DIGITAL TECHNOLOGIES FOR HEALTH FINANCING:
WHAT ARE THE BENEFITS AND RISKS FOR UHC?
SOME INITIAL REFLECTIONS

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Digital technologies for health financing: what are the benefits and risks for UHC? Some initial reflections

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CONTENTS

KEY MESSAGES:

- The objective of this paper is to outline potential benefits and to explore possible risks and challenges specifically in relation to health financing principles and UHC objective. A key premise of this paper is that digital technologies supporting health financing functions and tasks must contribute to progress towards to universal health coverage.

- Digital technologies can have various benefits for health financing, such as improved purchasing processes as well as increased revenue raising for health - when these revenues flow into large pools and transform out-of-pocket expenditure into prepayment. Digital technologies can also enable efficiency gains and enhanced accountability and transparency, thus ideally improving quality of care, financial protection and access to health services.

- But there are equally risks and concerns. Caution is warranted when digital technologies contribute to a pooling architecture with limited or reduced redistributive capacity, which worsens or consolidates inequities in financial protection at the detriment of poor, vulnerable and disadvantaged population groups.

- One starting point for governments to reap the benefits of digital technologies for health financing and minimize their risks is to give sufficient attention to health financing and the use of digital technologies in a country's national digital health strategy. Strengthening technical and regulatory capacities in this area will also be useful.

- Last but not least, it is important to gain a detailed overview of the digital technologies being used for health financing. The impacts of digital technologies for health financing should be evaluated in order to gather evidence. This will be the basis for developing guidance and recommendations on the use and design of digital technologies for health financing to support progress towards universal health coverage.

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1. INTRODUCTION: WHY DO DIGITAL TECHNOLOGIES MATTER FOR HEALTH FINANCING?

Digital innovation for health care and illness prevention with its potential to transform health-service delivery has received strong public attention over the past decade in both high-income and low- and middle-income countries (LMICs) *(1)*. However, the use of digital technologies and their role in enhancing health financing, and their implications for health systems transformation, are less well known, especially in LMICs. An important contribution and first step in this field was an article by Meessen *(2)* which looks at the role of digital strategies in health financing.

In this paper, we refer to digital technologies as electronic tools, systems and devices that generate, store, process or transmit data (cf. *(3)*). Digitalized data and information management systems, including data warehouse and related elements, are a wide and important area that is relevant to health financing. Moreover, this paper is particularly focused on digital technologies that significantly change "business as usual" – i.e. technologies that substantially transform the way in which health-financing tasks are undertaken by stewards, purchasers, providers, users and citizens in general. These technologies include mobile telephone applications, webpage interaction platforms, blockchain, big data analytics, and artificial intelligence including machine learning *(1)*. Digital health is the term used to describe "the field of knowledge and practice associated with the development and use of digital technologies to improve health" *(1)*. Consequently, digital technologies for health financing can be considered as one specific area within digital health.

With increasing spread of the Internet and mobile telephone connections, coupled with the digitalization of data and information management, new opportunities for health financing in LMICs may arise. There are, meanwhile, more than 7 billion cellular subscriptions around the world and 93% of the world's population lives within reach of a mobile broadband (or Internet) service *(4)*. The spread of Information-Communication-Technology is itself part of Sustainable Development Goal (SDG) No. 9 *(5)*, with the idea of also advancing the other SDGs.

A key premise of this paper is that digital technologies for health financing should contribute to universal health coverage (UHC), which falls under Sustainable Development Goal No. 3 *(5)*. The intermediate and final objectives of UHC include efficiency, equitable distribution of resources, accountability and transparency, as well as equity in access, fair financing and financial protection, and quality of care *(6, 7)*. To achieve progress towards UHC, digital technologies should support the achievement of widely agreed health-financing principles and desirable attributes – i.e. largely relying on public finance, reducing out-of-pocket expenditure and expanding prepaid and pooled funding, and making purchasing more strategic *(8, 9)*. These health financing principles and the UHC objectives can serve as assessment criteria for evaluating the benefits of digital technologies.

