A portfolio of digital platforms and services for digital health interventions, a case in Masvingo Province, Zimbabwe

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Abstract This paper introduces a case study to describe a portfolio of digital health platforms and services to cater for digital health interventions in Masvingo Province, Zimbabwe. The portfolio resulted from of a concerted effort of stake- and relationholders in Masvingo Province, under the guidance of the Ministry of Health and Child Care. It contains digital health platforms sustaining digital health services to cater for digital health interventions. This study shows an enactment in digital health from the so-called peripheries in Africa.

Keywords: digital health, platforms, services, Africa

1 Introduction

Digital health expands on the concept of eHealth, which is defined as the cost-effective and secure use of information and communications technologies in support of health and health-related fields, including healthcare services, health surveillance, health literature, and health education, knowledge and research [1]. Digital health includes all users of information technologies and an ever-expanding range of smart devices and connected apparatus. These include all digital technologies deployed for health outcomes, such as the Internet of things (IoT), artificial intelligence (AI), big data, and robotics [2]. The common denominator in all of this is health. Over time, the word digital will fade away when digital transformation is completed and all health services are digitised [3].

Digital health crystalises in the implementation of digital health interventions. These interventions are supported by digital health services,

which are discrete functions of digital technology, otherwise called applications. In turn, digital health services are sustained by digital health platforms (see figure 1).

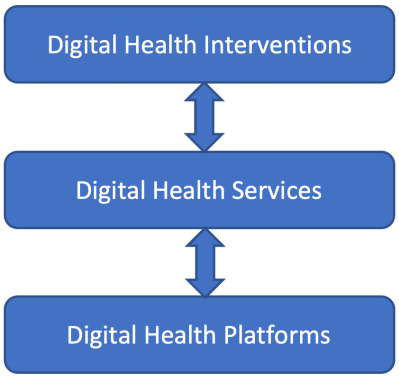

Figure 1, Digital health interventions, services, and platforms

Digital health interventions are of keen interest to relationholders and stakeholders on many levels: local, national, regional/continental, and international. In 2019, the World Health Organisation (WHO) provided a categorization and recommendations for a number of digital health interventions [4]. Technology-wise, digital health incorporates information and communication technology (ICT) systems and channels to facilitate digital health interventions and their information for health support. Digital health has the potential to enhance the accessibility of clinical data for health professionals' decision-making at all health care system levels, being the client, the care team, the health organizations, or the political and economic (data) environments [5, 6]. In addition, it can facilitate the visibility of information as feedback for continuous health improvement in communities, for individuals, and to strengthen health systems.

Digital health can be instrumental in meeting Sustainable Development Goal 3 (good health and wellbeing) when used to improve access to health care by vulnerable populations and the management of preventable diseases [7]. The World Health Organisation showed that it would be challenging to achieve universal health coverage without eHealth [8].

2 Method

This paper is an extended case study of developing a comprehensive portfolio of digital health platforms and services from 2016 till mid-2021 in Masvingo Province, southern Zimbabwe. In discourse development, the case study focusses on the local and then engages with the global context to allow for discovery of "action, taking full advantage of its cultural legacy and those technological advantages of modernity that can be used autonomously the less it would need any developmental type of assistance or intervention from outside" [9].
All authors are immersed in the studied developments and used qualitative observations from living in the environment, understanding local ways of acting in digital health, eliciting information through focus group discussions, in-situ observations, key informants, and interviews. Two authors engage full time in the content matter, cognisant that "from a community development perspective it is the community that makes the evaluative judgement" [10].
The outcome of this case study is a narrative and description of a portfolio of platforms, services, and intervention and their embedding in the context of digital health in the Zimbabwe context. It provides a positioned insight into an agentic and inclusive development in a province in Zimbabwe, hundreds of kilometres away from Harare, the capital.

