THE INTERSECTION OF
HEALTH EQUITY x
CLOUD TECHNOLOGY:
A LANDSCAPE ANALYSIS

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Contents

Executive Summary

Today, the World Bank estimates that more than 700 million people globally live in extreme poverty, with global challenges such as slow economic growth, fragility and conflict, and climate change contributing to this inequality.[1] Eighty percent of health and quality-of-life outcomes are driven by nonmedical factors such as income, health care access, community support, and physical environment, known as the social drivers of health.[2]

Cloud technology can drive social impact to reach under- and unserved populations on a one-to-many scale, creating an unprecedented opportunity at the intersection of health equity and cloud technology. Organizations across sectors can and should come together to embrace the growing opportunities of scalable cloud-enabled solutions in driving improved health and social outcomes. Investing in this intersection can enable communities to identify their most pressing health and social needs through more accessible data and analytics, to reveal and share insights more widely across communities through interoperable data and systems, and to accelerate the deployment of targeted solutions to where they are needed most, ultimately supporting the world's under- and unserved communities.

The Health Equity x Cloud Technology Landscape Analysis was commissioned by the AWS Social Responsibility and Impact (SRI) Health Equity team to serve as an initial look into the current state, gaps and future state opportunities for how the world's most pressing health equity priorities can be addressed at speed and scale through cloud-enabled solutions. The Landscape Analysis stems from the AWS SRI Health Equity vision that technology can play a role in providing everyone everywhere access to the resources they need to be healthy.

The Landscape Analysis that follows examines prominent health equity needs, cloud readiness, and related investments in specific regions of the world. It creates the foundation for further study. The Landscape Analysis is intended to ignite cross-sector dialogue, commitment, investment, and action at the intersection of Health Equity x Cloud Technology. The study of six countries in two regions – Latin America and Sub-Saharan Africa – and perspectives from global health equity innovators and cross-sector leaders highlights use cases at the intersection today, identifies gaps, and proposes future opportunities for the intersection of Health Equity x Cloud Technology. The regions and countries were selected based on defined health disparities with evidence of growing cloud adoption; indicating that cloud technology can be one way to address health equity needs in these geographical areas.

Now is the time to act at this intersection.

"Technology holds the transformative power to bridge health disparities and advance health equity globally, creating a future where everyone has the opportunity to achieve their highest level of health."
- AWS GLOBAL HEALTH LEADER

Public and private sector efforts at the intersection of Health Equity x Cloud Technology captured from around the world signal that this future opportunity may be realized. However, gaps remain.

Gaps exist in available health and social data, cloud and supporting infrastructure, financial sustainability of cloud, purpose-built cloud services developed to address health equity, and global collaboration. These gaps challenge cloud's adoption and use to address health equity in the parts of the world where health equity solutions are needed, such as (but not limited to) Sub-Saharan Africa and Latin America. Representative use cases show that solutions at the intersection of Health Equity x Cloud Technology are emerging. This set of use cases can be expanded further to optimize existing efforts to help address health equity and elevate new innovations through the power of cloud technology.

Doing so may require:

- Addressing challenges to cloud adoption in regions of the world where there are apparent health and social needs through policy, improved cloud infrastructure, and technical education

- Sharing of social drivers of health data and cloud-enabled health equity solutions so that health equity data can be collected, stored, and disseminated

- More intentional collaboration between health equity and technology leaders to implement solutions that address health equity needs with scaled impact in mind, e.g., cross-sector collaborations such as the World Economic Forum's Zero Health Gaps Pledge and continued investment in programs such as the AWS Health Equity Initiative

The Health Equity x Cloud Technology Landscape Analysis is a preliminary exploration into this intersection, highlighting the instrumental role public sector organizations and private sector businesses can play. The report asks builders to develop cloud solutions with health and social data interoperability at the core, shows that public and private sectors can collaboratively address community and system-level health gaps with coordinated investment in the technology infrastructure required to accelerate these efforts, and asks private sector investors and key players to align on a set of outcomes-based metrics that demonstrate true impact over time.

A global commitment is critical to help realize the full opportunity of the intersection of Health Equity x Cloud Technology. Global health equity can be realized at a greater speed and scale through the power of cloud technology. And cloud technology could expand its impact potential by intentionally addressing the world's most pressing health equity needs.

"Cloud computing services will be absolutely essential to reducing the digital health divide."
- Raxa Health

Introduction

"We were able to assemble a large diverse international database of over 10 million representative electrocardiograms (ECGs) from every populated continent. We also launched an international competition to enhance the database through novel AI methods to digitize paper ECGs from underrepresented African sources."
- Emory University Department of Biomedical Informatics

2024 has brought a growing global awareness and amplification of health equity commitments by players across the public and private sectors. The World Health Organization, African Development Bank, European Investment Bank, and Islamic Development Bank announced an investment of €1.5B to launch a new Health Impact Investment Platform in June 2023 to strengthen primary health care systems in low- and lower-middle income countries around the world.[3] AWS committed an additional $20M to the AWS Health Equity Initiative, an initial $40M commitment to help its customers harness the power of cloud technology to advance health equity globally.[4] By January 2024, the World Economic Forum's Global Health Equity Network had convened 100 companies and organizations to sign the Zero Health Gaps Pledge as a commitment to further action and collaboration.[5] Efforts such as these can equip researchers, innovators, and communities with the necessary resources and technology to advance global health equity and address the persistent and widening gaps of health and wellbeing around the world.

Cloud-based technologies, and artificial intelligence (AI) in particular, are poised to revolutionize health care and accelerate transformation across industries, and countries around the world are getting involved.[6,7] Investment in digital acceleration is a priority for many countries and is fueling projections of double-digit growth rates for cloud technology in new pockets of the world.[8]

Against the backdrop of such technological innovation, the concept of "techquity" has emerged as an imperative.[9] Techquity, or the intentional design, development, and deployment of technology, serves as inspiration for the Health Equity x Cloud Technology intersection.[10] As cloud adoption and capabilities expand around the world, cloud technology can play a role in advancing global health equity.

The Health Equity x Cloud Technology Landscape Analysis is rooted in the belief that health and social gaps can be closed through wider adoption of cloud technology and deploying purpose-built, cloud-enabled solutions with health equity in mind. The Landscape Analysis was commissioned by AWS and conducted and produced by Deloitte with intention to gain a deeper understanding of where this intersection has the greatest opportunity to close health and social gaps. It will be important to conduct further research at this intersection.

The initial study of two regions, Latin America and Sub-Saharan Africa, and additional perspectives from global innovators and technology leaders currently working at this intersection yielded a set of preliminary gaps and actions to realize the future opportunities at the intersection of Health Equity x Cloud Technology.

The Health Equity X Cloud Technology Landscape Analysis embodies three main objectives:

1. **Explore:** Develop an initial framework to explore, in a window of the world, the current state of the intersection of Health Equity x Cloud Technology and identify where gaps exist

2. **Envision:** Springboard from current state gaps to envision future opportunities at the intersection of Health Equity x Cloud Technology with a preliminary set of prioritized cloud solutions

3. **Catalyze:** Encourage action and focused study to collect more data, highlight further use cases, and drive progress forward to enable communities to own and sustain solutions at the intersection of Health Equity x Cloud Technology

The Health Equity x Cloud Technology Landscape Analysis is a jumping off point for further study on how cloud technology can advance health equity across all social drivers of health. Global coordination is paramount across health, social services, government, technology and beyond.

It is imperative that all efforts at this intersection are driven by collective voices of the organizations, communities, and individuals globally so that sustainable, scalable, measurable solutions stem from place-based change.[11]

We welcome you to act and realize opportunities at the intersection of **Health Equity x Cloud Technology**

Approach

The approach for the Health Equity x Cloud Technology Landscape Analysis is rooted in working backward from customers' needs – delivering targeted, scaled solutions to address the world's most pressing health equity needs.

THEORY OF CHANGE

IF…

global health disparities are clearly defined and elevated to cross-sector players, and countries can advance their cloud readiness…

THEN…

researchers, innovators, community builders, and customers can implement cloud solutions to accelerate the speed and scale of health equity efforts

SO THAT…

under- and unserved communities and individuals around the globe can achieve optimal health and wellbeing

Research exploring the current state and future opportunity of this theory of change was guided by a set of questions focusing on health equity, cloud technology, and the current efforts and opportunities at the intersection of these two spheres. This set of questions establishes an initial framework for exploring the Health Equity x Cloud Technology intersection to any country or region of the world, building from this Landscape Analysis.

HEALTH EQUITY x CLOUD TECHNOLOGY INTERSECTION GUIDING QUESTIONS

HEALTH EQUITY

What are the prominent health equity needs and examples of investments and players driving health equity efforts?

CLOUD TECHNOLOGY

What is the current state of cloud technology readiness and examples of investments and players driving innovation?
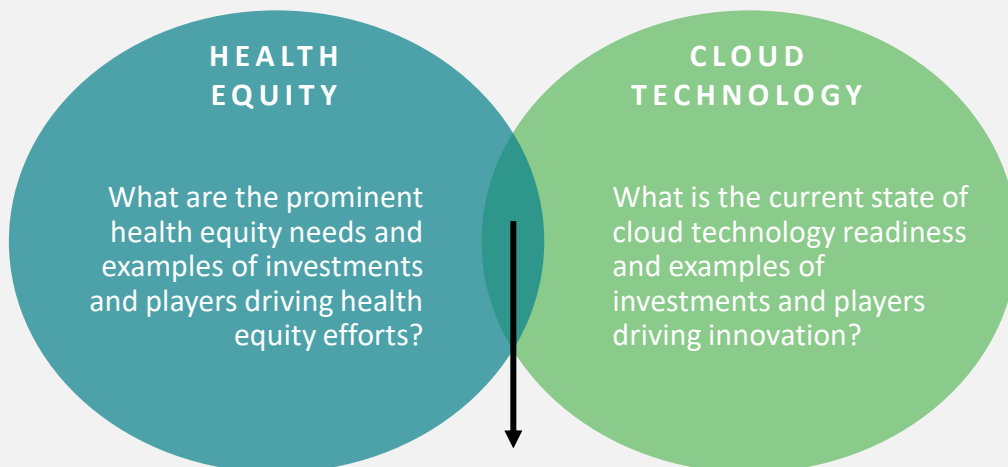
What are the current efforts and gaps for addressing health equity with cloud technology solutions?

