **Revised:** January 17, 2024. **Accepted:** March 3, 2024

are sometimes suboptimal due to a lack of funding, infrastructure, regulation or technical skills [12–14]. Burkina Faso has more than a decade of experience in the use of digital health technologies. Several digital solutions have been developed or implemented in the country at different levels of the health system as part of the Ministry of Health (MOH)'s strategic plans and through various initiatives promoted by nongovernmental organizations (NGOs) and private companies. However, these tools operate in isolation without synergizing or linking with each other, making it difficult to assess their overall impact on the health system.

To address this situation, Burkina Faso's MOH, in collaboration with NGOs promoting digital tools and with funding from the Bill & Melinda Gates Foundation (BMGF), is piloting a two-year project called the 'Minimal Digital Ecosystem (MDE)' in two health districts. This experience is unique in terms of the type of digital tools involved, the diversity of actors mobilized for its implementation and the interactions between them. This commentary highlights the initiatives, approaches and processes involved in setting up the MDE in Burkina Faso. It contributes to the emerging literature on strategies and efforts to synergize digital technologies in health to improve primary healthcare (PHC) delivery.

What is the minimal digital ecosystem and how does it work?

Burkina Faso's health system currently has over 100 digital tools, but they are disparate and generally operate in silos [15]. To address this situation, the MOH in Burkina Faso has a vision to implement an MDE that would work in synergy to support service access, delivery and management at the community, PHC facility and district hospital levels. The MDE would also strengthen oversight, planning and resource allocation at the regional and central levels. The MDE consists of identifying existing digital tools and developing additional ones with complementarity and synergy between them to deploy them simultaneously. The MOH hypothesizes that the introduction of this suite of digital tools, combined with the use of data and insights from these tools in performance management, will help improve the efficiency, quality and equity of health services provided. Specifically, it is envisioned that the MDE can help address the challenges faced by the country's free healthcare program for women and children under five, called *Gratuité* [16], by increasing efficiency, reducing fraud, reducing stock-outs and improving equity in the disbursement of scarce funds. *Gratuité*, which is being implemented in all public health facilities across the country, is one of the MOH's flagship programs to achieve universal health coverage (UHC). In addition, the MDE is meant to enable better allocation of financial resources based on data such as health facility finances, drug availability and some indicators such as attendance, cure rates and mortality.

The MOH selected eight digital tools for the MDE pilot in two health districts (see Table 1) to be implemented in all PHC facilities and their communities. The tools were chosen through a participatory and consensual process involving technical and financial partners, representatives of potential users and the MOH's central departments. The main selection criterion was the ability of these tools to support interventions and reforms within the MOH aimed at improving healthcare provision (REC-PCIME, REC-maternité and m-Health communautaire), health facility financial management (E-flux financier), healthcare cost efficiency and control (E-flux financier and Individual electronic care record), drug supply and availability (NetSIGL2.0), quality of care (E-Quality reference), health information system (E-Gratuite) and decision-making (Dashboard). Before the pilot, some tools were already being used at varying scales in the health system. Pilot districts were selected in part based on prior availability and routine use of some tools, which is expected to facilitate implementation, reduce incremental costs and mitigate risks associated with stakeholder buy-in and tools adoption.

In addition to the geographical extension of the initiative, additional digital solutions are planned to be gradually added to this initial package in the years following the pilot, with the support of other donors and NGOs. Besides deploying the tools, the MOH will develop interoperability capabilities to aggregate, analyze and visualize data from the different tools into decision-support dashboards for stakeholders at facility, district, regional and central levels. In fact, an important component of the MDE is to ensure that data are used for performance management, planning and resource allocation. For example, a monthly review of dashboards can inform supervision activities and identify urgent issues. The idea is to create simple and focused dashboards in collaboration with users to inform priority decisions, rather than creating tools that are too complex to scale.

Initially, the MOH and digital tool promoters collaborated with pilot health districts to assess logistical and equipment needs to identify any gaps. Many health facilities already had tablets suitable for MDE tools, which helped to keep equipment costs modest. One consideration was to avoid an excessive number of tablets in healthcare facilities, which can be challenging to manage and maintain. For example, it was deemed acceptable to have two applications on one tablet based on their frequency of use and the proximity of the intended users. Some tools, such as REC-PCIME or REC-maternité, may require multiple tablets per health facility to accommodate several providers using them simultaneously for consultations. Conversely, other tools, such as E-Gratuite or E-Quality reference, may not require dedicated tablets as they are used only occasionally during the month or even half-year respectively. Steps are also being taken to shore up MOH's data hosting capabilities. Currently, not all MDE tools are configured with domestic hosting arrangements. The MOH has acquired servers to replicate the data to enable the development of the Dashboard. The servers will also increase the national data storage capacity, allowing the maximum amount of data to be repatriated, particularly individual data, with the necessary security measures. Within its broader vision for digital transformation, one of the MOH's long-term goals is to establish the required IT infrastructure to achieve interoperability more easily among all tools.