3 Digital health in Zimbabwe

Zimbabwe's health system is seriously impacted by a struggling economy with uncertain supply chains, a situation in existence over the past two decades, and aggravated by the recent COVID-19 pandemic. According to the UNICEF health budget brief, the country's national budgetary allocation for health care was pegged at 10% of the total annual budget in 2020 [11].

In terms of the availability of ICT infrastructure, services and skills, eHealth implementations are varied across the country's health institutes. At the end of 2019, MoHCC performed its first national survey of the digital health infrastructure of Zimbabwe [12]. Forty researchers visited nearly 10% (n=119) of all health facilities at national, provincial and district levels. They assessed digital infrastructures, ICTs utilisation, and reliance on manual systems. They found a low availability of ageing equipment and utilisation challenges of government-supplied ICTs in the

public health sector. According to the survey, 72% of staff used personal devices for work, and half of the users had lost data during their work. Less than 20% of available health data is analysed in context, while less than 1% of the patient referrals are done electronically. Thus, the use of digital health infrastructure and services is structurally low in Zimbabwe's health system. Equipment is ageing with limited resources for maintenance or replacement.

Furthermore, connectivity and electricity challenges are common. The lack of IT skills among Health Care Workers (HCW) is one of the critical factors affecting the implementation and integration of digital in Zimbabwe's health system [13]. An estimated 60% of the health workforce need digital literacy training as such was not part of their tertiary education/college training. Therefore, there is a massive gap between digital health ambitions and infrastructural realities in Zimbabwe. Thus, the need for investments in ICTs, equipment, locally aligned research development, and leapfrogging.

Despite a growing investment and interest in digital health, execution has many barriers, including resistance to change among healthcare organizations and clinicians and fragmented investments and maintenance in an underfunded healthcare sector. The challenging environment and capacity fragmentation constrict Zimbabwe's Ministry of Health and Child Care (MoHCC)'s ability to fulfil all its digitisation ambitions and goals without international partner support. However, interplaying developments at the local/provincial, national, and international levels are likely to speed up progress. These developments include increased partner support for selected activities and the promotion of digital literacy among HCWs.

The COVID-19 pandemic highlighted the Zimbabwe health system's vulnerabilities in dealing with an epidemic in conjunction with routine health care. The pandemic caused significant disruptions in healthcare provisioning as the movement of people and supply chains were curtailed. However, the pandemic has put digitisation on the map and positioned it as the next frontier [14].

4 A comprehensive portfolio of platforms and services for digital health interventions in a Zimbabwean province

SolidarMed is a private voluntary organisation acting as an implementing partner of the MoHCC in Masvingo Province, Zimbabwe. Digital

health has been part of its focus for development since 2016 [15]. This study focusses on how the MoHCC and SolidarMed brought about the materialisation of some of the digital health potential in day-to-day practice in Masvingo. Through inclusive relationships and participation in MoHCC Technical Working Groups, SolidarMed offered an expert centre for conceptualization, piloting and roll-out of government systems and interventions in rural Zimbabwe. The work resulted in practical digital health interventions in the service of clients, healthcare providers, health system managers, and data services, and governance. Besides developing applications, developments included computer literacy and service trainings and network implementation support for SolidarMed partners and their health institutes in Bikita, Chiredzi, Masvingo and Zaka Districts (see figure 2).

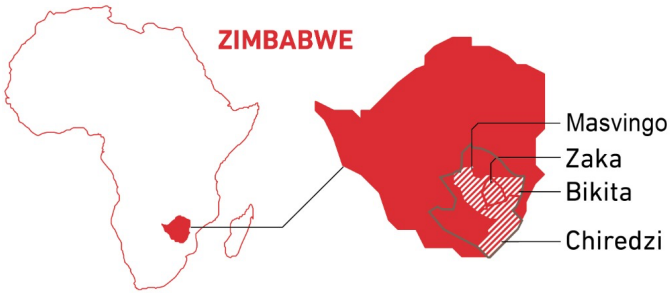

Figure 2, Focus areas for digital health portfolio development

In Zimbabwe, health system strengthening is guided by Zimbabwe's National Health Strategy [16]. The Transnational Framework Digital Health in International Cooperation provides guidance on such developments in international cooperation [17]. The latter depicts a decentered, purposefully ethical and environmentally conscious approach aligned with contextual values and revelation of the needs from within the context. The framework de-centers digital health and framed the development of the digital health portfolio along the axis of

