



Title: Digital Health Transformation in Africa: A Systematic Review

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Abstract:

Objectives: It is evident that the Covid-19 pandemic brought many effects worldwide to health systems. An expressive aspect was the acceleration of the use of technology and the digitalization of healthcare and services. This article analyzes the process of digital transformation of health in Africa. **Methods.** A bibliographic search was carried out in the electronic databases of PubMed, these data were treated and then a text analysis was performed with RStudio, evaluating the contents of the titles and abstracts of the articles located. **Results.** 397 articles were found using the search words “Digital Health” and “Africa”, all of which were considered for the first part of the analysis. Most of the articles were written after 2020. **Conclusions.** This systematic review highlights that COVID 19 impacted interests in digital health topics and must be taken into account by health professionals, institutions, and policymakers to ensure that this opportunity is not missed.

Keywords: Africa; Digital Health; Digital Health Transformation, Systematic Review

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Introduction

Digital transformation is “an organizational change that is triggered and shaped by the widespread diffusion of digital technologies” (Hanelt et al., 2021, p. 1160). It is one of the most evident trends in the health sector worldwide. The advancement of innovation in healthcare and health systems, including digitalization, has brought developing countries a new opportunity to address internal inequalities in access to health rights and in epidemiological monitoring and evaluation of programs implemented through public policies. This can be observed in the returns of public investments during the challenge of the COVID-19 pandemic in low and middle-income countries.

For African countries, innovation in health represents a significant milestone in the prevention of epidemics and in providing equal opportunities in access to health. This is particularly crucial given the high concentration of resources and structural inequality, which limit the chances of the poorest populations to have their health rights guaranteed.

Although digital health is receiving more and more attention in Africa, there aren't many thorough and systematic studies that assess the body of research on the transformation of digital health in Africa. Therefore, the objective of our review was to understand how digital health has advanced in Africa, identify the most recurring themes, and seek to understand the trends of transformation to support future public investments in political decisions that prioritize the most vulnerable populations.

Contextualization

Since January 2020, the global population has been grappling with epidemiological, health, and socioeconomic challenges stemming from the emergence of the COVID-19 virus, a crisis with parallels only to the Spanish flu of 1918. In that same month, the World Health Organization (WHO) declared the disease a public health emergency of international concern. By March 2020, COVID-19 was officially characterized by the WHO as a pandemic, at which point it had already exhibited significant transmission rates and a concerning mortality rate relative to other diseases. Despite the passage of a year since the onset of the pandemic, the situation remains dire, with ongoing community transmission.

The development of a vaccine only became a reality towards the end of 2020, and its distribution progressed slowly due to a combination of factors, including structural inequalities in access to healthcare technology. African countries were among the last to receive the vaccine, resulting in many preventable deaths.

"The coronavirus package presents a comprehensive dataset collected by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University. This dataset covers daily new and death cases from January 2020 to March 2023, as well as recovery cases up to August 2022."

As depicted in Table 1, the global COVID-19 pandemic did not uniformly result in massive fatalities across all countries. Notably, among the countries with the highest death tolls from COVID-19 between 2020 and 2023, South Africa emerged as the most affected African nation, with over 100,000 deaths, ranking it as the 18th most affected country by the pandemic.

Table 1.

Position	Country	Total of Deaths
1	US	1123836
2	Brazil	699276
3	India	530779
4	Russia	388478
5	Mexico	333188
6	United Kingdom	220721
7	Peru	219539
8	Italy	188322
9	Germany	168935
18	South Africa	102595

The tabulations are based on "The coronavirus package," which provides a well-organized format for the COVID-19 dataset collected by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University. This dataset encompasses daily new and death cases from January 2020 to March 2023, as well as recovery cases until August 2022.