Nevertheless, digital technologies may pose risks to health financing and the application and implementation of digital technologies face various challenges that could jeopardize their health-financing benefits *(1, 10)*. These specific risks for health financing need to be explored. Also importantly, digital technologies for health financing should be assessed against broader principles and criteria, such as data security and data protection for privacy and confidentiality of data. When big data analysis including algorithms and artificial intelligence are implied, other issues arise in relation to data accuracy, comprehensiveness and – importantly – minimization or elimination of biased algorithm outcomes, discrimination against specific population groups and erroneous prediction. One key question is how digital technologies, and particularly the use of artificial intelligence, affect health equity *(11)*. The WHO Bulletin devoted a special issue to Artificial intelligence in the health sector: ethical considerations to this subject, emphasizing the relevance of these concerns *(10).*

The objective of this paper is to outline potential benefits and to explore possible risks and challenges specifically in relation to health financing principles and UHC objectives on the basis of a scoping literature review, including published and grey literature, with a focus on LMICs. The next section provides an overview of digital technologies for health financing and assesses their potential benefits in contributing to UHC objectives.[1] This is followed by an exploration of the potential risks and challenges in relation to UHC objectives. These two sections are structured along the three core health financing functions – i.e. revenue-raising, pooling and purchasing, and they do not claim to be exhaustive. A mention or description of a specific digital technology or country case example in the sections below does not imply that it is considered beneficial or is endorsed by WHO. Finally, we provide initial conclusions and reflections on how to reap the benefits, and mitigate the risks and challenges, in relation to health financing.

The envisaged audience of this issue paper are decision-makers, policy analysts, advisors and managers working in the field of health financing as well as those dealing with digital technologies in relation to health financing.

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[1] Articulated as discrete functionalities of digital health implementation, these are also be found in the WHO Digital Health Interventions Classifications, where they are organized by user group (clients, health providers, health system managers, data services) (*12*).

2. HOW COULD DIGITAL TECHNOLOGIES CONTRIBUTE TO IMPROVING HEALTH FINANCING FOR UHC?

With respect to **revenue-raising**, mobile telephone applications for payment of health insurance contributions - as part of mobile wallet services ("mobile money") - open enormous opportunities for increased collection of revenues for health, especially in rural communities. Collecting health insurance contributions through mobile wallet services may substantially reduce transaction, opportunity and administration costs for individuals and agencies. For instance, in Rwanda, people can pay their health insurance contributions via mobile money *(13)*. Other examples are Kenya's Mpesa programme or M-Tiba's partnership with the National Health Insurance Fund *(14, 15)*, through which several hundred thousand members pay their health insurance contributions.

There is also potential to use mobile telephone applications to collect taxes *(16)*, thus contributing to timely tax payment and reduced operational costs for both tax collection staff and citizens, as in Rwanda *(17)*. A pilot project for tax collection via SMS is under way – for instance, in Zambia *(18)*. Additionally, mobile telephone applications are used for re-enrolment reminders, as in Ghana *(19)*, with the intention of contributing to continued coverage and financial protection as well as stable payment of health insurance contributions.

Moreover, digital technologies and digital tools that make various information management systems interoperable – across different ministries or different sectors – could improve the processes of identifying and targeting eligible beneficiaries for a health coverage programme. One such entry point are a digitalized civil registration and vital statistics systems *(20)*. A major leap could also be expected from a digital identification (ID) system, as is in place in India for example *(21)*, with open source systems being implemented in an increasing number of countries *(22)*. While this digital technology was not developed specifically for health financing, such innovations in other sectors can optimize health-financing tasks. Digital tools for identification and targeting could also be applied by health coverage schemes that provide coverage for defined population groups outside the formal economy – often the very poor or other medically vulnerable groups – by using state budget transfers to fully or partially subsidize their coverage.