1. **community engagement**, that materialized through engagement with MoHCC [15] and its Technical Working Groups, communities of practice and partners in all districts, participation in key events like provincial and national conferences, and hackathons [18];
2. **workforce enhancement**, that came about through a vibrant, dedicated eHealth team, a local eHealth laboratory in Masvingo, frequent

visits to and from key stakeholders in-country and abroad, involvement of youth and local experts, and the *in-situ* design, programming, and maintenance of both platforms and services, and the local management of digital health experiments and pilots;

3. **thought leadership**, witnessed, for instance, when 250 people onsite and 600 online participated in Masvingo's eHealth day in 2019, and through a steady stream of writings appearing in peer-reviewed publications.
4. **system conciliation**, where the wholesome assembly of platforms and services was structured to align and integrate with MoHCC architectures and facilities.

The development focus caused the establishing of Zimbabwean, sovereign digital platforms [19, 20] in cooperation with communities of people and practice. Much attention was paid to building and sustaining social and technical relationships (see figure 3).

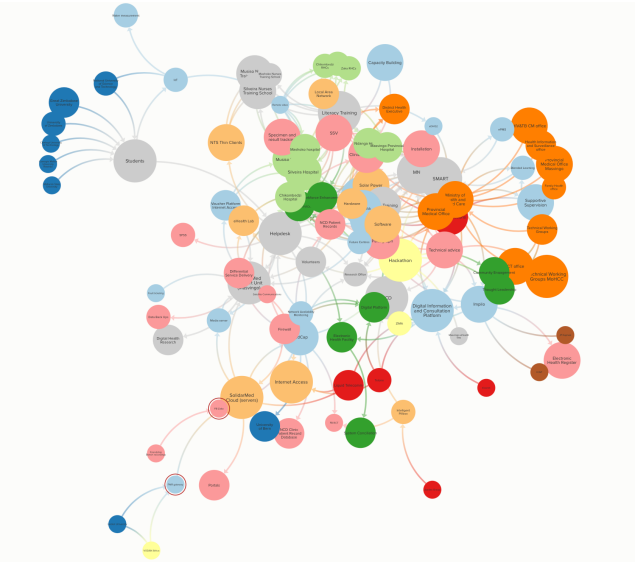

Figure 3, interrelations sustaining cooperative digital health developments (still of the interactive graph available at https://tinyurl.com/digital-health-masvingo)

Following MoHCC's guidance and aligned with the needs and demands from the Masvingo (health) community, from 2016, a comprehensive digital health portfolio proliferated. The requests for interventions

grew, for instance, out of requirements for training, clinical mentoring (in HIV and Mother and Child Health (MCH)), sovereign research data repositories, client messaging aligned with local realities of connectivity and phone use [21], and more. As a result, a portfolio of services and components emerged in the following manner:

Demands	**Digital health services**
Strengthening health system	ePartograph and Electronic Health Register (EHR) services
	Laboratory Information Management service (LIMS)
	Clinical Mentoring HIV/TB and Supportive Supervision MCH services
	iNyasha Client Messaging service
	Digital Fundoscopy Images Device (DFID) service
Capacity building HR4H	IT Literacy training services
	Blended and eLearning services
	Interactive video service
Health Data management	eDHIS decentralization service
	Non-Communicable Diseases (NCD) Clients service
	Geographical information service
	Sensor network services
Health Research support	Friendship bench RedCap service
	Differential Service Delivery RedCap service
	NCD/DFID RedCap service
Institutional support	SolidarMed Helpdesk service
	Media Database service
	Partner support services

Figure 4, Digital Health portfolio components in Masvingo, Zimbabwe

Developments of the technical systems sustaining the digital health interventions were in various stages of development, going from 1) proof-of-concept to proof-of-production, to 2) proof-of-reproduction (a Minimum Viable Product (MVP)) to 3) proof of reproduction.