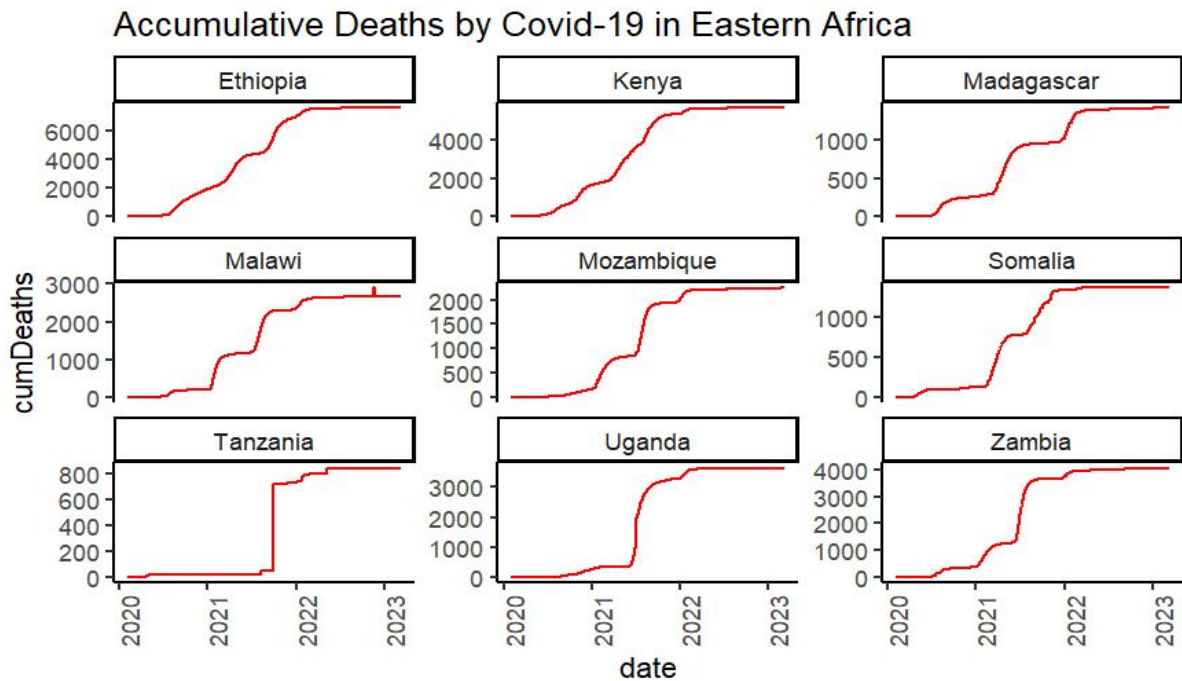
An analysis of mortality trends from COVID-19 can be crucial in understanding where the most acute cases were concentrated. It is important to consider interconnected factors that may contribute to mortality peaks, such as delays in accessing the vaccine or governance issues surrounding preventive measures to restrict mobility, as observed in Brazil. Conversely, the COVID-19 pandemic has magnified structural inequalities and weaknesses in primary and intensive care, highlighting the need for improvements in health infrastructure, public health systems, and economic resilience to global crises and epidemics.

In the figure below, we observe the cumulative number of deaths across Eastern African countries throughout the pandemic. This comparison reveals Ethiopia with the highest level of deaths, exceeding 6 thousand, followed by Zambia and Kenya with 4 thousand deaths, and Uganda and Malawi with over 3 thousand cumulative deaths. The graphics show an abrupt increase in Uganda, Zambia, and Tanzania from the middle of 2021 to the end of the year, contrasting with Ethiopia's slower increase.

According to Odeku (2022), the escalation of deaths in African countries may be attributed to what he termed "Vaccine Apartheid" – the uneven distribution of vaccines leading to an excess of deaths in poor countries. Brazil serves as a Latin American example, facing challenges in vaccine governance. This term underscores the significant inequality and neglect experienced by African countries, leaving their populations largely unprotected due to limited vaccine access. COVID-19 has had profound social and economic impacts on the African continent, with many countries still struggling to recover economically from the post-COVID-19 period. It is imperative to ensure that the African continent has pharmaceutical facilities capable of promptly responding to pandemics using modern technologies, thereby

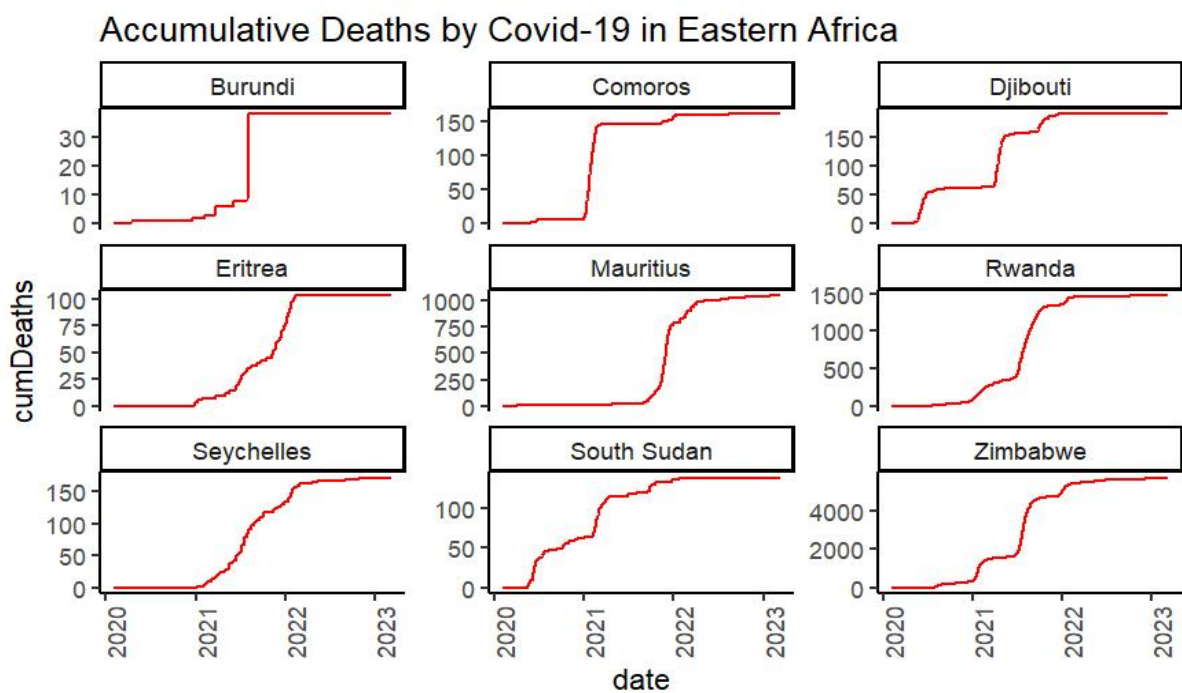
mitigating the risk of new pandemics and adequately preparing for future emergencies on principles of equity.

