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Health and WaSH

Thematic Futures

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In this entry, we describe and forecast improvements in the health and water, sanitation and hygiene (WaSH) sector in Africa and its impact on the continent's development trajectory. Improvements include reductions in the mortality rate associated with both communicable diseases and non-communicable diseases, as well as improvements in access to safe water and better sanitation. The impact on Africa's development trajectory is examined as part of a combined Demographics and Health scenario.

Summary

- **Africa has historically** experienced a high disease burden, which has contributed to low population densities in ancient times and curtailed development.

- Despite Africa's continued high disease burden, countries in sub-Saharan Africa spend significantly less on health as a percentage of gross domestic product than regions elsewhere in the world. **Urbanisation and disease**

- **The impact of HIV/AIDS** and the **COVID-19** pandemic have had pronounced negative effects on Africa's development with regard to economic productivity, mortality and life expectancy, and poverty reduction.

- Sub-Saharan Africa is forecast to achieve its epidemiological transition only around 2030, meaning an approaching **double burden of disease** with rapid unplanned **urbanisation and poor access to WaSH infrastructure** having a noticeable negative impact on health and well-being.

- **The Demographics and Health scenario** consists of various interventions to improve health outcomes in Africa, with concomitant improvements in **poverty** levels and **GDP per capita**

- Only 27 of 54 African countries will have full access to **safe water by 2043, and do poorly on improved sanitation** despite the significant push on WaSH infrastructure in this scenario. Yet our forecast underscores the imperative to design health programmes that extend beyond the health sector itself.

- Effective urban planning and a better understanding of the trade-offs in health policy versus investments like providing basic WaSH infrastructure will lead to better outcomes such as on **infant mortality and life expectancy**

- A reduction in Africa's high **disease burden** will result in a healthier population that will also be more productive and, once combined with better education and other enablers, improve economic growth prospects significantly, but it requires **planning and a comprehensive approach to the future**

- **The impact of the Demographics and Health scenario** is discussed separately in the Demographics theme and the Health theme, and its impact on African countries and regions is in each of the geographic reports.

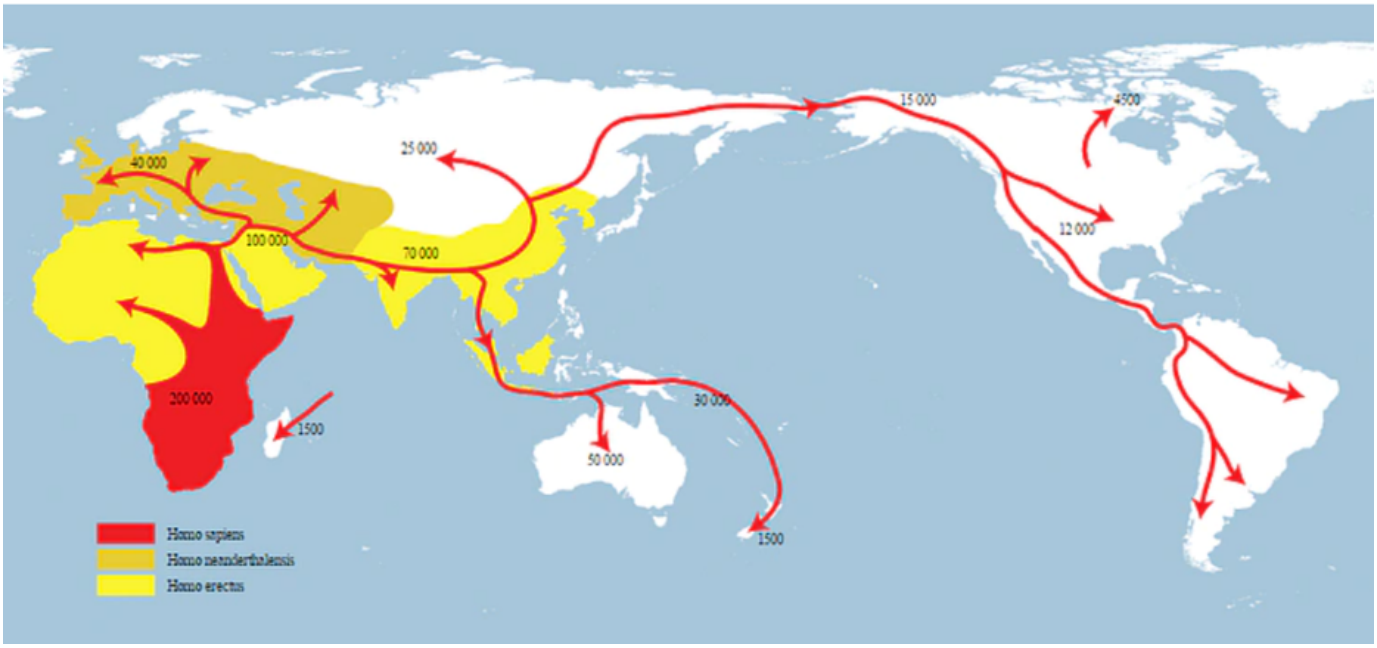
The Neolithic revolution and health in Africa

Early humans gained an initial health reprieve when, many thousands of years ago, their ancestors moved out of Africa into cooler regions with fewer insect-borne diseases and 'the many parasites and disease organisms that had evolved in parallel with the human species.'[1] As a result, humanity multiplied rapidly in these new areas, and eventually the large number of people required a more organised way of food production. Population increases gave rise to the first agricultural (or Neolithic) revolution that allowed humans, approximately 12 000 years ago, to slowly change from hunter-gatherer lifestyles into permanent settlements. It also enabled humans to transition from wild harvesting to cultivation techniques such as rudimentary irrigation systems, the selection of crops for cultivation, animal domestication, and the development of a secure food production, storage and the barter system.