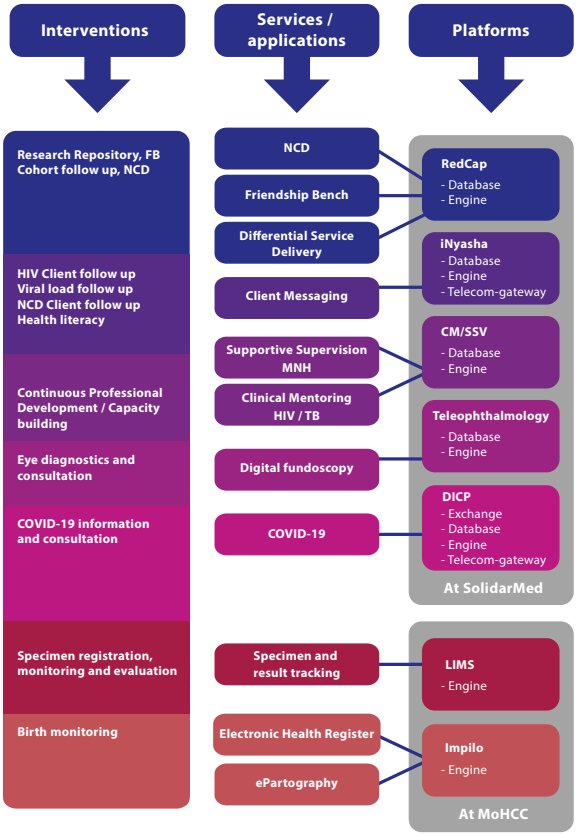

Figure 4, Overview of digital platforms, services, and digital health interventions developed and operational in Masvingo, Zimbabwe.

The alignment of the digital health platforms and services with the needs in health practices is evidenced by their uptake. Hundreds of Health Care Workers (HCW) used the various applications listed in Figure 4 at six hospitals in Masvingo Province (Chikombedzi, Ndanga, Musiso, Mashoko, Silveira, and Masvingo Provincial). In 2021, a third version of the iNyasha client messaging platform supported the response to the Lost to Follow Up of HIV patients. The REDCap platform and research database engine was used for capturing and storing data from various research in Zimbabwean districts within the province. An implementation of MoHCC's Impilo EHR platform supported the introduction of ePartography at Silveira hospital in Bikita District.

Health care workers were trained to use this Impilo service for early detection and management of birth complications.

Beyond the main platforms and services, SolidarMed augmented the portfolio with a digital literacy program. Before those, the nursing program's curriculum did not teach how to use computers to facilitate the work of HCWs. The digital literacy training of student nurses was recognised by MoHCC's policy assessment team as one of the activities to be used as an example for drafting the new curriculums for the HCWs training. Thin client systems were implemented at Nurses Training Schools in three districts.

Through both its conceptual and practical embodied action, SolidarMed was invited to be part of the MoHCC's Technical Working Groups and the national digital health strategy development processes in 2020. All platforms and services were developed for public utilisation and operations by MoHCC. They are in various stages of handover. The platforms and their services are built as containers with code packages on virtual machines, facilitating incorporation in MoHCC's infrastructure.

In 2021, the Zimbabwe government prioritized digital transformation by mainstreaming a national Electronic Health Register (EHR) architecture, aiming for paperless health operations (see figure 5). It assigned the Zimbabwean developed, modular, open-source Impilo EHR national roll-out up to 2023 [22]. A preliminary, donor supplemented, multi-million-dollar budget established Zimbabwe's sovereign, national, enabling, and digital environment for health sector reform and improvement. The Impilo EHR is co-developed by the Zimbabwean Ministries of Health and Ministry of Information and Communication Technologies, Postal, and Courier Services. Community of practice sustain the platform with an aim for paperless, interoperable and integrated client-facing services. It is interoperable with DHIS2, LIMS, and Zimbabwe's ePatient Monitoring System used in HIV care.