Figure 1.



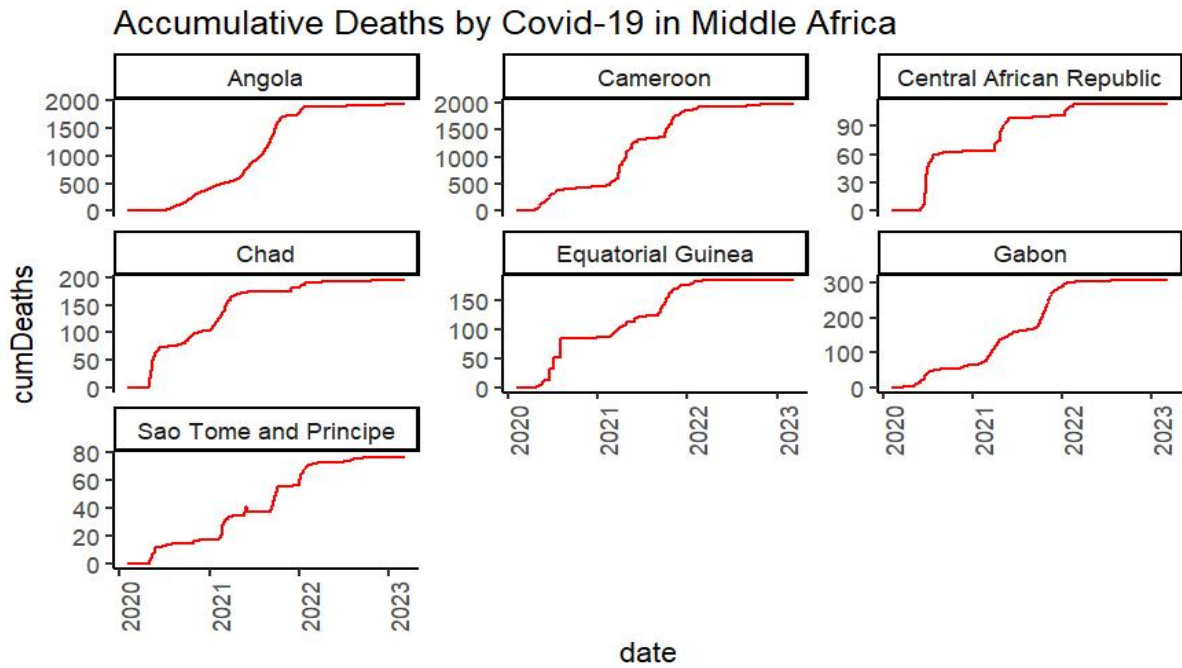
In the figure 2 below, we observe the second set of Eastern African countries and the cumulative number of deaths throughout the years of the pandemic. We can see that Zimbabwe has accumulated 4 thousand deaths across multiple waves.

Figure 2



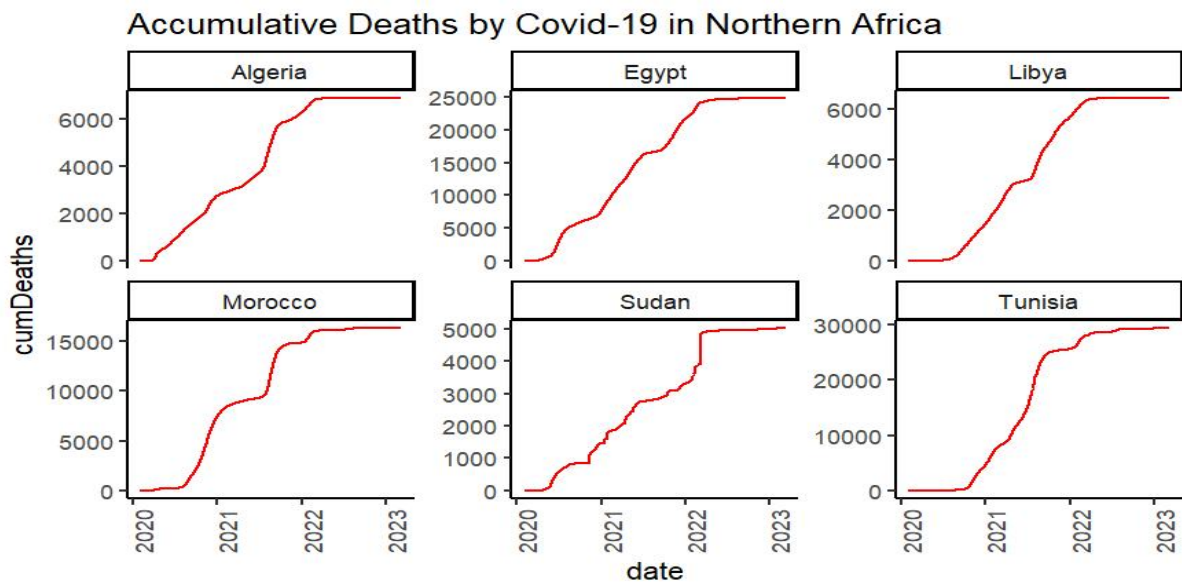
In the figure 3 below, we observe the set of Middle African countries and the cumulative number of deaths throughout the years of the pandemic. Mortality rates were relatively lower in this region, with Angola and Cameroon being the most impacted in terms of deaths, each accumulating around 2 thousand deaths.