The Landscape Analysis is framed as seven components informed by the data and insights across the spheres of health equity, cloud technology and examples at the intersection:

HEALTH EQUITY

- Health Equity Need: Statistics are representative measures of disparities aligned to the five social drivers of health – Health Care Access & Quality, Social & Community Context, Neighborhood & Built Environment, Education Access & Quality, Economic Stability[12]

- Health Equity Investments: Examples of current public, private, and philanthropic investments advancing health equity

- Health Equity Players: Examples of investors and other organizations across the public and private sector who have publicly driven efforts to advance health equity

CLOUD TECHNOLOGY

- Cloud Readiness: National policies, infrastructure, and current challenges impacting cloud adoption

- Cloud Investments: Examples of cloud technology investments across industries

- Cloud Players: Examples of cloud providers with a notable presence in the region

HEALTH EQUITY X CLOUD TECHNOLOGY

- Use Cases: Publicly disclosed examples of efforts to leverage cloud technology solutions to advance health equity

COMPONENTS OF HEALTH EQUITY x CLOUD TECHNOLOGY LANDSCAPE ANALYSIS

Health Equity Need	Cloud Technology Readiness
Health Equity Investments	Cloud Technology Investments
Health Equity Players	Cloud Technology Players
Health Equity x Cloud Technology Use Cases	

HEALTH EQUITY x CLOUD TECHNOLOGY INPUTS & INSIGHTS

Scan of Latin America & Sub-Saharan Africa Countries

Scan of Global Innovators

Cross-Sector Leader Perspectives

CURRENT STATE GAPS

FUTURE STATE SOLUTIONS

SHARED CALL TO ACTION
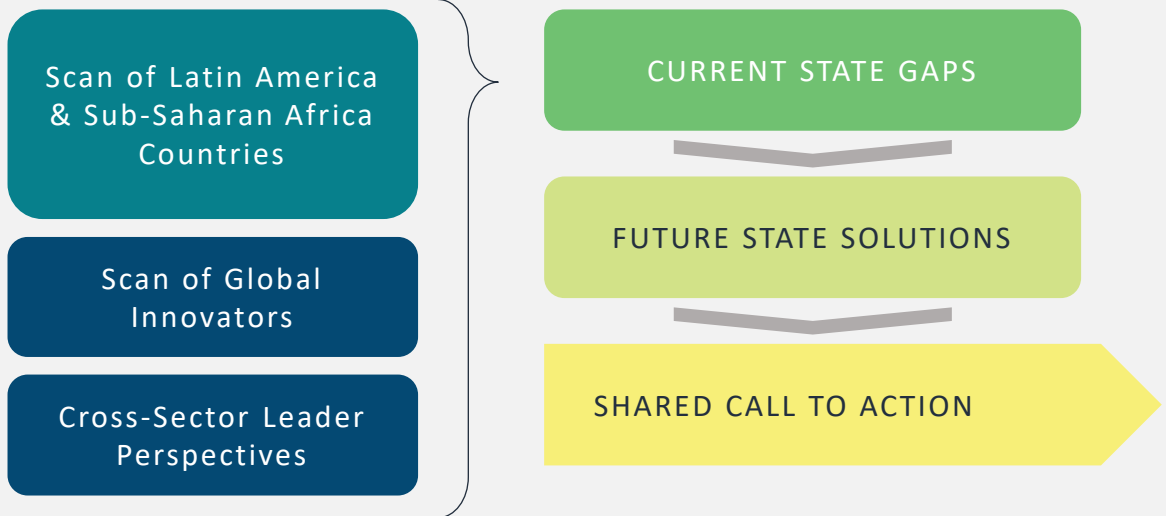
The Landscape Analysis includes regional and country-level insights from a rapid, high-level review of publicly available resources that collectively create a snapshot view of health equity, cloud technology, and use cases for Latin America and Sub-Saharan Africa with incorporated perspectives of global innovators and cross-sector leaders currently working at the intersection of Health Equity x Cloud Technology. The global innovators represent a set of AWS customers, using cloud technology, provided in part through AWS promotional credits, to design, implement and scale cloud-enabled health equity solutions in one or multiple regions in the world. Both the innovators and leaders shared their current efforts to address health equity through cloud technology and the future opportunities to increase the speed and scale of these efforts through the collaboration of cross-sector organizations.

Insights from these scans and perspectives were synthesized into a preliminary set of gaps at the intersection of Health Equity x Cloud Technology. These gaps inspired a vision for the future of this intersection and outlined recommendations to help realize new opportunities.

This initial Landscape Analysis focused on two regions: Latin America and Sub-Saharan Africa, to explore the opportunities at the intersection of Health Equity x Cloud Technology. Regional analysis focused on three countries within each – Mexico, Chile, and Brazil in Latin America and South Africa, Kenya, and Nigeria in Sub-Saharan Africa. To more concretely explore where cloud technology can help address health equity, regions and countries where there is a high degree of health equity need and growing cloud adoption were selected as a starting point.

The regional and country-level scan commissioned the AWS and conducted by Deloitte consisted of publicly available data, publications, news, discourse, and conversations with local specialists on apparent health equity needs and current state of cloud technology in a region or country. Recognizing that health equity is a broad topic that holds different meanings and interpretations to different groups around the world, this Landscape Analysis prioritized a set of comparable metrics and data-backed examples of disparities across the social drivers of health. And, recognizing cloud technology is a complex and rapidly evolving industry, this Landscape Analysis describes cloud technology and capabilities in a way that is intended to be inclusive to technical and non-technical audiences.
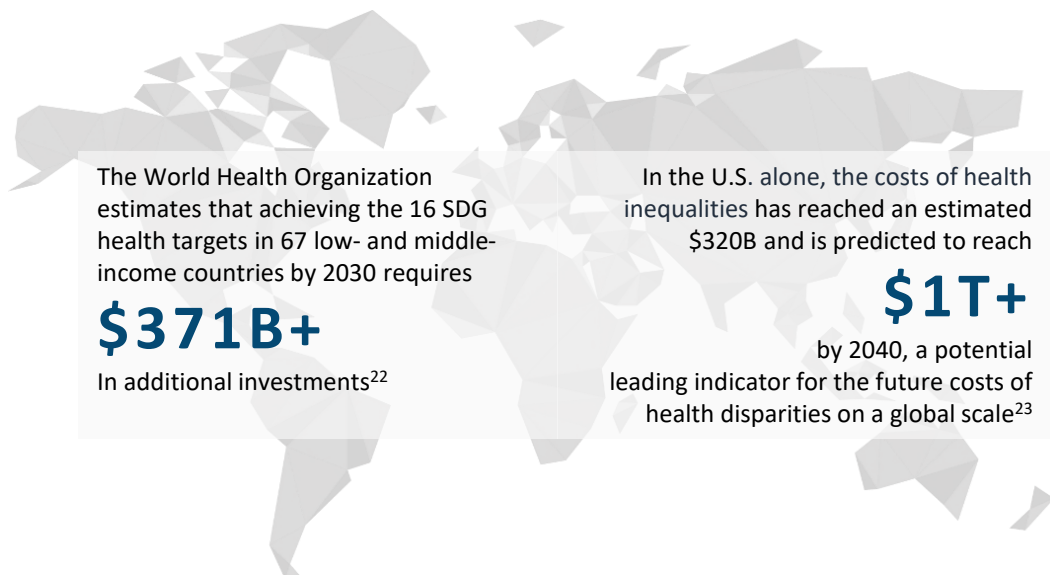
The Emergent Intersection of Health Equity x Cloud Technology

80%

of health and wellbeing outcomes are driven by the social drivers of health[21]

Health equity is achieved when every individual in any community around the world has the opportunity and access to attain optimal health and quality of life outcomes regardless of social position, circumstances, or place of origin.[13] Health disparities, or preventable differences in the burden of disease or quality of life experienced in different populations around the world today, are compounded by significant social challenges including but not limited to racism, and ethnic-based discrimination and bias stemming from complex social and historical circumstances of a unique country of community.[14] Health disparities are exacerbated by lack of access to quality care, health coverage, pharmaceuticals, medical devices, and therapeutics.[15] And health disparities are further influenced by a set of non-medical factors including economic stability, education access, physical environment and social and community context – collectively known as the social drivers of health.[16]

Health disparities are clear and pressing around the world; however, this challenge is acute in southern regions of the world where the mounting crisis of climate change and the migration of people due to environmental and social crises are putting immense pressure on already fragile health and social infrastructure.[17,18] Despite progress toward the United Nations' Sustainable Development Goals (SDG) there are significant and widening disparities in health and wellbeing in regions such as Latin America, the Middle East and North Africa, and Sub-Saharan Africa today.[19]

The World Health Organization estimates that achieving the 16 SDG health targets in 67 low- and middle-income countries by 2030 requires

$371B+

In additional investments[22]

In the U.S. alone, the costs of health inequalities has reached an estimated $320B and is predicted to reach

$1T+

by 2040, a potential leading indicator for the future costs of health disparities on a global scale[23]

There is no "quick fix" to addressing the global magnitude of health disparities. Addressing these disparities will likely need global collaboration among a broad set of industries and organizations, each who has a stake in minimizing the disparities for their workforce, customers, beneficiaries, or communities.[24] Cloud technology can play a role in the larger equation.

In the COVID-19 pandemic, the world saw first-hand how pronounced health disparities are and how cloud technology could begin to overcome obstacles to bring health and social services directly to individuals.[25,26] Since then, a growing conversation has emerged around technology's progress and opportunity to advance health.[27] Despite this growing conversation, progress in this space is uneven. Gaps in data can lead to bias and gaps in cloud access can lead to technological stratification, furthering health and social disparities.[28, 29] There is more to do to harness the cloud technology to better scale access to essential services to geographically, culturally and technologically hard-to-reach communities around the world.

Cloud providers can serve as a catalyst for advancing health equity, providing their customers with opportunities to better serve their communities by providing scaled access to the cloud, supporting the design and development of equitable tech solutions, and enabling data-driven decisions through the power of cloud capabilities.

CLOUD TECH ENABLES CUSTOMERS… → …TO **SCALE SOLUTIONS** TO SYSTEMS & COMMUNITIES

Start-Ups   Health Providers   NGOs

Enterprises   Government

CLOUD PROVIDERS   **CLOUD-ENABLED CUSTOMERS**   **END USERS & COMMUNITIES**
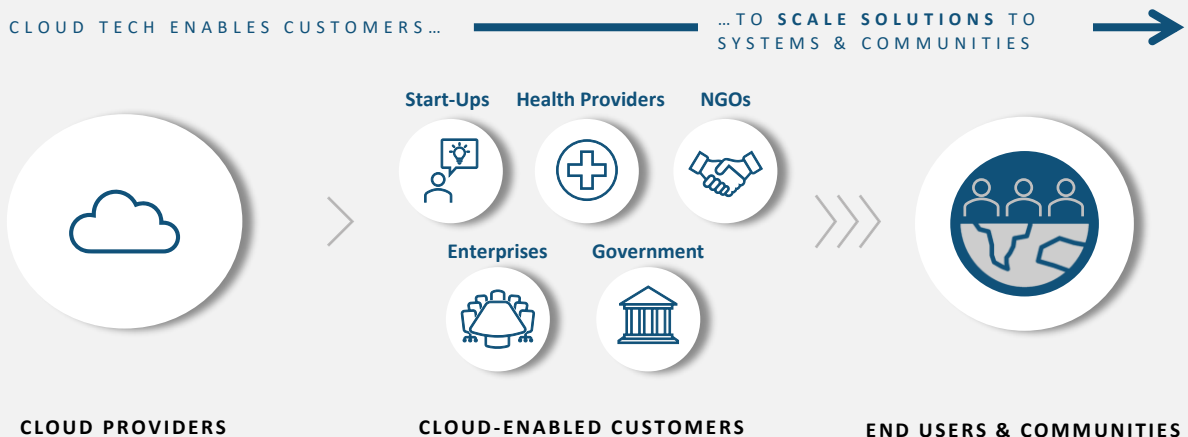
The learnings that follow is a window into where and how cloud technology can continue to advance greater health and social outcomes, specifically in Latin America and Sub-Saharan Africa.
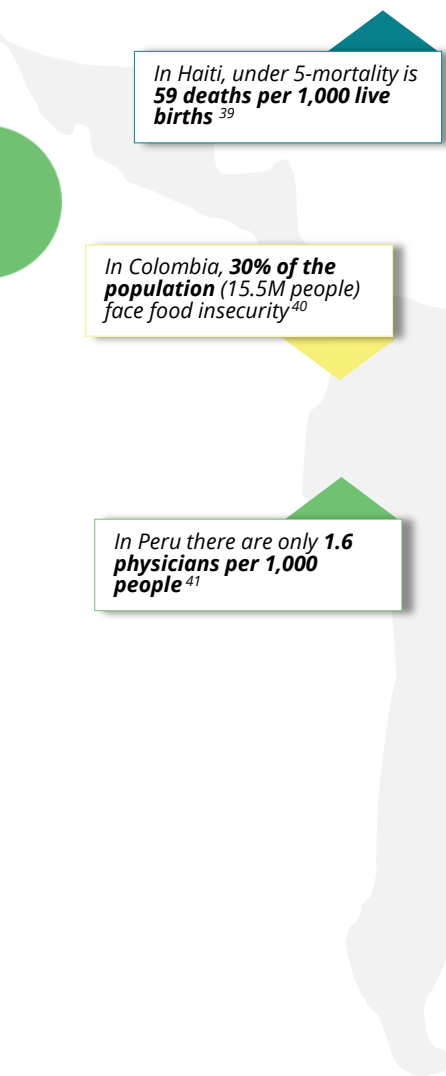
A First Look into the Intersection of Health Equity x Cloud Technology: Latin America