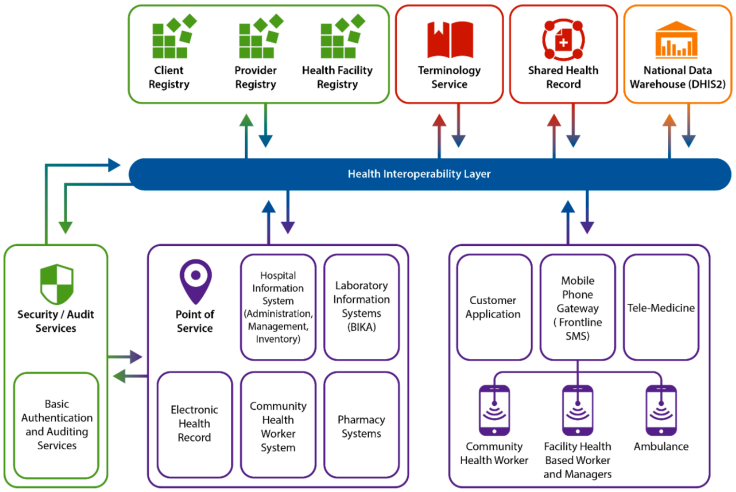

Figure 5, MoHCC's Health Information System architecture [23]

5 Discussion

The developments in Masvingo province align with African values like Unhu/Ubuntu and the involvement of all relation holders [24]. They allowed for sharing ideas at a local and national scale [25], prioritising sharing of lessons learned through constant oral dissemination of experiences when invited and through co-authored publications. All development activities are mindful of the public health imperatives to develop shared, public resources for the public cause, aiming to keep costs down, and submitting to the moral obligation of sharing benefits justly [26] following relatio-economics [27].

MoHCC challenged the Masvingo community to collaborate in national developments, like decentralising a Laboratory Information Management System (LIMS) from the provincial hospital to three district referral hospitals (Musiso, Silveira, and Mashoko). The proof-of-concept and proof-of-production in Masvingo reduced the turnaround time for test results from 21 days to 48 hours in rural settings [28]. This success was helpful for the national MoHCC team to raise funds for the hardware needed to implement the decentralized laboratory information system nationwide.

A Minimum Viable Product of the Digital Information and Consultation Platform (DICP) for COVID-19 triaging and information services became operational late 2020. An initial MoHCC COVID-expert team

of six agents received over hundreds of COVID-19 related calls, inaugurating the first provincial focused COVID-19 related information platform to the population of Masvingo province [29]. This unique Zimbabwean development led to a conceptualization of the Electronic Health Facility [30].

In 2020, the MoHCC started the process of crafting a national digital health strategy. As soon as COVID-19 restrictions allowed, cognisant of the digital health portfolio developments in the province, a three-day stakeholder meeting took place in Masvingo. The meeting was transmitted live over Facebook, where over 1.000 participants attended the proceedings.

Unfortunately, digitisation enhances the risk of the unethical appropriation of data. However, benefits can be gained from lessons learned in worldwide developments of standard approaches, such as influenza preparedness [31]. Sharing ideas and portfolio developments is fruitful to understand digital transformation holistically, to share its benefits, and to engender "a more supportive environment for home-grown digital platforms […] such that home-grown platforms can avoid being locked into the West or China's technology hardware, standards, and cyber governance systems on adverse terms." [32]

6 Conclusions

The process of developing a digital health portfolio positioned in a remote province and rooted in the community proved possible in Masvingo Province, Zimbabwe. The digital health portfolio of operational services is used and impacted communities. The portfolio had a national impact, with MoHCC officials travelling to Masvingo to collaborate and participate in developments catering for digital health interventions. These results are an indication that change can also be enacted from the so-called peripheries.