Figure 3



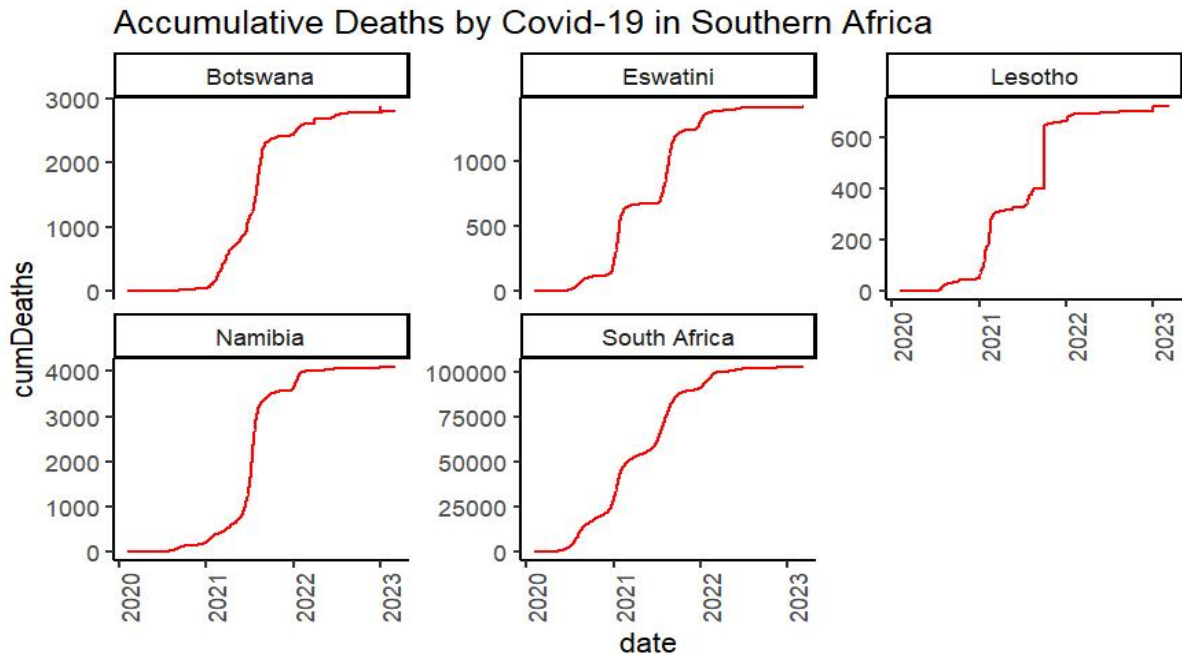
In the figure 4 below, we observe the Northern African countries and the cumulative number of deaths throughout the years of the pandemic. There is a notable high incidence of deaths in this region of Africa. Tunisia has reported over 30,000 deaths, Egypt over 25,000 deaths, and Morocco over 15,000 deaths, making them the most impacted countries.