A SNAPSHOT INTO THE **HEALTH EQUITY NEED** IN LATIN AMERICA

Roughly 50 million indigenous people live in Latin American countries, representing over 500 different ethnic groups with collective ancestral ties to the lands where they live and which make up one of the most socially under- and unserved populations in the world.[30] In Brazil, Mexico, and Chile, differences in life expectancy for indigenous groups relative to the overall population can be substantial – in some instances 20 years less and often tied to poverty and other social drivers.[31]

Latin America also holds some of the highest levels of income inequality in the world.[32] Reliance on informal job markets has led to a large unbanked population and limited ability to afford essential goods, including food.[33] The challenges to meet basic diet and health needs has led to a duality of challenges, both with high rates of malnutrition and growing rates of obesity across the region.[34] In addition, health and social opportunities related to the drivers of health are unevenly distributed in Latin America by location and gender.[35] Lack of information about health care and access to care itself remains challenging in remote regions such as Chile's remote deserts due to the centralization of health care services in urban areas and the shortage of physicians.[36]

The social challenges experienced in Latin America have been exacerbated by the effects of climate change. More than 1.6 million new climate disaster displacements were recorded in Latin America in 2021, disproportionately impacting rural populations and women.[37] In the Brazilian Amazon, record-level forest fires, changes in rainfall patterns and rising temperature have led to unprecedented migration for the inhabitants there, especially for indigenous people, riverside dwellers, and other traditional communities and with acute effects on women and children.[38]

*In Haiti, under 5-mortality is **59 deaths per 1,000 live births** [39]*

*In Colombia, **30% of the population** (15.5M people) face food insecurity [40]*

*In Peru there are only **1.6 physicians per 1,000 people** [41]*

REPRESENTATIVE **HEALTH EQUITY NEED**

MEXICO

Rural areas in Mexico have **higher mortality and morbidity levels** than urban areas; regions with large indigenous populations, such as Chiapas, Oaxaca, and portions of Guerrero, have especially high death rates[42]

Indigenous women living in municipalities are comparatively poorer, less educated and **excluded from maternal health interventions** including contraceptives, qualified antenatal care, skilled birth attendance, and mammography compared to non-Indigenous women living in those cities[43]

Roughly **one third of the Mexican population is obese, the 2nd highest prevalence of obesity in the world**. Similarly, Mexico suffers from the highest prevalence globally of childhood obesity and high rates of childhood diabetes[44]

More than 10% of the Mexican population lacks access to adequate food and between 25% and 35% in Mexico's most underserved states. The problem is exacerbated by chronic child malnutrition and obesity in children and adolescents[45,46]

20% of Mexicans report being the victim of a crime and 80% of Mexicans consider their state "unsafe"; exposure to violence is associated with low birth weight, worse mental health outcomes[47]

BRAZIL

Brazil's public health system (SUS) offers coverage for the whole population, however **over 50% of care spend is concentrated in private health care**, to which **only 23% of the population can access**[48]

Studies across 15 years of data in Brazil suggest a persistent relationship between education and health outcomes; **poor self-rated health was higher among those with lower educational levels** in every year examined[49]

Despite rates of moderate to severe food insecurity dropping to as low as 7.8% in 2013, the most recent surveys identified that **20.5% of the Brazilian population experiences moderate or severe food insecurity today**[50]

The World Health Organization has set a limit for average outdoor ambient air pollution of 10 micrograms of PM2.5 per cubic meter of air. However, about **40% of the Brazilian population is estimated to breathe air which is more polluted than the WHO guidelines**[51]

Life expectancy of men living in the richest parts of Rio Janeiro was 12.8 years longer than that of men living in deprived areas of the city, Rio's slums. For Rio residents older than 65, healthy life expectancy was 2x as high in the richest sector as in the slum sector[52]

CHILE

Lack of information about health care, especially in northern Chile's deserts, has been an obstacle for access to health care, combined with cost and **urban centralization of health care services** and **shortage of doctors** in the country[53]

Better health status was identified for Chilean adults whenever their mothers had a higher education level, their household income was higher, they were men, or lived in urban areas. The **region of residence also affects opportunities** to achieve good health in Chile[54]

34.4% of the Chilean population is obese while 39.8% is overweight, representing the second-highest excess weight prevalence within OECD countries with clear ties to an individual's economic status, as well as risk and diagnosis of diabetes[55]

The **Mapuche indigenous population** living in Chile's Ninth Region – a region with one of the worst global income distributions – **experiences higher mortality rates due to respiratory infections than non-Mapuches,** an outcome associated with poverty levels[56]

Tobacco use is epidemic in Chile, with a **smoking prevalence of 34% in adults** and 16% in youths (10-14 years), **leading to 12% of all deaths in Chile**[57]

HEALTH CARE & QUALITY

ECONOMIC STABLITY

SOCIAL CONTEXT & COMMUNITY

EDUCATION ACCESS

NEIGHBORHOOD & BUILT ENVIRONMENT

REPRESENTATIVE **DRIVERS OF HEALTH BENCHMARK DATA**

driver of health	HEALTH CARE & QUALITY	ECONOMIC STABLITY	SOCIAL CONTEXT & COMMUNITY	EDUCATION ACCESS	NEIGHBORHOOD & BUILT ENVIRONMENT
MEXICO	65.8	$11.5K	136th	8.3	45.5
BRAZIL	65.4	$7.5K	132nd	7.9	43.6
CHILE	70.0	$15.4K	58th	10.9	46.7
benchmark	Healthy life expectancy (years)[58]	GDP per capita (USD)[59]	Global Peace Index (global ranking)[60]	Educational attainment (years)[61]	Environmental Performance Index[62]

EXAMPLES OF **HEALTH EQUITY PLAYERS**

Inter-American Development Bank is a major funder of health equity projects across Latin America, including improving sanitation in Peru's water sources and Chile's renewable energy projects[63]

The **Organization of American States (OAS)** is committed to "more rights for more people, coordinating stakeholders to address inequalities in the region and realize universal health coverage[64]

The **Pan American Health Organization (PAHO)** is the international health agency for the Americas and Regional Office of the World Health Organization, working to improve and protect people's health[65]

USAID's health-related investments in Latin America include HIV & AIDS prevention in the Caribbean (PEPFAR), strengthening El Salvador's health system and region-wide emergency disaster response[66]

The **World Bank's** investments span Latin America, including Argentina's health sector reform and Brazil's Bolsa Familia Program provides cash transfer to families living in poverty[67, 68]

REPRESENTATIVE **HEALTH EQUITY INVESTMENTS**

| **MEXICO** | **BRAZIL** | **CHILE** |

$285 2020 government spend on health per person (USD)[69]

$314 2020 government spend on health per person (USD)[70]

$841 2020 government spend on health per person (USD)[71]

Compared to the world average of $1,177 in 2020[72]

Since, 2020, the Inter-American Development Bank (IDB) has…

Invested $18M+ in financing across nine projects in Mexico such as: interoperability of state pension systems; strengthening the analytical and operational agenda for gender and diversity mainstreaming; bringing medical technology to under- and unserved populations[73]

Provided $101.5M+ in financing across 14 projects in Brazil such as: program for Modernization and Quality Improvement of the Health System in Ourinhos; innovation and digital health to improve health in the Amazon region; enabling small and medium scale farmers through technology[74]

Provided $9.5M+ in financing across 6 projects in Chile such as: support for Chile's Open and Digital Government Agenda; design and implementation of a critical path for the labor inclusion of migrants; support for the strengthening of Chile's Ministry of Science, Technology, Knowledge, and Innovation[75]

Since 2020, the World Bank* has….

Provided $4.4B to finance projects in Mexico across the drivers of health[76]

Provided $4.1B to finance projects in Brazil across the drivers of health[77]

Provided $200M to finance projects in Chile across the drivers of health[78]

Other examples of investments across organizations…

The **Carlos Slim Foundation** focuses on health care programs, public health research, food security and vaccination[79]

State-controlled oil company **Petrobras** sponsors efforts to proactively monitor and combat infectious diseases[80]

The largest copper producer in the world, **Codelco**, invests in environmental health and saftey[81]

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* Total World Bank investments by country were determined by filtering publicly-available data on the World Bank Project Database as of March 2024 by country and by project financing approval year (January 2020-present). Projects were was then manually filtered based on the its description's alignment to the definition of Drivers of Health (DOH), the set of non-medical factors including economic stability, education access, physical environment and social and community context that impact health and quality-of-life outcomes

A SNAPSHOT INTO **CLOUD READINESS** IN LATIN AMERICA

Cloud technology in Latin America is experiencing an acceleration, predicted to grow by $18.7B by 2027.[82] This acceleration follows a decade of significant expansion of internet access, reaching 78% of the total Latin American population in 2022.[83] Cloud adoption is concentrated in Argentina, Brazil, Chile, Colombia, and Mexico, accounting for 84% of the region's spend on cloud technology.[84]

Latin America's cloud adoption has been catalyzed through the adoption of digital transformation initiatives across the region. According to the 2023 Global Health Digital Monitor (GHDM) survey, Argentina, Brazil, Chile, and Colombia are leading the region in digital maturity.[85] Chile's Digital 2035 strategy promotes digitalization of the public sector, with the goal of digitizing all public services by 2035.[86] Mexico established a national AI strategy in 2018 to drive innovation and improve quality of life through AI, including improving public health services, transportation, and the country's technology culture and skill base.[87]