With respect to budget formation, digital technologies such as integrated financial management information systems (IFMIS) that standardize budgeting activities can potentially help to improve the quality and timeliness of data and help visualize funding flows through dashboard applications thus ideally contributing to improved public financial management as well as increased transparency and accountability *(23)*. Lack of such digital tools has been shown to hinder consolidation of budget information across subnational areas and government tiers *(24)*.

The **pooling** function could be enhanced by making information management systems inter-operable across separate health coverage schemes for different population groups. Such inter-operability tools serve to integrate or aggregate data analysis, which could potentially facilitate pool-merging, improve risk equalization or risk adjustment mechanisms, or help harmonize benefits and payment rates across different schemes. Moreover, comparable information on different health coverage schemes and their benefits, payment and cost-sharing arrangements can be decisive in creating trust among users as a basis for building acceptability for pooling reforms.

Beyond the general trend of digitized information management by purchasers and providers, there is a wide range of digital technology innovations in the field of **purchasing**.

First of all, "business intelligence" applications such as intelligent dashboards are considered to be powerful tools for providing analytics and visualization. Moreover, digitalized data and information management tools can contribute to improved availability and timeliness of data on financial flows and budget expenditure, thus facilitating public financial management, budget allocation decisions and budget execution. This is again decisive for better management and monitoring, leading to enhanced transparency, as illustrated in Nigeria *(24)*.

Digitalized information management is valuable for many other purposes in purchasing, including measuring and evaluating provider performance and quality of care. For instance, open source software for results-based financing schemes could facilitate purchasing agencies' tasks such as facility enrolment, collection of performance data from facilities, data verification, payment, production of invoices or analytical dashboard visualizations, and public

reporting on facility performance *(2)*. In addition to better information management, comprehensive open source software seeks to facilitate a holistic approach to management and monitoring. This could potentially enhance the integration of pay-for-performance (P4P) approaches with other parts of the health system, ultimately leading to greater efficiency and a more equitable distribution of resources. More specifically, digital tools could be used to identify outliers or untypical data, thus simplifying the time-consuming verification processes of P4P mechanisms and reducing the significant verification costs. A performance-based financing pilot programme in Zambia exemplifies the use of machine-learning methods to verify the performance on quantity indicators *(25)*.

Digital tools helping to integrate or make information management systems interoperable could both support and improve the interaction between government authorities, purchasers and providers and thus help reduce fragmentation in information management systems. In China for instance, Li et al. *(26)* report that the integration and interoperability of the medical insurance information system with other social security and ID databases have effectively supported the operation of the health insurance system. This has allowed cross-provincial inpatient care fees to be applied as a way to enhance portability for populations that are highly mobile *(27)*. Moreover, interoperable information management systems create a potential for setting up health provider networks, thus ultimately facilitating integrated/coordinated care and leading to better quality of care. This could, for example, support the development of innovative bundled payment methods, as found in a total capitation system in Germany's Healthy Kinzig Valley *(28)*, in a pilot programme in Hungary *(29)* or in Estonia's well-aligned multiple payment system *(30)*.

Digital payment processes and digital bank accounts could help health facilities, particularly in remote areas, to receive funds quickly and at low transaction costs. Above all, this could contribute to strengthening facilities' managerial and financial autonomy. Similarly, digitalized payment of copayments could save patients a lot of time, as reported in China *(31)*.

Moreover, country examples suggest that claims management can be optimized by digitalization. In China, for instance, digitalized claim processing at the point of service delivery with real-time online copayment settlements have enabled a shift from cumbersome and lengthy reimbursement processes. This lowers the financial burden on patients and reduces the administrative workload for purchasers *(31)*. Digitalized claims management also facilitates fraud detection – e.g. through automated software programs, as in Korea's Health Insurance Review & Assessment Service (HIRA) *(32)*, or by artificial intelligence as in the case of PhilHealh *(33)*. This should reduce costs and increase efficient spending. Furthermore, digitalized claims analysis coupled with big data analysis could better reveal the service priorities of providers and patients and help to simplify the adjustment of payment rates in order to steer provider behaviour.