Figure 4



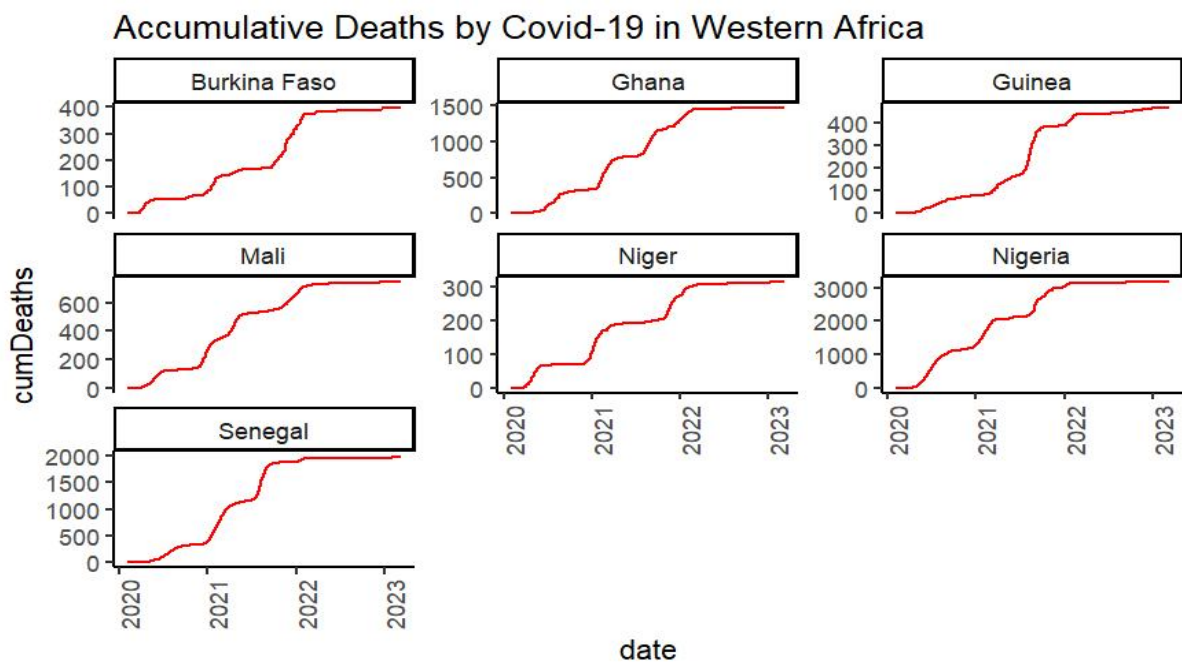
In the figure 5 below, we observe the first set of Southern African countries and the cumulative number of deaths throughout the years of the pandemic. South Africa was the most impacted, with over 100 thousand deaths.

Figure 5



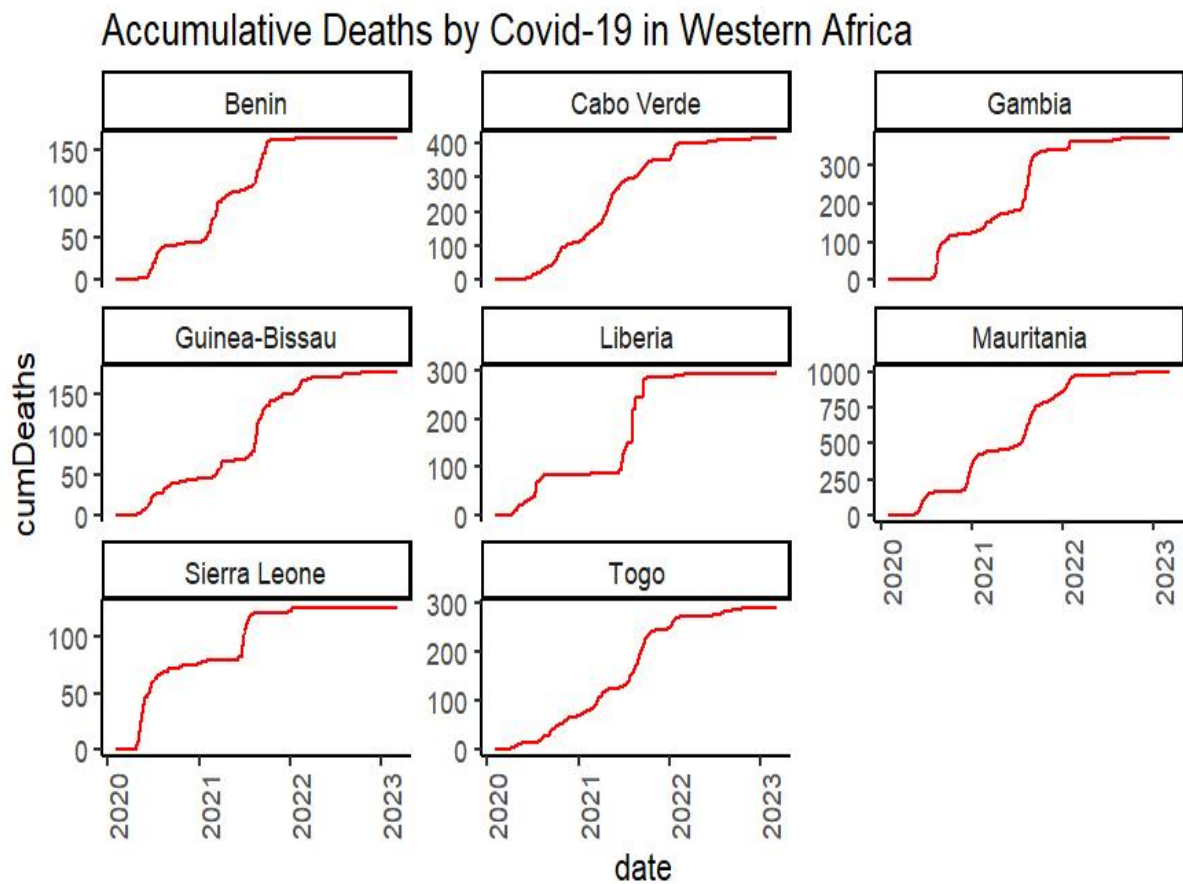
In the figure 6 below, we observe the first set of Western African countries and the cumulative number of deaths throughout the years of the pandemic. Nigeria, Senegal, and Ghana emerge as the most impacted countries in this selection.