The growth of cloud provides Latin America the opportunity to fuel sustainable economic development in health care, financial services, and public services. Cloud computing is expected to be used by 50% of Brazilian companies by 2027 and the total number of connected devices in the country could reach 27.1 billion by 2025, enabling the possibility of more comprehensive assessment and activation of care.[88] The Mexican health care system is leading efforts in interoperability to improve data sharing and system efficiency in the country; however, challenges in data standards, regulatory obstacles and the skills required delay realizing true interoperability.[89] Chile has focused on reaching a fully digital state by integrating public services through digital systems, allowing for data sharing and accessibility among agencies.[90]

CLOUD TECHNOLOGY BY THE NUMBERS:

$18.7B — Predicted growth of cloud technology in Latin American, 2022-27[91]

16.3% — Spend on cloud technology in Latin America 2022-27[92]

84% — Spend on cloud technology by Latin America's top 6 economies[93]

CLOUD TECHNOLOGY READINESS SIGNALS

	MEXICO	**BRAZIL**	**CHILE**
Cloud-related policies	**No specific national laws currently regulate cloud computing services**; existing laws address related issues such as personal data protection, intellectual property, and confidentiality and security of data stored in the cloud[94]	There is currently **no specific law to regulate cloud services in Brazil**, but guidelines in the Brazilian General Data Protection Law (LGPD) and Resolution 4,893 cybersecurity policies include cloud-related rules around data processing, storage and usage for personal data such as medical information[100]	The government's Chile Digital 2035 strategy aims to promote digital rights, infrastructure development, cybersecurity, and digitalization of the public sector, with the **goal of reaching 100% of public services being digitized by 2035**. In 2021, **86% were digitized**[106]
Cloud presence	Mexico is the **second largest user of cloud technology in Latin America, behind Brazil** and recognized as one of the largest data center operators in the region.[95] AWS, Huawei, Microsoft Azure, and Oracle have availability zones in the country, mainly in Querétaro or Mexico City, and Google Cloud has announced plans to enter. The Mexico cloud is predicted to reach $1B by 2027[96]	Brazil is the **leader in cloud adoption in Latin America**, with cloud spend outpacing other countries in the region by 5-6x post-COVID.[101] AWS, Google Cloud, Huawei, IBM, Microsoft Azure, Oracle, and Tencent all have a presence in São Paulo, while Microsoft Azure and Oracle have a presence in Campinas and Rio de Janeiro, respectively[102]	Chile is **increasingly becoming a player in the cloud infrastructure and data center space in Latin America**. Google Cloud, Huawei, Microsoft Azure, and Oracle all have availability zones in Santiago, with Oracle opening a second in Valparaiso in December 2023[107, 108]
Challenges to cloud adoption	**Internet access**: Roughly 9 million households in Mexico do not have access to the internet, a number that has stagnated in the last five years. Cost is the main reason (60%) for limited internet access[97] **Education and skills gaps:** Mexicans attain an average 15.4 years of education, less than the OECD average of 18 years and the lowest level in the OECD, limiting size of a cloud-skilled workforce[98] **Lack of data standards**: A lack of standards for data classification limits Mexico ability to foster trust in and ability for interoperability[99]	**Costs:** High energy and infrastructure costs may limit the growth of data centers in Brazil; heavy taxation may limit the number of cloud adopters in the country[103] **Public AI adoption:** Most of Brazil's federal organizations reported no plans to use AI and were defined as being at 'Level 0' when it comes to AI maturity as of 2022[104] **Personal information concerns:** Challenges in national cybersecurity efforts may lead to data confidentiality and security concerns related to cloud adoption and usage[105]	**Lack of specialized professionals:** Chile had an annual deficit of about 6,000 IT professionals as of mid-2022; a Fundacion Pais Digital report suggest Chile's economy could miss out on nearly $13B in growth by 2030 if the skill gap is not closed[109] **Privacy & cybersecurity:** Chile saw a 208% increase in attempted cyberattacks in the first half of 2023, compared to the same period in 2022, raising concerns about increased risk to privacy and data protection with public cloud adoption[110]

CLOUD TECHNOLOGY EXAMPLE INVESTMENTS & PLAYERS

MEXICO	BRAZIL	CHILE

Example Investment in Cloud Tech

The **Mexican health care system is utilizing interoperability efforts** to improve patient care, data sharing, and system efficiency. Challenges such as the need for a standardization mechanism to keep up with a large amount of innovation, regulatory obstacles, and the requirement for significant time and resources with expertise in AI/ML to obtain correct information suggest that true interoperability may not be reached for two more decades[111]

Mexico **established a national AI strategy in 2018,** outlining select opportunities to drive innovation and improve quality of life through AI, including improving public health services, improved transportation, and fostering a stronger technology culture and skill base; the strategy also outlined the need for stronger governance to mitigate against bias in AI[112]

Cloud computing is **expected to be used by 50% of Brazilian companies by 2027 and the total number of connected devices in Brazil could reach 27.1 billion by 2025**, enabling IoT solutions and data sharing to drive better health outcomes, notably in the ability for wearable devices to collect and integrate real-time health data, enabling a more comprehensive assessment and activation of care[113]

The **Brazilian Strategy for Artificial Intelligence (EBIA) guides country-wide development of AI solutions** and stimulates research and innovation in areas of education, workforce and training, public sector solutions and public safety. A study by Brazil's Federal Court of Accounts found that the objectives set out in EBIA's national AI strategy are unachievable, with considerable lag in the private sector of developing AI solutions[114]

Stemming from Chile's Digital 2035 goals, Chile has **focused on reaching a fully digital state by integrating public services through digital systems, allowing for seamless data sharing and accessibility among governmental agencies**. Efforts, investments, and partnerships have also been made to address data interoperability in the health care system and related to migrant populations[115]

Chile has **demonstrated a leading position in AI capabilities** based on the Latin America Artificial Intelligence Index's review of infrastructure, regulation, and human capital opportunities for AI's use in the region. In October 2023, Chile's government convened Latin American leaders to sign the Santiago Declaration to Promote Ethical Artificial Intelligence and address UNESCO recommendations on ethical AI[116]

Examples of Cloud Players

AWS has a presence in Latin America, with data centers in Brazil and local or edge zones in Chile, Mexico, Argentina, Peru, and soon Colombia[117, 118]

Google Cloud has a presence in Latin America, establishing cloud regions, establishing strategic partners, and investing in training initiatives[119, 120]

Microsoft Azure has data center regions in Brazil, Mexico, and more, providing AI, Internet of Things (IoT), and business applications, and local skill building[121]

Oracle has a cloud footprint in Latin America with cloud regions in Brazil, Chile and more with cloud service solution[122]

HEALTH EQUITY X CLOUD TECHNOLOGY
EXAMPLES IN MEXICO, BRAZIL, AND CHILE

Emerging use cases for Health Equity x Cloud Technology in Mexico, Chile, and Brazil include advancing telehealth, health data aggregation, and AI-enabled care delivery, among others. While current cloud-based solutions are emerging and growing, not all are serving the region's most marginalized communities.

The following examples are a representative set of the types of solutions that are developing across Mexico, Brazil and Chile to advance health equity using cloud technology.

MEXICO

Doctoralia is a scheduling and telehealth platform that helps connect patients with physicians. In 2023, the platform scheduled 60.7M+ patient visits. Doctoralia uses the cloud to analyze patient data, providing physicians with insights on their patient population's needs and patients with easier access to their health information[123]

Clinicas del Azucar is the largest private provider of specialized diabetes care in Mexico with 33 clinics targeting low-income populations. The company uses behavioral science and AI-powered cloud technology to capture a high volume of data from 220,000 patients to develop personalized treatment plans[124]

DNAnexus is a bioinformatics platform that leverages the cloud to access and analyze biomedical data from the Mexico City Prospective Study, the country's largest population health research study, to better link two decades of participants' health records to social drivers of health factors influencing major causes of death in Mexican adults[125]

The **TeleNordeste program** provides access to online specialist consults integrated into primary care visits for Brazil's northeast rural population at 700 primary care facilities. TeleNordeste resolves the need for a specialist referral for 90% of patients; mitigating the need for a specialist referral and the need for rural patients to travel long distances to be seen by a specialist in another facility. This program also serves some indigenous populations [126]

Unimed Grande Florianópolis, one of Brazil's largest medical co-op groups, utilized the cloud in 400+ medical facilities, enabling the development of a network of telemedicine kiosks to provide patients 24/7 access to a physician and a patient app to easier access to medical records and appointments, reducing the challenges to accessing care[127]

Albert Einstein Hospital's Telemedicine Center uses the cloud to connect patients to providers, providing convenient access to care to patients across Brazil. During the COVID-19 pandemic, Albert Einstein Hospital's Telemedicine Center helped serve over 2M patients, addressing the challenges to accessing care[128]

BRAZIL

CHILE

The **Chilean Ministry of Health** adopted cloud technology to improve the interoperability of patient health records across 400+ health facilities. Cloud technology also improved patient access to medical device telemetry and simplified aggregation and analysis of patient data for the Ministry of Health[129]

AccuHealth is a virtual care management platform for patients with non-communicable diseases (NCD). Cloud technology powers the platform's remote monitoring, artificial intelligence, behavioral nudging, and telehealth capabilities, helping to increase the geographical coverage of specialists and improving health facility operations[130]

RedSalud is a private health care provider focused on delivering low-cost care through 50+ medical and dental centers in Chile. During the COVID-19 pandemic, RedSalud adopted Google Cloud technology to build its telehealth capabilities. This change enabled the delivery of care in the home and expanded the populations RedSalud could reach[131]

FUTURE OPPORTUNITIES

The future of solutions at the intersection of Health Equity x Cloud Technology in Latin America can build from the solutions that are developing in the region today. Drawing on the growing amount of health and social driver of health data on the cloud in cloud-forward Latin American countries, cloud technology can further integrate disparate data sources together to drive health and social care from powerful data insights. Existing telehealth and AI-enabled care delivery platforms can collaborate with community-based organizations and community health workers to expand the reach to more remote populations.