The services, interventions and platforms that make up the digital health portfolio in Masvingo have sparked ideas in other MoHCC partners. As a result of these developments, the MoHCC, which regulates and implements digital health strategy and activities can refer to Zimbabwean minimum viable products, platforms, and services.

7 Author contributions

Ronald Manhibi: writing; investigation; supervision, project administration. Laura Ruckstuhl: project administration; review, Amadeus Shamu: supervision, Janneke van Dijk: Project administration; supervision; editing, Gertjan van Stam: Conceptualization; investigation; methodology; investigation; writing-original draft & editing.

8 References

1. World Health Organization: WHA58.28 eHealth. eHealth Resolut. to 58th Meet. World Heal. Assem. 121–123 (2004).
2. World Health Organization: Global strategy on digital health, 2020-2024. World Health Organization, Geneva (2020).
3. Mehl, G., Tunçalp, Ö., Ratanaprayul, N., Tamrat, T., Barreix, M., Lowrance, D., Bartolomeos, K., Say, L., Kostanjsek, N., Jakob, R., Grove, J., Mariano Jr, B., Swaminathan, S.: WHO SMART guidelines: optimising country-level use of guideline recommendations in the digital age. Lancet Digit. Heal. (2021).
4. World Health Organization: WHO guideline: Recommendations on digital interventions for health system strengthening. World Health Organization, Geneva (2019).
5. Reid, P.P., Compton, W.D., Grossman, J.H., Fanjiang, G.: Building a better delivery system: A new engineering/health care partnership. National Academies Press, Washington (2005).
6. World Health Organization: Classification of digital health Interventions. World Health Organization, Geneva (2018).
7. Abdullahi, I., Amare, S.Y., Aktau, A., Ayele, W., Basajja, M., Chindoza, K., Flikkenschild, E., Folorunso, S., Ghardallou, M., Graybeal, J., Jati, P.H.P., Kawu, A.A., Lin, Y., Liu, F., Medhanyie, A.A., Mpezamihgo, M., Musen, M.A., Nalugala, R., Oladipo, F., Osigwe, O., Schultes, E., Stocker, J., Stokmans, M., Taye, G.T., van Reisen, M., van Stam, G., Wolstencroft, K., Wirtz, M.: Design of a FAIR digital data health infrastructure in Africa for COVID-19 reporting and research. Adv. Genet. (2021).
8. World Health Organization: Global diffusion of eHealth: making universal health coverage achievable. Report of the third global survey on eHealth. World Health Organization, Geneva (2016).

9. Rahnema, M., Bawtree, V. eds: The post-development reader. Zed Books, London (1997).
10. Ife, J.: Community development: Community-based alternatives in an age of globalisation. Pearson Education, Frenchs Forest (2002).
11. UNICEF: 2020 Health budget brief. UNICEF, Harare (2020).
12. Chawurura, T., Manhibi, R., van Dijk, J.H., van Stam, G.: Stocktaking the digital health infrastructure in Zimbabwe. In: Public Health Conference (ICOPH 2020) (2020).
13. Furusa, S.S., Coleman, A.: Factors influencing e-health implementation by medical doctors in public hospitals in Zimbabwe. South African J. Inf. Manag. 20, 1–9 (2018).
14. Kickbusch, I., Piselli, D., Agrawal, A., Balicer, R., Banner, O., Adelhardt, M., Capobianco, E., Fabian, C., Gill, A.S., Lupton, D., Medhora, R.P., Ndili, N., Rys, A., Sambuli, N., Settle, D., Swaminathan, S., Morales, J.V., Wolpert, M., Wyckoff, A.W., Xue, L.: The Lancet and Financial Times Commission on governing health futures 2030: Growing up in a digital world. Lancet. (2021).
15. Bishi, J., Shamu, A., van Dijk, J.H., van Stam, G.: Community Engagement for eHealth in Masvingo, Zimbabwe. In: 1st International Multi Disciplinary Conference, 23-25 Aug 2017, Lusaka, Zambia (2017).
16. MoHCC: The National Health Strategy for Zimbabwe, 2016-2020. Equity and quality in health: Leaving no one behind. Ministry of Health and Child Care, Government of Republic of Zimbabwe, Harare (2016).
17. Medicus Mundi Switzerland: Digital health in international cooperation: A transnational framework. Medicus Mundi Switzerland, Basel (2020).
18. Hobbins, M., Kavenga, M., Manhibi, R., van Dijk, J.H., van Stam, G.: eHealth: Connecting communities for health, selected cases in Zimbabwe. Med. Mundi Bull. Swiss online J. Int. Coop. Heal. 148, (2018).
19. Mawere, M., van Stam, G.: Data sovereignty, a perspective from Zimbabwe. In: WebSci'20 Companion: 12th ACM Conference on Web Science Proceedings. pp. 13–19 (2020).
20. Mawere, M., van Stam, G.: Digital health, technology, and digital diplomacy: African solutions for African challenges. J.