Various purchasing-related digital tools support users and patients directly. For instance, mobile telephone-based portals and/or web-based platforms, such as in Indonesia *(34)* and Tunisia *(35)*, serve to improve the provision of information to users on benefit packages, cost-sharing schedules (including remaining ceilings, etc.) and allow patients to follow-up their claims. Overall, this may contribute to increased transparency and accountability for patients and responsiveness of purchasers, strengthening trust, saving time and reducing costs for both patients and

purchasers (see *(2)*. Mobile telephone or web-based applications could also provide easier, low-cost access to reporting and grievance mechanisms – as in Indonesia *(34)* and Thailand *(36)*. This could make it easier to report prohibited provider behaviour and balance billing. In Estonia, making medical bills visible on a patient portal aim to increase transparency on provider bills and the use of funds. Anecdotal evidence suggests that this also enables double-billing or ghost billing to be identified *(37)*, ultimately contributing to fraud detection. Mobile telephone-based reporting applications could potentially also be used to report hospital detention practices, as proposed by a WHO policy brief on ending hospital detention *(38)*.

A second area in which users and patients can be supported directly is the digitalization of information on benefits utilization. This could provide real-time information on accumulated cost-sharing payments or whether one's cost-sharing ceiling has been reached. It could also simplify procedures, remove administrative barriers for reimbursement or even notify people about their eligibility for a specific benefit (e.g. reduced or exempted cost-sharing for medicines when a ceiling is reached). In Estonia, for instance, the pharmacy information technology system provides medicine benefits automatically rather than requiring people to apply for them *(39)*. Such measures serve to improve financial protection of patients. Digitalized referral letters could also speed up processes, save time and costs for both patients and providers, and improve quality of care.

A third area relates to the provision of electronic vouchers (e-vouchers) via mobile telephone technology in order to help facilitate financial access to health services or transport to such services. There are various examples from the field of maternal care *(40, 41)*.

Consequently, the wide range of digital technologies and their potential for health financing seem promising. The examples suggest that they could make an important contribution to supporting health financing functions and thus to achieving the objectives of UHC. Not only could digital technologies enhance access to processed information for citizens and patients – as well as providers, purchasers and policy-makers – thus improving transparency, accountability and trust. They could also help to save time and reduce administration and opportunity costs, thus contributing to efficiency, particularly in the purchasing function. Mobile phone applications can have an enormous potential for increasing revenue raising for health, for example from people in the informal economy. Moreover, digitalization in health financing may have important effects on other sectors, and vice versa, such as the digitalization of payments in the informal economy.

Nonetheless, despite the promising potential for, and indications of, many benefits, there remains insufficiently documented evidence of the benefits of digital technologies on health financing and UHC. Several of the examples cited here are small initiatives or pilot projects and no evaluations are available on how well they function and what they achieve.

3. WHAT ARE THE POSSIBLE RISKS AND CHALLENGES OF DIGITAL TECHNOLOGIES IN HEALTH FINANCING?

Various generic risks and challenges in digital health and digital technologies for the health sector (and other sectors) exist and are well known and widely discussed in the digital health community *(1, 10)*. These are also highly relevant for health financing. We briefly mention these generic risks first to understand the broader context challenges, before we then turn to the specific risks for health financing and related challenges that may affect UHC objectives.

One major generic concern relates to the multiple digital divides between regions, population and income groups, and genders. These digital divides undermine the principle of equal distribution of benefits for all and potentially increase inequalities and inequities in access to health services and financial protection *(11)*. A second overall concern relates to data security and data protection. The use of electronic health records – i.e. personal data – for purchasing-related tasks, such as claims management and other analytics, needs to be based on legislation and informed consent. People must be able to understand what they consent to. Moreover, benefits may be thwarted by implementation challenges and insufficient adaptation to the existing digital environment – such as: insufficient digital infrastructure (including Internet and mobile telephone connectivity) *(42)*; gaps in data interoperability and interface management *(43)*; insufficient skills and knowledge of persons designing, implementing or using digital technologies *(44)*; lack of understanding, trust and acceptability by users such as health workers and patients *(10)*; and even resistance to providing or

processing data because of burdensome (documentation) processes.