This analysis must also acknowledge the pronounced differences in health and lived experience between the region's three richest countries by GDP and the rest of Latin America. Mexico, Chile, and Brazil experience some of the most advanced health and social systems in the region and are among regional leaders in cloud infrastructure and adoption. To help address the most prominent health equity needs in the region through cloud solutions, cloud infrastructure and the underlying human and physical infrastructure that supports it, further efforts across the region are needed. Efforts may include investing in technical skill development for women, which provides critical financial stability and empowerment, while also fueling the future of innovation in the region.[132]

A First Look into the Intersection of Health Equity x Cloud Technology: Sub-Saharan Africa

A SNAPSHOT INTO THE **HEALTH EQUITY NEED** IN SUB-SAHARAN AFRICA

Health disparities in Sub-Saharan Africa are significant and multifaceted, with inequalities based on environmental, economic, social, or political factors. Remote populations suffer particularly from a shortage of health and social services due to the compounding effects of limited transportation infrastructure and environmental factors. In Nigeria's wetland states, the limited network of roads impedes the population's ability to access timely health and social services.[133] In Kenya, more than 33% of the population lives under the international poverty line, with communities in the country's expansive dry regions more severely impacted.[134]

Malnutrition, water quality and sanitation issues expose Sub-Saharan Africa's most impoverished, and often youngest, populations to illnesses, disability, and conditions that can persist throughout their lives. Nearly half (46%) of South Africa's water supply systems pose human health risks because of bacteria or other pathogens.[135] 60 million Nigerians are living without access to basic drinking water.[136] Due to limited access to drinking water, women and girls bear the burden of water collection over long distances, which disproportionately affects their wellbeing, school attendance, and puts them at a higher risk of gender-based violence.[137] Gender-based health disparities are also persistent in Sub-Saharan Africa. More than half of global maternal deaths occur in Sub-Saharan Africa, where 525 mothers die every 100,000 live births.[138]

Infectious disease remains a pressing issue in Sub-Saharan Africa. Nigeria experiences the third highest burden of HIV in the world and accounts for 27% of malaria cases worldwide.[139] In Kenya, there are an estimated 590,000 orphans due to AIDS.[140] And yet as epidemic conditions are controlled and lifespans gradually expand, African countries like Kenya, South Africa and Nigeria are experiencing a higher prevalence of non-communicable diseases, which put new strains on health systems.[141]

*In Nigeria, **47%** of children under five are **chronically malnourished** [142]*

***45% of Sudan's population** living in conflict-afflicted states lack safe drinking water [143]*

***HPV prevalence among girls and women in Botswana is 29.4%,** leading to the world's highest incidences of cervical cancer [144]*

REPRESENTATIVE **HEALTH EQUITY NEED**

SOUTH AFRICA

38% of the South African population lives in rural areas, however professional health care services are concentrated in urban areas. There is an imbalance in access and quality between urban and rural health care[145]

Since 2015, South Africa has **experienced record-low levels of precipitation**, straining the supply of drinking water. N**early half (46%) of all water supply systems pose human health risks** because of bacteria or other pathogens[146]

South Africa has one of the **highest rates of gender-based violence in the world**; the rate at which women are killed by intimate partners is 5x higher than the global averages. Women lack equal access to financial services in the country as well and face higher rates of poverty in retirement than men[147]

Apartheid-era urban planning has left a legacy of services that are inaccessible and inconvenient to many of Black South Africans. Public health facilities are often far from patients from periphery townships who have been referred for care but are unable to or can't afford to travel[148]

South Africa carries the **largest share of the global HIV burden, impacting 6.4 million people or about 12.2% of the population**, with a disproportionate impact on Black South African women[149]

KENYA

As of 2018, **less than 20% of Kenyans have health insurance**, with a disproportionate number of those covered tending to be individuals who are wealthier, formally employed, and have higher educational achievement[150]

More than **33% of the Kenyan population still lives under the international poverty line**, with communities in drier regions, which make up 80% of Kenya, being more severely impacted[151, 152]

Neonatal conditions are the leading cause of mortality in Kenya, with a mortality rate of 31 deaths per 1,000 live infant births, compared to a global average of 27.4. The leading probable cause of infant deaths was a lack of regular check-ups, unskilled antenatal care provision, and lack of tetanus injection[153]

Kenya has the **12th highest HIV/AIDS prevalence** globally at 3.7%, and an estimated 590,000 orphans due to AIDS[154]

The wealth gap in Kenya has widened dramatically with the country's economic development. **Less than 0.1% of the population (8,300 people) own more wealth than the bottom 99.9% (more than 44 million people)**, leading to related inequalities in access to health care and social services[155]

NIGERIA

Nigeria is **on track to become the world's 3rd most populous country, and yet lacks medical professionals**, in part due to migration of educated professionals to Western countries. Nigeria has **only about 35,000 doctors despite needing 6x that number**[156]

60 million Nigerians country-wide live without access to basic drinking water. Women and girls largely bear the burden of water collection, which has been associated with negative effects on wellbeing, school attendance, and a higher risk of gender-based violence[157]

Nigeria **contributes 13% of the global under-five mortalities globally, with an infant mortality rate of 72.2 deaths per 1,000 live births in 2020.** This high prevalence can be tied to the mother's socioeconomic status[158]

Nigeria has the world's **third highest burden of HIV**, with nearly two million people affected. Support from social networks can help improve the quality of life for those with HIV and reduces the perceived stigma, however this support suboptimal in Nigeria[159]

76% of Nigeria's population live in high transmission areas for malaria. Nigeria accounts for 27% of malaria cases worldwide and the highest number of malaria-related deaths in the world (25%)[160]

HEALTH CARE & QUALITY

ECONOMIC STABLITY

SOCIAL CONTEXT & COMMUNITY

EDUCATION ACCESS

NEIGHBORHOOD & BUILT ENVIRONMENT

REPRESENTATIVE **DRIVERS OF HEALTH BENCHMARK DATA**

driver of health	HEALTH CARE & QUALITY	ECONOMIC STABLITY	SOCIAL CONTEXT & COMMUNITY	EDUCATION ACCESS	NEIGHBORHOOD & BUILT ENVIRONMENT
SOUTH AFRICA	56.2	$6.8K	9.8	130th	37.2
KENYA	57.7	$2.1K	8.0	117th	30.8
NIGERIA	54.5	$2.2K	6.2	144th	28.3
benchmark	Healthy life expectancy (years)[161]	GDP per capita (USD)[162]	Global Peace Index (global ranking)[163]	Educational attainment (years)[164]	Environmental Performance Index[165]

EXAMPLES OF HEALTH EQUITY PLAYERS

In 2022, the **Bill & Melinda Gates Foundation** committed $7B over four years to African countries and institutions to address hunger, disease (AIDS, tuberculosis, malaria), gender inequality, and poverty[166]

Johnson & Johnson (J&J) committed $250M to scale digital health programs and address the growing shortage in frontline health workers in sub-Saharan Africa[167]

Since 1966, the **Rockefeller Foundation** has worked to form partnerships with pan-African entities, governments, and academic institutions to improve renewable energy, access to local produce, and health data for disease surveillance[168]

USAID committed $415M in partnership with Côte d'Ivoire, Ghana, Kenya, Malawi, and Nigeria to increase primary care access and support the Transform Health Fund to innovate and improve health care quality[169]

The **World Bank** made investments in 90 projects worth over $16B in Africa in 2021, with initiatives including strengthening food and climate resilience, digital transformation, and health security[170]

REPRESENTATIVE **HEALTH EQUITY INVESTMENTS**

| **SOUTH AFRICA** | **KENYA** | **NIGERIA** |

$304 2020 government spend on health per person (USD)[171]

$40 2020 government spend on health per person (USD)[172]

$10 2020 government spend on health per person (USD)[173]

Compared to the world average of $1,177 in 2020[174]

Since 2022, USAID has…

Provided $351M in funding across 165 projects in South Africa, with funding concentrated on addressing HIV/AIDS and basic health needs for the country[175]

Provided $568M in funding across 250 projects in Kenya, with funding concentrated on addressing emergency response, HIV/AIDS, and basic health needs[176]

Provided $788M in funding across 278 projects in Nigeria, with funding concentrated on addressing basic health needs, emergency response, HIV/AIDs, and maternal and child health[177]

Since 2020, the World Bank* has…

Provided $2.7B to finance projects in South Africa addressing the social drivers of health[178]

Provided $7.2B to finance projects in Kenya addressing the social drivers of health[179]

Provided $11.7B to finance projects in Nigeria addressing the social drivers of health[180]

Other examples of investments across organizations…

Atlantic Philanthropies established the Atlantic Fellows Program for Health Equity, to identify, connect, and prepare a new generation leaders dedicated to advancing health equity in South Africa, **investing more than $400M there in the last two decades**[181]

Over the past two decades, **Vodacom invested $50M+** to providing affordable internet and mobile devices and improve access to quality health care and education in South Africa[184]

The **M-PESA Foundation**, **via Safaricom** supports education, health care, and economic enablement efforts; their Maternal Health Program aims to reduce maternal and neonatal mortality rates in **partnership with the Kenyan Ministry of Health**[182]

The **Kenya Medical Research Institute**, **supported by the Nipon Electric Company**, launched a cloud-based vaccination tracking system for maternal and infant care[185]

The **United States Trade and Development Agency (USTDA)** announced a **series of health system investments in Nigeria totaling $3M**, including a feasibility study for the expansion of health care and related-sector logistics using unmanned aerial vehicles[183]

As part of a **$250M regional commitment**, **J&J** co-created frontline worker platforms to strengthen community-primary care and oncology programs across Nigeria[186]

* Total World Bank investments by country were determined by filtering publicly-available data on the World Bank Project Database as of March 2024 by country and by project financing approval year (January 2020-present). Projects were was then manually filtered based on the its description's alignment to the definition of Drivers of Health (DOH), the set of non-medical factors including economic stability, education access, physical environment and social and community context that impact health and quality-of-life outcomes

A SNAPSHOT INTO **CLOUD READINESS** IN SUB-SAHARAN AFRICA

Cloud adoption is nascent in Sub-Saharan Africa. Data residency laws in countries, including Nigeria, Kenya, and a draft law in South Africa, aim to create an enabling environment for cloud technology while still strengthening protections for data sovereignty.[187] The development of new data centers and investments in subsea cables can expand cloud infrastructure to allow African countries to maintain data rights and advance cloud technology.[188]

Africa's population of 1.3 billion people, which includes the world's youngest populations, is experiencing a comparatively unprecedented level of digital adoption.[189] Today roughly 25% of the population has access to the internet, but this is predicted to increase to 75% by 2030.[190] Mobile device and digital adoption is growing across the continent, but especially in Kenya, which during the COVID-19 pandemic expanded internet access and started to elevate the quality of life through important health apps aiding under- and unserved groups.[191] However, according to the 2023 Global Health Digital Monitor (GHDM) survey, the region still behind in terms of digital maturity, with Ethiopia, Guinea, Malawi, and Tanzania as the exceptions.[192] Internet access and quality also continue to be inconsistent across the continent.[193] Innovation may provide an inflection point toward more cloud adoption in time.