Seeking to align and streamline the project design

The MDE stems from the MOH's focus on leveraging existing digital tools that operate in silos and are promoted by various actors. However, it is also expected that a small set of tools will be developed to enhance or complement existing tools. It is therefore essential to bring together and coordinate all stakeholders, in particular the developers/promoters and intended users of the digital tools, and technical departments of the MOH, including the Technical Secretariat for Health Financing Reforms, tasked with leading the process and the Information Systems Department, responsible for ensuring that any development and/or adaptation of existing digital tools meet the government's needs. To ensure broad ownership of the lessons learned from the project, other directorates and agencies concerned with the modules covered by each tool are involved as appropriate. A concept note for the MDE was prepared by the Ministry of Health in November 2022, with consultations unfolding in the subsequent months to achieve technical alignment and arrange funding.

Table 1. Name, description and characteristics of the MDE tools, including the dashboard

Name of the digital tool	Description of the digital tool	User, hardware and underlying technology	Coverage before the MDE	Promoter or developer
REC-PCIME (*Electronic consultation register—Integrated management of childhood illnesses*)	Consultation registry and job aid that guides health workers through the Integrated Management of Childhood Illnesses (IMCI) protocol. This tool enables healthcare providers to create an electronic record for each patient and facilitates the collection of diagnostic and treatment data at district level	Health worker at PHC facility Android-based tablet CommCare	Available in 53 health districts (out of 70), including the pilot districts	Terre des Hommes
REC-maternité (*Electronic consultation register—Maternity*)	Consultation registry and job aid to guide health workers through protocols for pregnancy-related services. Available modules cover antenatal care, delivery, postnatal care, family planning and postabortion care. This tool creates an electronic record for each mother and newborn, improving data collection and the quality of maternal and newborn health monitoring	Health worker at PHC facility Android-based tablet CommCare	Implemented in 24 health districts (out of 70), including one pilot district and all PHC facilities within the districts	Terre des Hommes
E-flux financier	This tool facilitates access to real-time financial data, ensures regular monitoring of financial flows (income, expenditure, receivables, payables, cash flow, etc.) and improves the financial management procedures of health facilities. The aim is to automate operations, automatically generate the monthly cash flow report based on the data entered and enable stakeholders at all levels of the health system to view key financial performance indicators via a dashboard for better monitoring and informed decision-making on issues related to resource allocation and financial management	Health facility financial management personnel Android-based tablet	Implemented in 12 PHC facilities in four health districts (out of 70), including three PHC facilities in a pilot district with a total of 71 PHC facilities	Clinton Health Access Initiative
Individual electronic care record	Digitized care sheet for *gratuité*, making it possible to optimize patient treatment and monitor prescriptions by care providers. It also serves as a visit-specific claim	Health worker at PHC facility Android-based tablet	None	MOH
NetSIGL2.0	An electronic platform designed to facilitate the management of medicines and pharmaceutical stocks at all levels of the supply chain. NetSIGL 2.0 also provides real-time logistics data for the country's healthcare facilities	Health worker at PHC facility Android-based tablet DHIS2	Implemented in five health districts (out of 70) and all PHC facilities within the districts. National rollout underway.	MOH
m-Health communautaire	Diagnostic and therapeutic guidelines at community level. Can help to health promotion (awareness-raising, patient education) and search for those lost to follow-up. Systematic collection of care data at community level	Community health worker Android-based phone CommCare	Implemented in nine health districts, including in one pilot district and all PHC facilities within the districts	MOH
E-Quality reference	Tool developed as part of the certification process for health facilities in Burkina Faso. This platform contains all the checklists needed to conduct internal and external audits for certification at different levels of health care in Burkina Faso. It can be used to calculate a quality score and take action to improve quality in health facilities. The tool also helps to build the capacity of health workers for continuous quality improvement	Health Facility Manager Android-based tablet; Computer DHIS2	Implemented in all health districts, including all PHC facilities within the districts	ThinkWell Institute
E-Gratuite	Electronic platform for collecting data on the implementation of the *gratuité* scheme. This includes data on invoices issued by health facilities, payments, and monitoring of *gratuité* effectiveness. The platform also collects data on the management of medicines and medical consumables, as well as assessing the workload of health workers. E-Gratuite improves the transparency and accountability of the *gratuité* scheme	Health Facility Manager; Health information manager within the district management team Android-based tablet; computer DHIS2	All health districts and all PHC facilities within the districts	ThinkWell Institute
Dashboard	Digital interface displaying key indicators selected from the various digital tools making up the MDE and updated dynamically and systematically to facilitate evidence-based decision-making	Health managers at health facility, district, regional and central level Computer and mobile devices (browser); mobile applications Python	None	Cooper Smith