Turning to the specific risks for health financing and related challenges, digital technologies must be assessed with respect to their effects on health financing principles and UHC objectives.

With regard to raising revenue, one immediate concern relates to the use of mobile wallet applications when they facilitate and promote the collection of voluntary health insurance contributions. Likewise, some telecommunication companies offer varying levels of voluntary health insurance coverage for free depending on the amount of airtime bought *(2)*, thus providing voluntary coverage in an automatic way. The more airtime a person buys, the larger the benefit package or coverage amount in some schemes. This could turn out to be inequitable, when assuming that people with higher income buy more airtime. The concern is not about the fact that digital technologies facilitate raising additional revenue, but how these funds are pooled.

With respect to pooling, the concern is that digital technologies supporting or simplifying the collection of voluntary payments for health may contribute to increasing the number of pools or consolidating multiple pools, thus enhancing fragmentation in the health financing system. Such digital technologies may also expand the role of voluntary health coverage (commercial private health insurance or micro health insurance including community-based health

insurance), yet with limited redistributive capacity. Moreover, these voluntary coverage schemes may not be aligned with public health coverage benefits. In sum, this may increase inequities with respect to access to care and financial protection as well as inefficiencies at the health system level due to functional duplication and fragmented health information management systems *(45)*. Simplifying the collection of contributions and automatically providing voluntary health insurance coverage may also make it more difficult for national policy makers to raise political support for expanding public health coverage schemes. More evidence is needed to assess how such digital applications affect the share of prepayment and pooling of funds in public versus voluntary health coverage schemes.

In the case of an NGO-funded project in Madagascar, support was provided to create a mobile wallet application to enhance personal savings of pregnant women so they could pay their user charges (out-of-pocket expenditure) digitally at the time of their delivery *(46)*. However, this effort does not contribute to strengthening inter-personal pooling.

Regarding purchasing, there are several potential risks. Increased digitalization could also lead to further fragmentation, when purchasers operate segmented information management systems that are not made inter-operable through respective digital applications. When the digitalization of information management systems is not coordinated and when there are no attempts to align or harmonize them, this may consolidate blind spots for population groups that are not covered by a specific health coverage scheme *(9)*. The main concern is that data that are digitalized but incomplete may lead to biased decision-making, which

results in exclusion, inequitable access or poorer financial protection for vulnerable population groups.

Moreover, claims analysis can be enhanced by artificial intelligence, and big data analytics could make it easier to identify and predict high-risk/high-cost individuals *(47)*. Such tools are used by voluntary health insurance, government agencies and hospitals. While there is no indication of this happening so far in the European Union, there may be a danger – particularly in the case of voluntary health insurance – that high-risk persons could be excluded from coverage or be moved into plans for which they have to pay higher insurance premiums *(48)*. This is clearly in contradiction with the UHC-oriented health-financing principles outlined above. The use of risk-score ratings has also increased the number of risk pools – i.e. specific voluntary health insurance policies for high-risk people who are pooled separately *(48)*. This implies further fragmentation, limiting redistributive capacity and affecting financial protection and equitable access to health services *(49)*. In addition, anticipating future costs of specific individuals via big data analysis raises various legal and ethical questions (cf. *50*).

In sum, risks do not relate to advances in the digitalization of data as such (except for uncoordinated digitalization processes). However, concerns arise about digital technologies for health financing that contribute to consolidating or expanding pooling arrangements with limited or even reduced redistributive capacity, such as voluntary health coverage schemes, personal saving accounts, risk-score rating or predictive claims analysis. This affects health system efficiency, the equitable distribution of resources and financial protection.