Cloud infrastructure is also slowly entering the Sub-Saharan region. South Africa has seen a jump in the number of major availability zones and AI-related institutes located in the country.[194] In Nairobi, Kenya – Africa's "Silicon Savannah" – cloud development and innovation centers have recently been built.[195] In most other African countries, smaller, local data centers are the predominant cloud infrastructure option.[196] While cloud technology is being used in the region today, especially in the financial and health care sectors, cloud migrations are still generally uncommon. As of 2021, only 27% of Nigerian organizations reported adopting cloud computing solutions.[197]

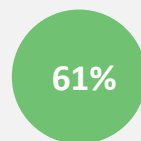### CLOUD TECHNOLOGY BY THE NUMBERS:
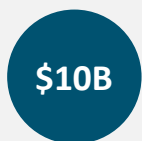
$10B — Projected public cloud spend in Africa in 2024[198]

15.2% — Projected growth of public cloud in Africa 2024-2027[199]

61% — Increase in the spend on cloud by African countries in 2022[200]

CLOUD TECHNOLOGY READINESS SIGNALS

	SOUTH AFRICA	KENYA	NIGERIA
Cloud-related policies	**The South African government has released a Draft National Data and Cloud Policy in 2021** to create an enabling environment for cloud and help enable data generated in South Africa remains within the country, align ownership, and control of personal information, and enhance cybersecurity measures related to the cloud[201]	**Kenya's Data Protection Act (DPA) of 2019** strengthens data sovereignty and data privacy rules. The DPA stipulates that personal data strategic to the interests of the state must be processed through servers and data centers located in Kenya, and related cloud Computing Standards were likewise issued by Kenya in 2019 [207]	**Nigeria's Cloud Computing Policy (NCCP) of 2019** aims to support cloud adoption among public Institutions and businesses by 30% by 2024 by reducing costs, improving delivery, and adding transparency. The policy includes local content requirements that encourage cloud adoption while addressing privacy concerns and reinforcing data sovereignty[213]
Cloud presence	**South Africa's cloud infrastructure is rapidly expanding**, with Google Cloud joining AWS, Microsoft Azure, and Oracle with availability zones in Johannesburg in 2024. The presence of cloud providers prepares South Africa to become a hub for cloud computing and digital innovation in Africa[202,203]	Kenya's **cloud infrastructure is developing** with an AWS Development Centre and Local Zone and a Google Dedicated Cloud Interconnect in Nairobi. The Olkaria Ecocloud Data Centre, Africa's first geothermal-powered data center, demonstrates Kenya's dedication to sustainable data solutions[208, 209]	As of 2021, **only 27% of Nigerian organizations reported adopting cloud computing solutions**. Cloud infrastructure in Nigeria has predominantly been developed by local cloud providers like Africa Data Centers. AWS and Microsoft have recently begun offering services in Nigeria[214, 215]
Challenges to cloud adoption	**Data security concerns**: Managing data security is a major challenge, as organizations are hesitant to adopt hybrid cloud solutions due to the complexities of ensuring secure environments[204] **Internet reliability**: Inadequate or unreliable network performance can impact the efficiency and reliability of cloud services, posing a significant challenge to cloud adoption[205] **Skills shortage**: A lack of sufficiently skilled professionals creates a challenge for effectively managing and optimizing cloud in South Africa[206]	**High speed internet connectivity**: Inadequate access to reliable, high-speed internet connectivity is a major hurdle to effective and widespread cloud adoption in Kenya[210] **Regulatory confusion**: Legal considerations, especially in terms of data sovereignty, privacy and intellectual property rights, continue to create concerns and confusion for cloud adoption and use[211] **Cost of cloud solutions**: Cost of cloud adoption, relative to status quo solutions, provide reluctance to move Kenya to the cloud[212]	**High speed internet connectivity**: Nigeria's unreliable power supply, inconsistent broadband internet access, and poor internet connectivity, especially in rural areas, limits cloud capabilities[216] **Reluctance to share data**: Persistent beliefs in some industries about maintaining one's own data infrastructure, along with high incidences of cybercrime have led to reluctance to adopt cloud technology[217] **Cost of cloud solutions**: High upfront costs and limited affordable financing make cloud services difficult for budget-constrained small and medium enterprises to adopt in Nigeria[218]

CLOUD TECHNOLOGY EXAMPLE INVESTMENTS & PLAYERS

SOUTH AFRICA | KENYA | NIGERIA

Example Investment in Cloud Tech

SOUTH AFRICA

The **State Information Technology Agency (SITA)** has supported migrating South African government data to cloud services[219]

In South Africa, **major organizations are embracing cloud-based strategies that create stability and reliability of data but have not reached a state of meaningful data integration or interoperability efforts**, despite a clear need for integration solutions, especially in health care to coordinate EHRs[220]

South Africa has seen **growth in AI / ML across education, financial services, and health care sectors** – using AI to enhance efficiency and personalized care and to improve R&D in pharmaceuticals. The country is also becoming a destination for AI investments in Africa, with the establishment of an AI Institute to boost AI / ML skill-based education on the continent[221]

KENYA

Nairobi's reputation as the "Silicon Savannah" and **investment in affordable smartphones and the rollout of 3G and 4G networks** bolsters opportunities for future cloud technology opportunities[222]

There are **national efforts to address the Kenyan health sector's data integration into a single source**, focusing on HIV/AIDS data, supported by the Global Partnership for Sustainable Development Data, provides a baseline for future cloud data integration within Kenya's health care sector[223]

The spread of mobile technologies in Kenya could raise expectations and opportunities for AI adoption. And yet Kenya, like many African nations **lacks the necessary infrastructure, data capacity, and governance to effectively implement AI/ML.** Kenya, on average, outperforms the Sub-Saharan region in these foundational areas, but has seen other countries in the region and globally overtake their cloud readiness position[224]

NIGERIA

Financial services and health care are two Nigerian industries in which there is growing recognition of the need of cloud-based data integration and interoperability solutions, for example to advance the use of EHRs. Delays to advancing adoption in these sectors may be due to skill gaps, fears of short-term job loss, and reluctance to share data on foreign cloud[225]

Applications in financial services and health care indicate growing AI adoption in Nigeria, yet the landscape is still developing, with opportunities for expansion in capabilities and broader industry adoption over time. In August 2023, Nigeria's government called for researchers of Nigerian descent from around the world to help form the country's first National AI Strategy[226]

Examples of Cloud Players

Africa Data Centers is one example of developing networks of data centers to enable cloud technology that keeps data local[227]

AWS has expanded their presence with data centers in South Africa, innovation centers in Kenya, and the AWS re/Start skills program across the region[228]

In 2024, **Google Cloud** opened their first data centers in Johannesburg, tapping into their completed private sub-cable Equiano, connecting Europe and Africa[229]

Microsoft Azure has two cloud regions in South Africa and four in the Middle East; it's Airband Initiative seeks to provide internet to 100M people by 2025[230, 231]

HEALTH EQUITY X CLOUD TECHNOLOGY
EXAMPLES IN SOUTH AFRICA, KENYA, AND NIGERIA

Today, emerging use cases for cloud technology in South Africa, Kenya, and Nigeria include advancing telehealth, disease surveillance, health data and EHRs aggregation, and AI-enabled care and resource delivery, among others. Many have tapped into the growing power of African mobile networks and demonstrate the opportunity for cloud technology's impact.

The following examples are a representative set of the types of solutions that are developing across South Africa, Kenya, and Nigeria to advance health equity using cloud technology.

SOUTH AFRICA

MomConnect is a digital service that provides educational information and guidance to support 1.8M pregnant mothers. With cloud technology, mothers can enroll in MomConnect at 95% of clinics across the country, receive personalized educational SMS messages and reminders, and more easily connect to care providers[232]

Aviro Health is a preventative care and HIV detection platform for high-risk groups who do not traditionally access facility-based HIV testing services. Cloud technology enables the patient app, which aggregates patient inputs to inform providers on patient health needs and concerns, reducing the burden of care coordination and improving preventative health services[233]

The **CareConnect Health Information Exchange**, a public-private partnership led by South Africa's Government, to create a universal patient record. Using cloud technology, the platform aggregates health data from multiple sources to create a single online entry point for providers to access a patient's entire medical history. To date, the platform contains 5.2M patient records[234]

Twiga Foods, one of Kenya's largest grocers, leveraged the cloud to optimize its grow-to-grocery cycle to reduce waste and monitor its supply chain, limiting disruptions to food supply and enabling growth to additional regions where need for high quality food is the highest[235]

Leap by mHealth, is a mobile platform for training Kenyan health care workers. With the cloud, Leap can deploy and measure user learning progress, develop real-time performance reports, and run a 24/7 helpdesk with SMS and IVR. Leap has contributed to a 42% increase in material skilled delivery across the 30+ clinics it is utilized in[236]

The **United Nations Program on HIV/AIDS (UNAIDS)** developed cloud-based APIs that enabled better monitoring of HIV across Kenya. With Google Maps, UNAIDs can have a street-level view into where HIV testing services exist and where outbreaks are occurring, enabling more targeted interventions across the entire country[237]

KENYA USE

NIGERIA

eHealth Africa addresses data gaps in public health data to enable more targeted public health planning in Nigeria. With cloud, eHealth Africa has been able to analyze inputs from 36 datasets and across 12 sectors, providing more than 26,000 users the ability to identify public health needs across social, community, economic and health indicators[238]

The **Surveillance Outbreak Response Management & Analysis System (SORMAS)** is an open-source, disease surveillance tool developed to coordinate COVID-19 patient monitoring. Leveraging the cloud, SORMAS has been able to provide real-time data to providers, labs, and government authorities across five countries to monitor multiple diseases[239]

Helium Health is a Nigerian-based start-up that provides cloud-based solutions to health care providers. Helium's platform includes also shares real-world data it collects with NGOs and partner organizations improve drug development and disease surveillance[240]

FUTURE OPPORTUNITIES

In many parts of Sub-Saharan Africa, state and regional governments fund and manage their population's holistic care with limited resources. [241] Because of this dynamic, future cloud technology efforts should begin by centering on localized solutions that demonstrate the opportunity to both scale and coordinate with core infrastructure needs. This may include leveraging the power of AI/ML to optimize pharmaceutical supply chains and provide delivery of prescriptions so that individuals consistently have the medications they need to be healthy. The spread of cell phones also may enable mobile-based cloud solutions developed across the continent that can be curated, organized, and shared more widely than ever before.

The future of cloud-enabled Sub-Saharan Africa, and the solutions that it could bring, requires a commitment to expanding the support infrastructure in the region. By acknowledging data sovereignty requirements, committing to further local cloud infrastructure, and training a skilled workforce, there exists future opportunities to drive real and lasting impact at the intersection of Health Equity x Cloud Technology in Sub-Saharan Africa.

Global Health Equity Innovator Insights

Building from the insights uncovered in the regional and country-level scans, the Health Equity x Cloud Technology Landscape Analysis looked to a set of AWS customers, global innovators who are using cloud technology, provided in part through AWS promotional credits, to design, implement and scale cloud-enabled health equity solutions. The purpose of this initial survey, conducted by Deloitte, was to investigate the gaps seen in the existing analysis and generate new insights from a more global perspective.

The innovators' work spanned the globe, with cloud technology solutions largely focused on:

- Improving access to health services for underserved populations (e.g., reducing the cost of preventative care, telehealth solutions, AI-assisted disease management);

- Leveraging and addressing gaps in health data (e.g., aggregating disparate data on the social drivers of health and collecting primary health data on underserved populations);

- Developing digital diagnostics (e.g., melanoma and HIV/AIDs screening tools)

Experiences shared by these innovators reinforced the importance of making cloud technology more accessible and affordable to health equity technology innovators: 90% of the innovators viewed promotional cloud credits to be effective or highly effective in supporting their current efforts. Value was created specifically in three areas: increasing the scale and speed of their efforts (40% of respondents), de-risking the adoption of new cloud technology (34%), and allowing organizations to build a stronger understanding of the communities they served (27%). Innovators shared that access to cloud technologies enabled them to rapidly adopt and deploy solutions that were not previously financially accessible, collect and analyze data from populations they serve and share those insights back with local health care providers and community partners, and leverage digital capabilities to expand into previously inaccessible regions.

These innovators shared the metrics that they used to track their efforts; for now, measurement of Health Equity x Cloud Technology remained predominantly at the process level (e.g., number of users, lives reached, regions expanded into) due to limits in the quality of data available to measure outcomes. A small number of innovators shared outcome metrics, such as self-reported improvements in health, knowledge or trust.