A cocreation approach is used to support the planning and subsequent implementation of the project while ensuring that it leads to government-owned outcomes that will be adopted for scale-up. A technical committee bringing together all key stakeholders was established under the leadership of the MOH with coordination support from one of the NGOs. A series of online and in-person technical meetings were then held with implementing partners and operational stakeholders to discuss topics as diverse as: (i) developing a logical framework, a roadmap for operationalizing the MDE, a monitoring and evaluation plan, a guide for supervision and coaching; a plan to implement the tools not yet implemented; (ii) identifying and prioritizing the gaps in the digital tools at district level and/or in the functionality and content of existing tools; (iii) developing complementary tools together with demo presentations; (iv) identifying key areas where interoperability needs to be achieved and the scope of this interoperability work; (v) selecting indicators to be displayed in the MDE dashboards; (vi) storing and securing data, (vii) quantifying logistical needs and (viii) training actors in the use of the digital tools. These technical meetings are complemented by regular email and WhatsApp exchanges, fostering dynamic, multiparty and two-way communication between MDE stakeholders. This approach and these interactions are essential to ensuring that there is a shared vision and understanding of the MDE among key stakeholders and that the emerging knowledge and lessons learned are incorporated into operational plans for its deployment. The MDE's cocreation approach aims to foster coinvestment and efficiency in tool development and implementation costs, as well as align implementing partners with MOH priorities to avoid duplication.

To date, stakeholder exchanges have revealed that the main criteria for successful implementation of the MDE are tools that are available, simple, fully functional and fluid; endorsed by health service providers who use them effectively and satisfactorily; provide reliable data in real-time or in a timely manner for decision-making and promote transparency and accountability while directly combating fraud and inefficiencies.

Challenges and the way forward

The implementation of the MDE is a dynamic process with a set of challenges. The MOH has adopted a 'learning by doing' ethos and an iterative approach. A roadmap was developed at the outset and is being regularly updated as the context evolves. Consequently, there were no formal terms of reference or guidelines for the implementation of the MDE. This approach has allowed for a degree of flexibility and adaptability in implementation. Additionally, achieving seamless interoperability between disparate software solutions and ensuring a smooth flow of data is a learning process that requires a great deal of planning and technical expertise [17–19].

The MDE is being implemented in a health system that is typically recognized as complex and adaptive—therefore, the results of the intervention are inherently unpredictable [20]. Indeed, while digital tools can simplify day-to-day work and improve productivity and quality of care [7–9, 21], several internal and external factors can hinder this potential. In the case of the MDE, the main issues may include: (i) poor internet connectivity; (ii) problems with energy availability to recharge tablets and mobile phones; (iii) lack of funds for the provision of training and the acquisition of equipment, including its replacement and (iv) health worker mobility and motivation. In fact, effective digital health relies on a skilled and engaged workforce; thus, health teams need to be trained in the use of the tools and provided with ongoing support and mentorship to encourage uptake and identify and address challenges [12, 22]. In addition, the MDE can increase healthcare workers' workload and thus have a negative impact on the quality of care, especially in the early stages, as paper documents are not immediately discarded. Another challenge and key success factor is to find the right incentives and keep health staff consistently engaged. These issues deserve special attention and ongoing dialog and advocacy between stakeholders, including those outside the health sector (e.g. to address internet connectivity problems), to find appropriate solutions.