Figure 6



In the figure 7 below, we observe the second set of Western African countries and the cumulative number of deaths throughout the years of the pandemic, with Mauritania being the most impacted.

Figure 7



As evidenced by the significant mortality rates observed in some African countries, such as South Africa, COVID-19 has had devastating effects. Conversely, the pandemic has also accelerated various processes, particularly in the realms of technology and healthcare.

According to Getachew et al. (2023), COVID-19 has served as a catalyst for the emergence and adoption of digital health innovations (DHIs). These technologies have played a crucial role in maintaining healthcare services during periods of social distancing measures. Telemedicine, for instance, has facilitated the continuous delivery of healthcare services, ensuring the safety of both patients and healthcare providers. With hospitals closed during lockdowns, the public has turned to alternative digital health solutions, such as smartphones, to connect with clinicians and receive routine care. Furthermore, the utilization of digital health tools for COVID-19 screening has not only reduced visits to emergency departments but also enhanced the overall organization of healthcare systems. Mobile health (m-Health), telemedicine, e-Health, and various other digital health applications have become increasingly prominent during lockdowns, demonstrating their potential for diagnosis, clinical care, and patient follow-up, extending beyond serving marginalized communities.

Objectives: The Covid-19 pandemic has brought about numerous effects worldwide, prompting health systems to quickly and efficiently reformulate their approaches to combat the disease's mortality. A significant factor contributing to the success of health interventions has been the accelerated adoption of information technology, digital healthcare, and e-services. This article aims to explore the emerging issues stemming from specialized health research over the past 25 years, particularly within the African context.

Methods: We conducted a computational review by searching electronic databases such as PubMed, spanning from the year 2000 to 2024. The collected data underwent processing, followed by text analysis using RStudio. This analysis evaluated the contents of the titles and abstracts of the located articles.

Results and discussion

During our research on PubMed using the keywords "Digital Health" and "Africa," we identified 397 articles. All of these papers were included in the initial analysis phase. It's noteworthy that a majority of these articles were published after 2020, providing further evidence to support the hypothesis that the pandemic has expedited digital transformation efforts within African countries. The description of the search is outlined in Table 2 below.

It was evident that "Healthcare" and "COVID-19" emerged as the most prominent keywords in the paper's selection. Another significant theme was telemedicine, which is increasingly prominent in discussions about technology's role in the healthcare sector. The breakdown of traditional healthcare systems during the pandemic highlighted telemedicine platforms as a viable alternative. Drawing from these experiences, implementing telemedicine as a means to receive clinical recommendations from remotely located medical experts and continue treatments, even in remote or isolated areas, is considered a best practice. The description of the search is outlined in Table 2 below.

Table 2

Descriptive table of the corpus located using the keywords in title: Digital health and Africa, main aspects sought.		
Key word	N	Percent
M-Health	18	4,53
HealthCare	126	31,74
Covid-19	37	9,32
Electronic health records	16	4,03
Telemedicine	21	5,29
Artificial intelligence	12	3,02
Total	397	100

The African countries most frequently referenced in the papers were South Africa, Kenya, Uganda, and Ethiopia. Additionally, there were comparative studies conducted with Asian countries, as well as intra-African comparisons and sub-regional studies, particularly focusing on Eastern Africa. These findings are summarized in Table 3.

Table 3

Descriptive table of the corpus located using the keywords in title: Digital health and Africa, main aspects sought.		
Key word	N	%
Africa	32	8,06
<i>Countries mentioned</i>		
Africa and India	1	0,25
Africa, Asia and the Americas	1	0,25
Bangladesh, South Africa, and Tanzania	1	0,25
Botswana	1	0,25
Burkina Faso	1	0,25
Burundi	1	0,25
Cambodia	1	0,25
East Africa	1	0,25
Ethiopia	4	1,01
Ghana	1	0,25
Ghana, Kenya and Vietnam	1	0,25
India	2	0,50
Indonesia	1	0,25
Jordan	1	0,25
Kenya	14	3,53
Kenya and Rwanda	1	0,25
Kenya and south Africa	1	0,25
Kingandu	1	0,25
Lesotho	1	0,25
Low- and Middle-Income Country	4	1,01
Madagascar	2	0,50
Malawi	3	0,76
Mali and Cameroon	1	0,25
Marrocos	1	0,25
Middle East and North Africa (MENA) region	2	0,50
Nigeria	4	1,01