"We [improved] health literacy at scale through advance technical capabilities and a customized user experience powered by AI/ML. In 2023, our participants had a 62% documented knowledge improvement of health conditions and a 47% improvement in health confidence."

— EDLOGICS

Despite the important role promotional credits played in these innovator efforts, the sustainability of cloud solutions remained a concern. A clear majority of respondents (60%) noted the cost of cloud as a challenge to cloud adoption in their region; internal technical skills (48%), and regional infrastructure such as high-speed internet and physical data centers (36%) were additional concerns for future scale. When asked about future roles cloud providers can play at the intersection of Health Equity x Cloud Technology, these innovators asked for more cloud credits (81%) more support securing funding (77%) and more coordinated technical and business support from cloud providers (63%). Requests for more infrastructure investments were also particularly important to innovators.

Innovators also looked to the technology sector at large to serve as champions of Health Equity x Cloud Technology solutions and a bridge –convening organizations of various size and geographic region to collaborate and share learnings to accelerate technological upskilling and improve the speed and scale of solutions. Some innovators shared ideas of a Health Equity x Cloud Technology space in which innovators can share, integrate, and improve cloud-enabled solutions to drive more impact in more places around the world.

"Our target markets (South Asia, Africa, South America, Caribbean) are understandably hesitant to have their health system data and metadata stored in the cloud. Ministries of Health in these regions do not have sufficient capacity to deploy their own cloud infrastructure that can be used reliably at scale. Regional services or country hosted infrastructure could go a long way to reducing the barriers to cloud utilization."

– GLOBAL CONNECT DEVELOPMENT GROUP

"There is so much noise in the marketplace, and especially when it comes to organizations that are focused on advancing health equity in underserved communities…**the tech sector could go a massive distance toward helping to curate the available solutions**, **provide a setting in which individuals working with health equity can come together to see, learn, experience, even "test drive" solutions**… and have a chance to tell what worked so that others who are on the lookout have positive models to follow."

– BEYOND LUCID TECHNOLOGIES: THE R.U.S.H. INITIATIVE FOR CHILDREN

Current Gaps & Future Opportunities at the Intersection of Health Equity x Cloud Technology

CURRENT GAPS & CHALLENGES

Exploration of the emerging use cases in Latin America and Sub-Saharan Africa and insights from global innovators collectively reinforce the idea that there are powerful opportunities at the intersection of Health Equity x Cloud Technology, representing untapped possibilities.

But there is more to do to realize this opportunity. Five gaps were revealed throughout the Health Equity x Cloud Technology Landscape Analysis:

1. CLOUD & SUPPORTING INFRASTRUCTURE: Broader cloud adoption in Latin America and Sub-Saharan Africa will require considerable investments in high-speed internet and the upskilling of local workforces in technical enablement to address health equity through cloud solutions at scale. In 37% of countries, digital infrastructure maturity is in its earliest stages.[242] Adoption in these regions, and in Sub-Saharan Africa especially, will require regional trust– building in the necessary cloud infrastructure (e.g., data centers) and local presence, so that communities may be empowered to leverage cloud technology.

2. SUSTAINABLE CLOUD USE: While cloud technology can be cost-efficient relative to alternatives, global innovators shared concerns that their current health equity technology solutions were sustained by cloud credits and that it would be a challenge to continue without more financing support or flexibility long-term.

3. HEALTH EQUITY-CENTERERED TECHNOLOGY: Across the regions and countries explored in this Landscape Analysis, and from the perspectives of AWS customers and global innovators, a pattern emerged. Most cloud technology solutions today are not designed, developed, or deployed as purpose built cloud-enabled solutions with health equity in mind. Outside of a small number of use cases, cloud solutions primarily address the health needs of the general population, rather than focusing on disparities across the social drivers of health.

"[Cloud Providers] need to establish trust and local presence in more African countries. Each country wants their own local, physical sense of ownership."
- QUANTITATIVE ENGINEERING DESIGN

4. HEALTH EQUITY DATA: Cloud-enabled solutions are only as good as the data they leverage. Existing cloud solutions attempt to integrate social and health data together to better understand health disparities. However, data on socially under- and unserved groups is limited, especially in regions of the world that are still adopting cloud at scale such as Latin America and Sub-Saharan Africa.

5. CHALLENGES TO SCALING AND SPREADING SOLUTIONS: Use cases across Latin America and Sub-Saharan Africa and the solutions created by other global innovators suggest that similar cloud technology solutions are being deployed to address similar challenges in different parts of the world. Such parallels present the opportunity for innovators to work together on similar issues or types of cloud solutions. The future of the intersection of Health Equity x Cloud Technology should bridge gaps and make global connections to begin to drive impact.

> "Innovators need better data to drive outcomes for social drivers of health. We can play a huge role in helping them source, analyze, and act."
> **- AWS LEADER**

THE FUTURE OF HEALTH EQUITY x CLOUD TECHNOLOGY

As we look to the future, cloud technology will likely play a larger role in addressing health equity and, in turn, advancing techquity. Cloud providers can invest in cross-sector collaborations to help address disparities in the social drivers of health globally. Expanding access to cloud technology can enable customers and organizations to better understand the communities they serve, reduce the costs of delivering technology solutions where they are most needed, and scale the reach of their existing and new technology solutions. One customer's innovation could drive another's, expanding the range of possible technology solutions available to address global health and quality of life disparities.

Such intentional design, development, and deployment of technology to advance health is called techquity – and it represents the future of the intersection of Health Equity x Cloud Technology. Insights from this snapshot suggest health equity investments can see greater scale, efficiency, and impact if enabled by cloud technology's ability to securely host and store data, integrate data and platforms to allow for interoperability, and harness the power advanced technology, such as AI, to provide health and social services to communities in need at greater speed and scale.
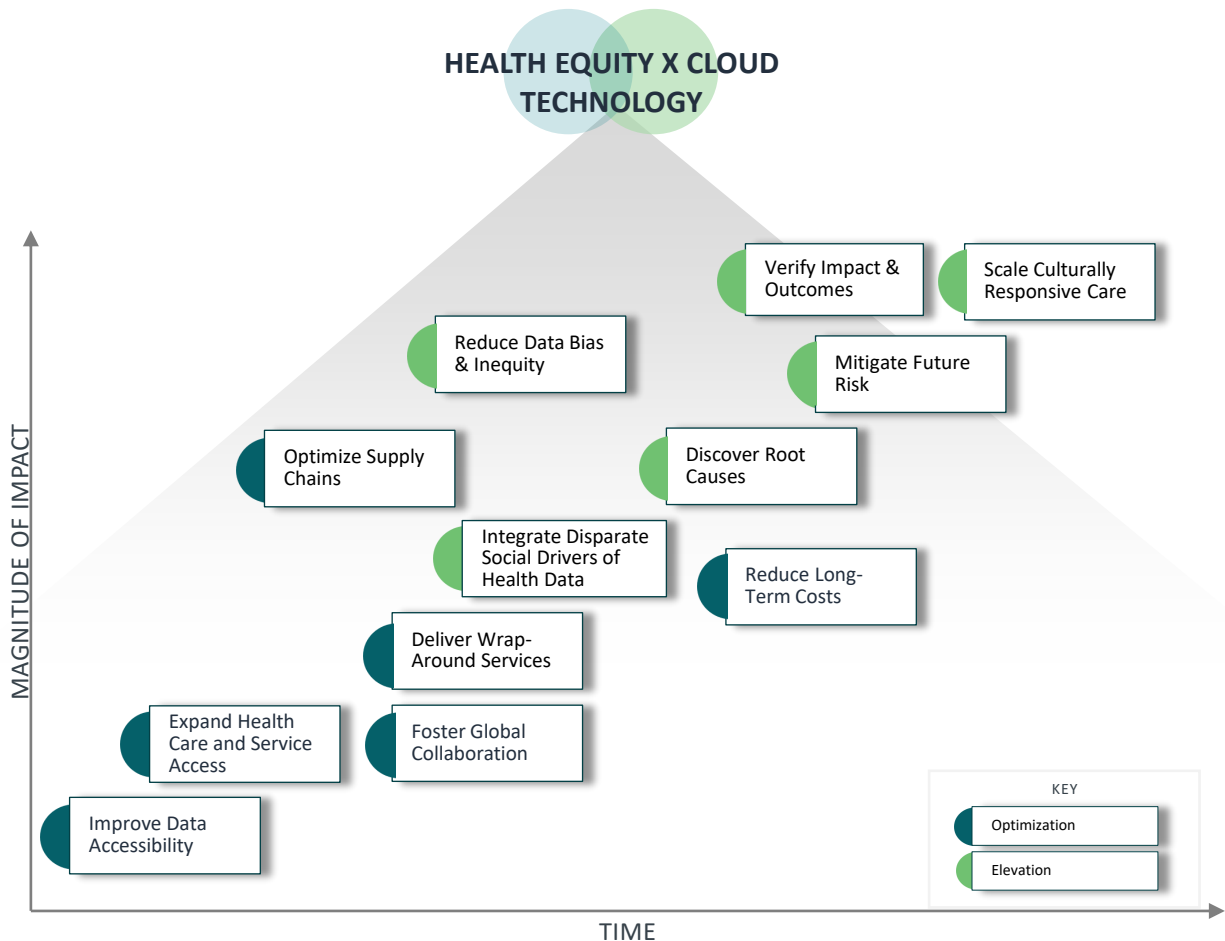
FUTURE TECHQUITY SOLUTIONS

Emerging use cases at the intersection of Health Equity x Cloud Technology provide a lens into how cloud technology can realize meaningful health equity outcomes in the future.

Future solutions fall into two general categories:

- **Optimization**: Solutions that improve the efficiency, reach, or cost-effectiveness of existing efforts to address health equity through the benefits of cloud-based technology

- **Elevation:** Solutions that "raise the bar" of what is possible in addressing health equity, unlocking new insights and services through advances in cloud technology

While these solutions vary in magnitude of standalone impact and time to realization, they represent the collective power of cloud technology in addressing health equity.