In this vein, critical to the success of the MDE is good coordination among stakeholders, especially government agencies, NGOs and donors. This requires careful planning and clear communication to create a collaborative environment and avoid misunderstandings; negotiation skills to balance different perspectives and mechanisms to promote a common vision and accountability. Another critical success factor is a robust monitoring and evaluation system that allows regular feedback loops and adjustments for continuous improvement. A WhatsApp group has been established to connect users, NGOs and managers at the district, regional and central levels. This channel allows users to share feedback on good practices, and any challenges they face, to find solutions. The MOH plans to appoint a 'digital health' focal point in each district. These focal points will coach health facilities on how to make better use of MDE tools, gather grievances and find local solutions. If a suitable solution cannot be found, the focal points will pass the grievances on to the appropriate supervisory level. In the medium-term and once the project has reached scale, there are plans to create the position of digital health manager within the district health management teams. In addition, some NGOs promoting digital tools plan to assign a focal point per region to assist users with the tools they are promoting. These NGO focal points will need to work synergistically with the 'digital health' focal points appointed by the MOH to improve the effectiveness of their actions.

To assess and learn from the MDE pilot, an independent evaluation using implementation science techniques has been commissioned from a national research organization, *Recherche pour la Santé et le Développement* or RESADE (Research for Health and Development). This includes an evaluation of the MDE process, outputs and outcomes, seeking to identify factors that would enable or hinder effective implementation, as well as determine whether the project improves the management and readiness of PHC services (e.g. timely data available, reduction in stock-outs, improved financial management, improved productivity of health workers, increased use of services by the population) and access to health care, including equity aspects. The evaluation effort will also include an analysis of MDE implementation costs and considerations for scale-up.

As mentioned above, there are plans to expand the range of tools that comprise the MDE. Particular attention should then be paid to those that are targeted at or affect the community. In this respect, the MOH, in collaboration with the BMGF's Institute for Disease Modeling, envisions modeling and digitalizing the routing of community health workers for more effective door-to-door PHC campaigns [23]. In addition, awareness-raising SMS or voice messages sent to the community; reminders about treatment adherence or follow-up appointments, e.g. for pregnant women, parents of children with malnutrition and parents of children to be vaccinated; or the provision of platforms for making appointments with health workers are all solutions that could be integrated into the MDE.

CONCLUSION

Complementarity and interoperability among digital tools is a common challenge for health systems in low- and middle-income countries. Burkina Faso's MDE initiative attempts to address this issue on a small scale by bringing together a set of eight digital tools in two pilot health districts. This experiment aims to improve the availability of timely and high-quality data for decision making and, in turn, the efficiency and quality of PHC delivery. If successful, this approach could serve as an example for other countries facing similar health system challenges.

ACKNOWLEDGEMENTS

This article is inspired by the reflections, discussions and documents being developed for the implementation of the MDE. We are grateful to all implementing partners for their critical contributions to this process.

STUDY FUNDING

This work was supported in whole or in part by the Bill & Melinda Gates Foundation [INV-056021 for authors affiliated with RESADE; INV-001119 for authors affiliated with Cooper/Smith]. Under the grant conditions of the Foundation, a Creative Commons Attribution 4.0 Generic License has already been assigned to the Author Accepted Manuscript version.

CONFLICT OF INTEREST

The MOH of Burkina Faso is the initiator and final beneficiary of the project, with two co-authors, JSDO and SPY, heavily involved in its design and implementation. In addition, the MOH of Burkina Faso is the promoter of three tools. Three co-authors, GF, SH and DG are from the NGO Cooper Smith, which is responsible for the design and development of the dashboard. Two co-authors, MC and ALO, are from the BMGF, which is funding the project. The other co-authors declare that they have no conflicts of interest.

AUTHORS' CONTRIBUTIONS

The different sections of the article were conceptualized by JAK with contributions from C.T., O.S., I.K., Y.K., S.T., D.Z., R.K., N.K. and N.R. Different sections of the article were written by J.A.K., C.T., O.S., I.K. and Y.K.,J.A.K., J.S.D.O., G.F., S.H., D.G., A.L.O. and S.P.Y. revised the content of the sections. JAK and MC ensured the consistency of the article and the final edits. All coauthors approved the final version of this article.

DATA AVAILABILITY

No new data were generated or analyzed in support of this article.