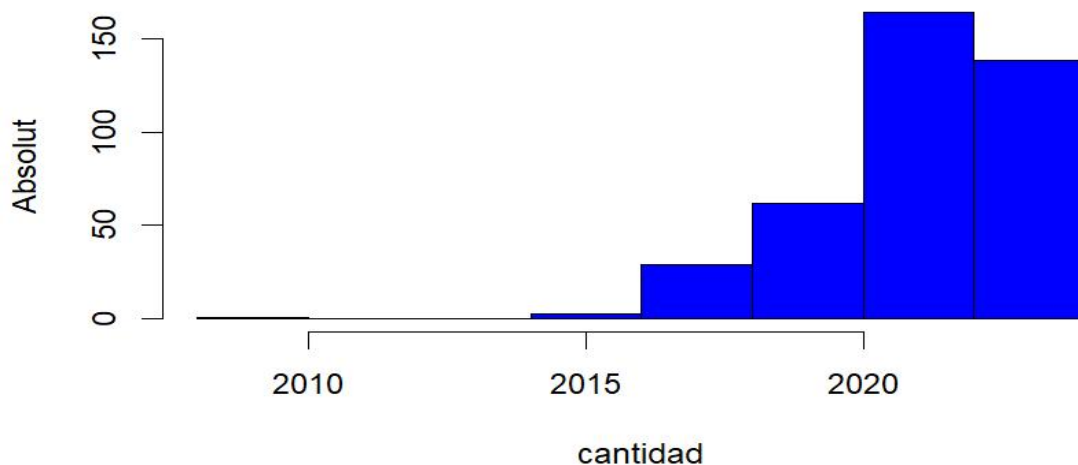
Nigeria and Uganda	1	0,25
Nigeria, Uganda and Zimbabwe	2	0,50
Rwanda	2	0,50
South Africa	30	7,56
Sub-Saharan Africa	17	4,28
Sudan	1	0,25
Tanzania	2	0,50
Uganda	10	2,52
West Africa	1	0,25
Zanzibar	1	0,25
Zimbabwe and Malawi	1	0,25
Total	397	100

Subsequently, we conducted a natural language processing (NLP) analysis using RStudio to examine the frequency of publication years, identify the most recurrent words in the titles, and gain deeper insights into the positive and negative sentiments expressed in the papers through sentiment analysis.

The majority of articles on digital health and Africa were written from 2020 onwards, underscoring the thesis that the COVID-19 pandemic has significantly increased visibility for this topic.

Figure 8

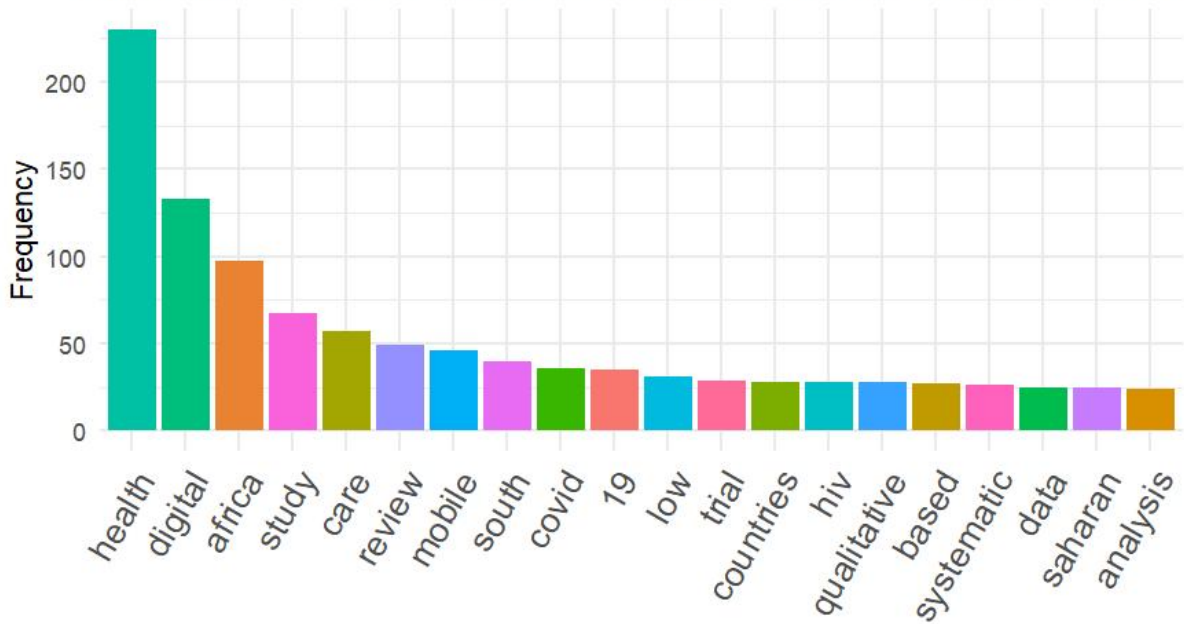
Papers on Digital Health in Africa by year, PubMed



The studies focus on healthcare, mobile phones, and COVID-19.