Sustain. Dev. Africa. 22, 35–45 (2020).
21. van Stam, G.: Access to digital platforms: Can 'mobile'networks coverage reports be relied upon? Observations from Zambia and Zimbabwe. In: Proceedings of the 1st Virtual Conference on Implications of Information and Digital Technologies for Development, 2021. pp. 177–185 (2021).
22. MoHCC: Zimbabwe Electronic Health Records documents: EHR project documents, https://apps.mohcc.gov.zw/mrs-docs/project_documents.html.
23. Ministry of Health and Child Care: Zimbabwe, Electronic Health Record (EHR) Roadmap - 2016. Government of Zimbabwe, Harare (2016).
24. Woermann, M., Engelbrecht, S.: The ubuntu challenge to business: From stakeholders to relationholders. J. Bus. Ethics. 157, 27–44 (2019).
25. Makamba, P., Matewa, C.E.F., van Dijk, J.H., van Stam, G., Vhoko, P.: Participatory video, giving voice and respect to the epistemic sovereignty of communities in rural Zimbabwe. In: Nielsen, P. and Kimaro, H.C. (eds.) Information and Communication Technologies for Development. Strengthening Southern-Driven Cooperation as a Catalyst for ICT4D. ICT4D 2019. IFIP Advances in Information and Communication Technology, vol 552. pp. 110–121. Springer, Cham (2019).
26. Gnebreyesus, T.: WHO Director-General's opening remarks at 148th session of the Executive Board, https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-148th-session-of-the-executive-board.
27. Sheneberger, K., van Stam, G.: Relatio: An examination of the relational dimension of resource allocation. Econ. Financ. Rev. 1, 26–33 (2011).
28. Manhibi, R., Shamu, T., Simbi, R., van Dijk, J.H., van Stam, G.: Rolling out a laboratory information management system and viral load information flow management beyond Masvingo Provincial Hospital in Masvingo Province, Zimbabwe. In: Public Health Conference (ICOPH 2020) (2020).
29. Chawurura, T., Chikomo, S., Manhibi, R., van Dijk, J.H., van Stam, G.: Developing a Digital Information and Consultation Platform in Zimbabwe. In: Africomm 2021 (2021).

30. Chawurura, T., Manhibi, R., van Dijk, J., van Stam, G.: Towards country-level capacity for Electronic Health Facilities. Med. Mundi Bull. Swiss online J. Int. Coop. Heal. (2021).
31. WHO: Pandemic influenza preparedness: Sharing of influenza viruses and access to vaccines and other benefits. In: Sixty-fourth World Health Assembly (2011).
32. Naudé, W.: Late Industrialisation under Platform Capitalism. In: SARChI Industrial Development Working Paper Series, WP 2021-07. SARChI Industrial Development, University of Johannesburg, Johannesburg (2021).