REFERENCES

1. World Health Organization Fifty-eighth World Health Assembly - WHA58.28. eHealth. Resolutions and Decision. 2005, 121–3.
2. World Health Organization Sixty-sixth World Health Assembly - WHA66.24. Agenda item 17.5. eHealth Standardization and Interoperability. 2013, 1–3.
3. World Health Organization Seventy-first World Health Assembly - WHA71.7. Digital Health. Agenda item 12.4. Digital health. 2018, 1–4.
4. World Health Organization. *Classification of digital interventions, services and applications in health: a shared language to describe the uses of digital technology for health*, 2nd edn. Geneva: WHO, 2023. https://iris.who.int/bitstream/handle/10665/373581/9789240081949-eng.pdf?sequence=1 (25 March 2024, date last accessed)
5. Al-Shorbaji N. Improving healthcare access through digital health: The use of information and communication technologies. In: Agrawal A, Kosgi S (eds.), *Healthcare Access*. IntechOpen, 2021. https://doi.org/10.5772/INTECHOPEN.99607.
6. Ibeneme S, Karamagi H, Muneene D *et al.* Strengthening health systems using innovative digital health technologies in Africa. *Front Digit Health* 2022;**4**:1–8
7. Borges do Nascimento IJ, Abdulazeem HM, Vasanthan LT *et al.* The global effect of digital health technologies on health workers' competencies and health workplace: an umbrella review of systematic reviews and lexical-based and sentence-based meta-analysis. *Lancet Digit Health* 2023;**5**: e534–44
8. World Health Organization. Digital tools positively impact health workers' performance, new WHO study shows. https://www.who.int/europe/news/item/27-07-2023-digital-tools-positively-impact-health-workers--performance--new-who-study-shows (25 March 2024, date last accessed)
9. Erku D, Khatri R, Endalamaw A *et al.* Digital health interventions to improve access to and quality of primary health care services: a scoping review. *Int J Environ Res Public Health* 2023;**20**: 6854
10. Labrique AB, Wadhwani C, Williams KA *et al.* Best practices in scaling digital health in low and middle income countries. *Glob Health* 2018;**14**:1–8
11. Atkinson K, Mabey D. Revolutionizing tropical medicine: Point-of-care tests, new imaging technologies and digital health. In: Atkinson K, Mabey D (eds.), *Revolutionizing Tropical Medicine: Point-of-Care Tests, New Imaging Technologies and Digital Health*. Hoboken, NJ: Wiley Blackwell, 2019, 1–728
12. Kaboré SS, Ngangue P, Soubeiga D *et al.* Barriers and facilitators for the sustainability of digital health interventions in low and middle-income countries: a systematic review. *Front Digit Health* 2022;**4**:1014375
13. Duggal M, El Ayadi A, Duggal B *et al.* Editorial: challenges in implementing digital health in public health settings in low and middle income countries. *Front Public Health* 2022;**10**: 1090303
14. Hui CY, Abdulla A, Ahmed Z *et al.* Mapping national information and communication technology (ICT) infrastructure to the requirements of potential digital health interventions in low and middle-income countries. *J Glob Health* 2022;**12**:12
15. Ministry of Health and Public Hygiene. National Health Information System and 2010–2020 Strategic Plan Evaluation. Ouagadougou, 2020 https://static1.squarespace.com/static/548487dce4b08bf981fe60d5/t/60354eef1ec0a67d735b4a1f/1614106365430/BurkinaFaso_Report_Final.pdf (26 March 2024, date last accessed)
16. Boxshall M, Kiendrébéogo JA, Kafando Y *et al. An Overview of the User Fee Exemption Policy (Gratuité) in Burkina Faso*. Washington, DC: ThinkWell Institute, 2020
17. Oemig F, Blobel B. Modeling digital health systems to foster interoperability. *Front Med (Lausanne)* 2022;**9**:896670
18. Lehne M, Sass J, Essenwanger A *et al.* Why digital medicine depends on interoperability. *NPJ Digit Med* 2019;**2**:1–5
19. Kouroubali A, Katehakis DG. Policy and strategy for interoperability of digital health in Europe. *Stud Health Technol Inform* 2022;**290**:897–901

20. Martínez-García M, Hernández-Lemus E, Martínez-García M *et al.* Health systems as complex systems. *Am J Oper Res* 2013;**3**:113–26
21. Lounsbury O, Roberts L, Kurek N *et al.* The role of digital innovation in improving healthcare quality in extreme adversity: an interpretative phenomenological analysis study. *J Glob Health Rep* 2022;**6**:e2022040
22. Borges do Nascimento IJ, Abdulazeem H, Vasanthan LT *et al.* Barriers and facilitators to utilizing digital health technologies by healthcare professionals. *NPJ Digit Med* 2023;**6**:1–28
23. Ouédraogo AL, Zhang J, Tinto H *et al.* A microplanning model to improve door-to-door health service delivery: the case of seasonal malaria chemoprevention in sub-Saharan African villages. *BMC Health Serv Res* 2020;**20**:1–11