4. HOW CAN GOVERNMENTS REAP BENEFITS AND MINIMIZE RISKS OF DIGITAL TECHNOLOGIES FOR HEALTH FINANCING?

Health financing arrangements need to be designed and implemented in a UHC-conducive way in the first place. Digital technologies should support, improve and facilitate such UHC-conducive health financing arrangements, but not all may actually achieve this. The challenges arise when they negatively affect UHC-conducive health financing arrangements (due to design or implementation challenges), thereby reducing progress towards achieving UHC objectives. Another big concern refers to such digital technologies that enhance, support or create health financing arrangements that are not UHC-conducive in the first place.

This paper has explored the potential benefits of digital technologies for health financing and has also reflected on some of the possible risks and challenges. This overview suggests that there can be multiple and significant benefits of digital technologies for health financing, such as increased revenue raising for health - when they flow into large pools and transform out-of-pocket expenditure into prepayment -, and improved purchasing processes. Digital technologies allow for efficiency gains and enhanced accountability and transparency, ideally improving quality of care, financial protection and equitable access to health services. But there are equally risks and concerns around certain uses of digital technologies. Caution is warranted when digital technologies contribute to a pooling architecture with limited or reduced redistributive capacity, which worsens or consolidates inequities in financial protection at the detriment of poor, vulnerable and disadvantaged population groups.

Governments – specifically ministries of health – can take various measures to reap their benefits and minimize their risks with the support of the global community.

As a first measure, health financing and the use of digital technologies need to receive sufficient attention in the national digital health strategy *(1)*. This strategy should be clear about which digital technologies for health financing are supported or promoted and should both outline their benefits and show how risks can be addressed. This provides the basis for defining strategic directions, policies, procedures, roles and responsibilities of the various stakeholders involved in designing and implementing digital technologies for health financing (cf. *(51)*). This quest with respect to health financing takes place in the larger context of digital transformation in the health sector and beyond – such as improved digital infrastructure and connectivity, the digitization of the public sector, the development of interoperability and interfaceability of digital technologies to fit into the ecosystem, data standardization and the creation of data governance structures *(1)*.

Second, to take advantage of opportunities and tackle the related risks and challenges, there is need for government actors to strengthen capacities and skills in specific digital technologies for health financing and regulatory capacity to address legal and ethical questions (cf. *(52)*) – including data security and data protection to protect people's privacy. This serves, moreover, to reduce and potentially overcome the digital divide between the private and public sectors. Strong governance and regulation may be needed, particularly in the field of purchasing in relation to big data and artificial intelligence. This is a known challenge for the health sector in general but is also pertinent for health financing and purchasing in particular. Regulation serves to establish clear processes to assess the quality, ethics, value basis and impact of algorithms and big data analytics and to establish effective stakeholder involvement *(48, 53)*. Guidelines on evaluating artificial intelligence for health from various perspectives and an online platform (and complementary tools) for the benchmarking of artificial intelligence for health can be found in the whitepaper for the ITU/WHO Focus Group on Artificial Intelligence for Health *(54)*.

Third, the global community could support investments in both governance and capacity-strengthening of governments to leverage the benefits of digital technologies for health financing (cf. *(1, 49)*). Platforms that engage all stakeholders could be supported to enable a constructive and open dialogue through which the various digital divides can be overcome. Similarly, it will be useful to foster a learning process across communities, sectors and countries.

Finally, the most critical measure is to gain a detailed overview of what is already happening with respect to digital technologies for health financing. Inspired by WHO's Atlas of eHealth country profiles *(55)*, a similar exercise could focus specifically on mapping digital technologies for health financing. Most importantly, digital technologies should be evaluated in order to gather and synthesize evidence. The key research question is to assess the impact of digital technologies on health-financing principles and UHC objectives and to measure it against the costs of the risks and challenges, for example by applying and adjusting WHO's methodological guidance on monitoring and evaluating digital health interventions *(56, 57)*. Whether or not digital technologies can transform health financing in such a way that health-financing principles can be modified or are even disrupted remains to be seen.

The ultimate objective is to provide guidance and recommendations on the use and design of digital technologies that support health financing and UHC objectives.

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