Figure 9

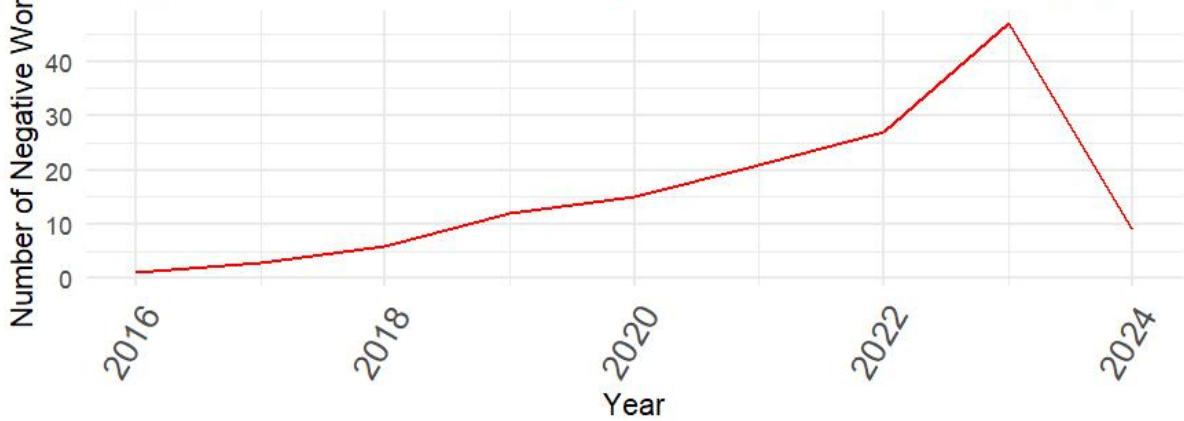
Most Frequent Words search: Digital Health in Africa



It was observed that negative sentiments regarding the topic have tended to decrease in recent years.

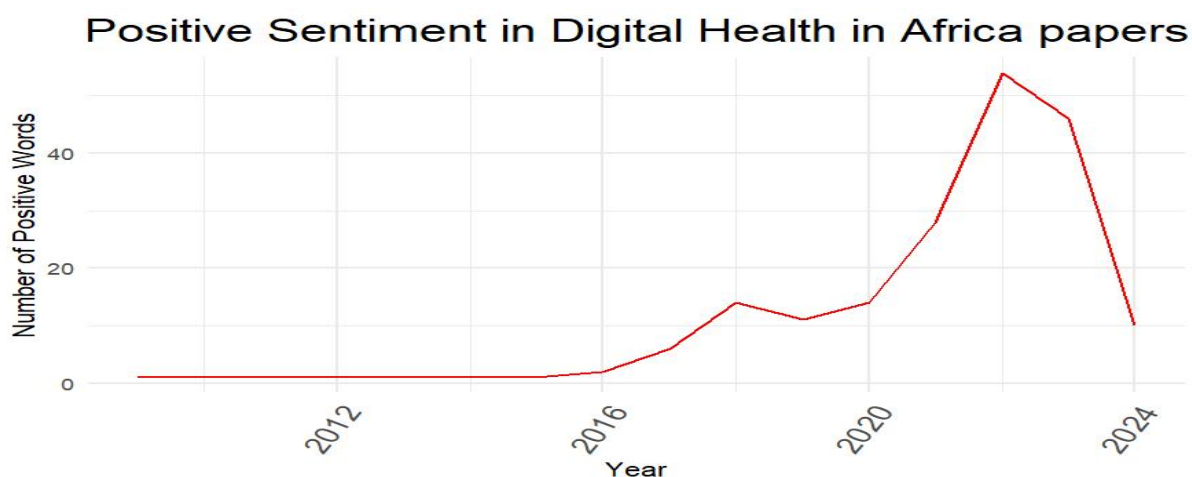
Figure 10

Negative Sentiment in Digital Health in Africa papers



And positive sentiments have shown a consistent increase year by year, indicating a growing acceptance of the importance of the topic.

Figure 11



Conclusions

The current status of Africa's digital health transformation is assessed in this systematic review. This research hopes to add to the current conversation on the transformation of digital health in Africa and provide guidance for developing plans to fully utilize digital technology to enhance healthcare delivery and outcomes throughout the continent. This review underscores the impact of COVID-19 on the interest in digital health topics and emphasizes the importance of health professionals, institutions, and policymakers recognizing and seizing this opportunity. As we navigate the complexities of modern healthcare, embracing digital transformation is crucial.

Acknowledgement

We are truly grateful to SICSS-Howard/Mathematica Summer Institute in Computational Social Science (2023) for providing us a support and summer school boot camp as an Alumni of 2023.

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