HEALTH EQUITY X CLOUD TECHNOLOGY

MAGNITUDE OF IMPACT

- Verify Impact & Outcomes
- Scale Culturally Responsive Care
- Reduce Data Bias & Inequity
- Mitigate Future Risk
- Optimize Supply Chains
- Discover Root Causes
- Integrate Disparate Social Drivers of Health Data
- Reduce Long-Term Costs
- Deliver Wrap-Around Services
- Expand Health Care and Service Access
- Foster Global Collaboration
- Improve Data Accessibility

KEY
- Optimization
- Elevation

TIME

Health Equity X Cloud Technology Optimization Solutions:

Improve Data Accessibility
Empowering health care providers and community-based organizations with data access to make informed decisions for under- and unserved populations

Expand Health Care and Service Access
Scaling the reach of telehealth, a corner-stone of cloud technology, to reach the most remote or underserved populations in their own communities

Foster Global Collaboration
Connecting health and social solutions from different parts of the world to bridge the gap in different regions and cultures (e.g., for non-communicable diseases)

Optimize Supply Chains
Analyzing patterns in resource utilization and health needs to create pathways to providing access to medicine and supplies to the most remote communities

Deliver Wrap-Around Services
Enhancing care through a coordinated set of social support services to improve quality of treatment or prevention efforts matched to individual needs

Reduce Long-Term Costs
Reducing physical infrastructure and maintenance costs to allow for a more equalized opportunity for small solutions to scale to underserved areas

Health Equity x Cloud Technology Elevation Solutions:

Integrate Disparate Social Drivers of Health Data
Pooling EHRs with social, environmental, and economic data to enable research and policy to identify root causes for disparities more concretely than before

Reduce Bias & Inequity
Advanced analytics to highlight disparities and biases based on ethnicity, gender, race, or other socioeconomic or cultural factors

Discover Root Causes
Identifying potential correlations (e.g., poor housing conditions and asthma [243]) to design an intervention that can mitigate health disparities for a population of need

Mitigate Future Risk
Using advanced analytics to identify communities at the highest risk for adverse health outcomes based on the social context or inequities faced

Verify Impact & Outcomes
Evaluating the effectiveness of social programs and investments more accurately than ever before using an integrated set of social drivers of health data points

Scale Culturally Responsive Care
Leveraging large-language models (LLMs) with community health workers to help meet the linguistic, cultural, and social needs of the world's marginalized populations

Where Do We Go From Here?
A Cross-Sector Call to Action

Health equity and cloud technology leaders can and should work together to realize the opportunity of the intersection of Health Equity x Cloud Technology, though a community-based lens, recognizing that cloud technology can serve as an enabler in addressing the health equity needs of specific communities. Actions are required across sectors, including builders designing cloud-enabled solutions, cloud providers catalyzing their use and scale, donors intentionally investing in and measuring impact, and organizations across the public and private sector committing to and engaging at this intersection.

Realizing the future opportunity of Health Equity x Cloud Technology involve consideration and action across six areas:

1. INVEST IN CLOUD INFRASTRUCTURE AND POLICIES: Explore opportunities to increase global investment and promote cloud-friendly policies that improve cloud infrastructure and expand cloud access to regions and communities where need is the greatest, particularly in Latin America and Sub-Saharan Africa

2. CONSIDER LONG-TERM FINANCIAL SOLUTIONS: Encourage the adoption of cloud in both the short- and long-term by lowering the obstacles to accessing the cloud

3. DEVELOP PURPOSE-BUILT HEALTH EQUITY CLOUD SOLUTIONS: Develop and deploy cloud solutions that address specific health equity needs and with scaled impact as the outcome across health care, life sciences, and adjacent industries that influence social drivers of health

4. CLOSE GAPS IN HEALTH EQUITY DATA: Integrate social drivers of health and health care data to better define what valuable health data is and enable innovators to have the appropriate access to this data. The integration of disparate data will involve enhanced data governance, access, sharing, and translation of health equity information

5. CREATE A HEALTH EQUITY X CLOUD TECHNOLOGY INCUBATOR: Establish a collaborative "marketplace" for health equity technology solutions through global coalitions and cloud-enabled platforms in which innovators and communities come together to share examples of cloud-enabled health equity solutions, design new iterations, and scale the impact of innovation to new parts of the world

6. COMMIT TO MEASURING IMPACT: The future of the Health Equity x Cloud Technology intersection will require innovators to be able to precisely measure impact on individual health outcomes and broader social drivers of health. Creating a standard set of metrics that can indicate equity-driven cloud technology solutions, that is aligned on across health equity leaders and cloud providers, is an important step toward measuring impact at the intersection.
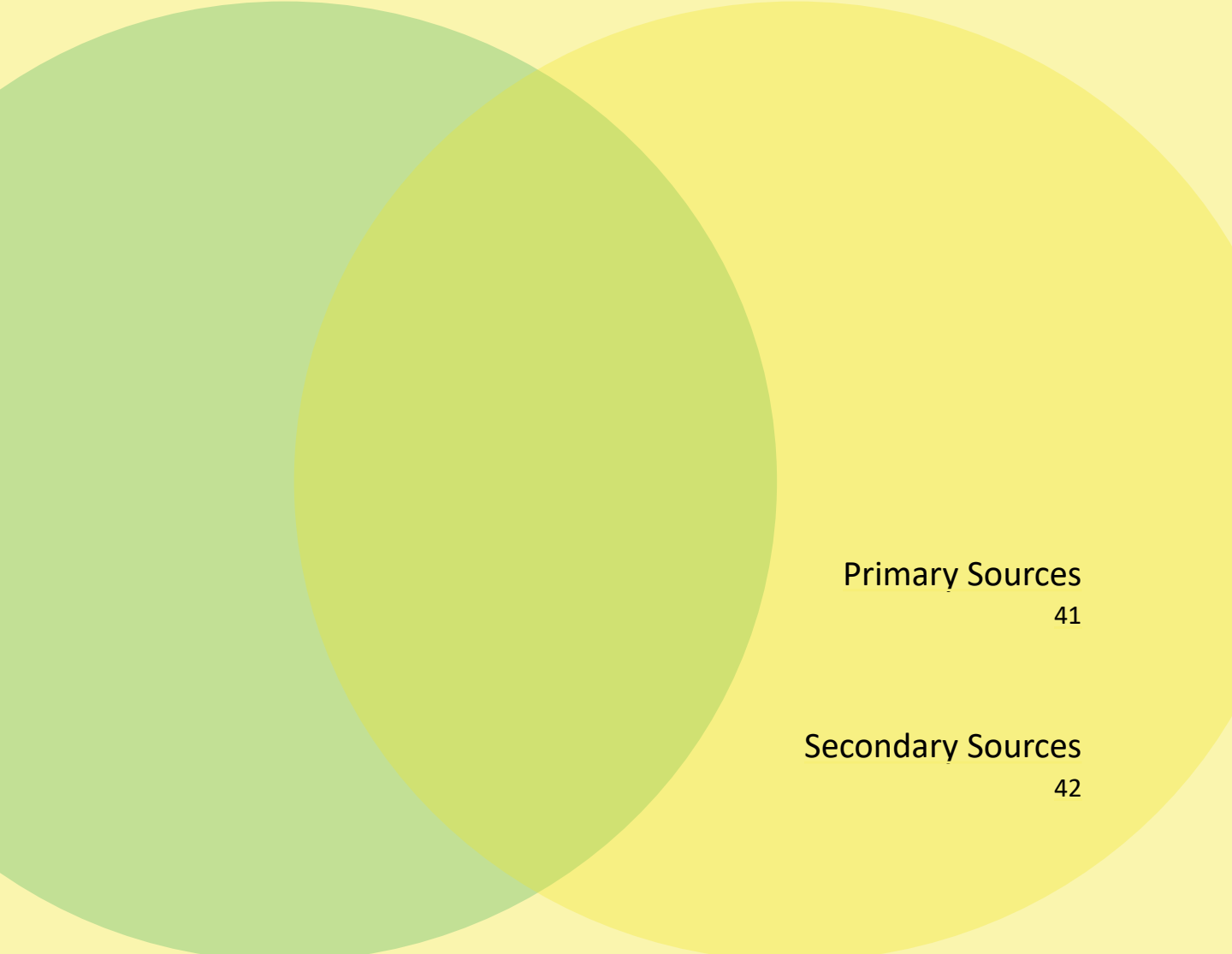
Above all else, this work begins and ends with a commitment to place-based change. The future opportunity at the intersection of Health Equity x Cloud Technology involves the understanding of local context that informs health equity needs, cloud technology readiness, and the intentional design of solutions that can scale while honoring the unique needs of a given place, community, or individual.

The urgent health equity needs identified around the world and gaps surfaced at the intersection of Health Equity x Cloud Technology today point to why a shared call to action is necessary. And now is the time to act.

Building a set of concrete milestones, shared responsibilities, and measurable objectives is an important next step toward realizing the future opportunity of Health Equity x Cloud Technology. Expanding upon these insights and exploring efforts at the intersection in other parts of the world is important as well. We welcome you to act and enable **every individual in every community to attain their optimal health and quality of life outcomes through the power of cloud technology.**

"This is a moment for urgent action and intentional collaboration across industries and sectors to raise the bar on how we address health equity at a global scale. Cloud technology can help pinpoint local opportunities for place-based change and expand the reach of health equity solutions around the world."
- DELOITTE US LIFE SCIENCE & HEALTH CARE PRACTICE LEADER

APPENDIX

Primary Sources

GLOBAL INNOVATORS

The global innovators represent a set of AWS customers, provided in part through AWS promotional credits, to design, implement and scale cloud-enabled health equity solutions in one or multiple regions

ACIRAH Health, Inc	Genetic Alliance	NUCLEIX LTD
AdaptX	Global Connect Development Group LLC	One Clinic Company Limited
AmberFlux EdgeAI Private Limited	Greenstand	OpenAQ
Arizona Housing Analytics Collaborative	Harmony Healthcare Solutions	Operation M.I.S.T.
Axesshealth	Healthera Ltd	Ophthalytics Inc
Axialhealthcare (d.b.a. Wayspring)	Healthvana	Oral Genome
Axis Solutions Africa	HeHealth Inc	Polyview Health, Inc.
Beyond Lucid Technologies, the R.U.S.H. Initiative for Children	Hera Inc	Quantitative Engineering Design
Byteflies NV	Honeybee Health	Raxa Health
CareConnect	Hyrax Biosciences	Reach52
ClickMedix	Interoperability Institute*	REAN Foundation
Cloud 9 Telehealth	IntraHealth International	Render Health Technology
Core Value ltd	iSWoT LLC	Safe Surgery South Africa NPC
Counter Tools	Karecirc LLC	Saludtools (Saludtools Holdgins LLC)
curaJOY	Khushi Baby	Sevamob Ventures USA Inc
Deep Surface AI	Last Mile Health	SiSU Health Group
Department of Biomedical Informatics, Emory University	Lightspeed Systems	SoMuchBetter LLC
DirectTrust.org, Inc.	Logiksavvy Innovations	Surgo Health
Easterseals DC MD VA	Lumeca Health Inc	Synapser
EdLogics LLC	Medic Mobile Inc	Texas Homeless Network
EPA Bienestar IA	Miguel Corporate Services Pte Ltd	The Lens/Cambia
equalityMD	Mitra Bio	Touch Foundation
eVisit, Inc.	Montefiore Medical Center	Unite USA, Inc.
First Place AZ	MultiplAI Health	University of Nebraska Omaha
Flikshop	N1 Health	Valera Health
FOLX Health	NACHC	VaxApp
Fortem Genus, Inc., SDVOSB	Navigating Cancer	WelTel Incorporated
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KEY TERM

*"**Under-and Unserved Populations":** Groups that have little or no access to resources or that are otherwise disenfranchised. These groups may include people who are socioeconomically disadvantaged; geographically isolated or educationally disenfranchised people; people of color as well as those of ethnic and national origin minorities; women and children; individuals with disabilities and others with access and functional needs; and seniors. Barriers to access can result in poorer health outcomes and disparities compared to other groups. Technology serves as a powerful tool to advance health equity for these groups by bridging gaps in access to care.

We welcome you to join in this effort to enable **every individual in every community** to attain their optimal health and quality of life outcomes **through the power of cloud technology.**

Contact:

Email **AWS-HEI@Amazon.com**

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