Agriculture was developed several different times and in different places such as in Mesopotamia, South and Central America and elsewhere. Most prominent were the changes that ocurred in the region subsequently known as the Fertile Crescent, covering the modern-day countries of eastern Turkey, Iraq, and south-western Iran. Sometimes it spread to other suitable locations through migration and trade but, with the exception of the Nile Delta, generally did not progress above certain levels in much of Africa since the demand, large human settlements, was generally absent.

Surplus food production allowed humans to establish permanent settlements and led to even higher population densities and eventually the emergence of larger groups, even civilisations. It was accompanied by commerce, a division of labour, systems of property ownership and a tiered political system. Competition spurred innovation and technological advancement. However, higher population density also bred new diseases and also led to competition, and sometimes conflict, between people over land, food, status and trade.[2]

Chart 1: Journey of Homo sapiens from Africa



Source: World History Encyclopedia, https://www.worldhistory.org/article/1070/early-human-migration/

In contrast to what was generally happening elsewhere, large parts of ancient Africa's interior were consistently characterised by low population densities due to its high disease burden and subsequent slow agricultural transition since relatively low population densities did not require more productive agricultural systems.

In temperate zones, such as much of Europe, parts of Asia and North Africa, the annual seasonal fluctuations serve as a

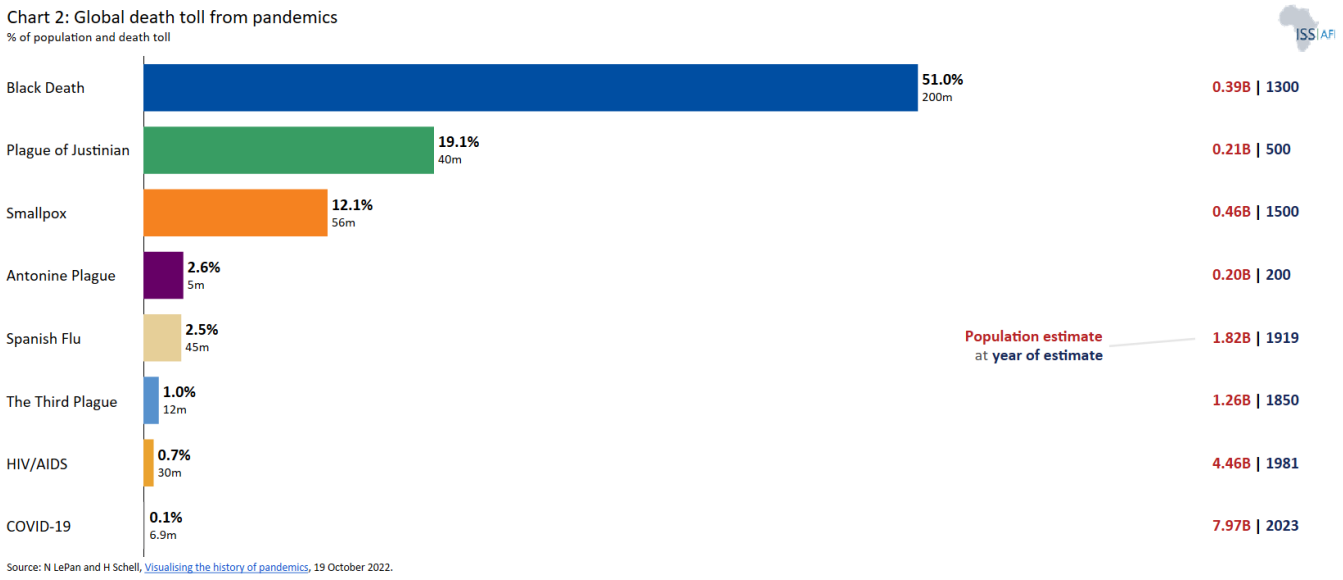
natural constraint on the breeding cycle of parasites, viruses, bacteria and insects,[3] but in sub-Saharan Africa, this cycle is not similarly disrupted. There, vector-borne diseases have been regularly transmitted to humans by mosquitoes, ticks and tsetse flies common in tropical and sub-tropical regions such as Central Africa and places where access to safe drinking water and sanitation is limited.

Vector-borne diseases have been endemic in large parts of Africa for thousands of years, which, in addition to their impact on humans, also prevented the use of the horse, ox or camel and so limited opportunities for agriculture and technological progress.[4] Malaria is particularly prevalent in Africa, with around 90% of cases and deaths still occurring here. The continent also accounts for 34 of the 47 countries prone to yellow fever outbreaks and about 40% of the global burden of lymphatic filariasis (elephantiasis), both being diseases spread by mosquitoes in tropical areas. Today, 16 of the 30 countries listed by the World Health Organization (WHO) as having a high burden of tuberculosis are in Africa, although none are in the top five.

In around 1 000 BCE, large populations[5] eventually appear to have grouped in five regions globally: China, the Indian subcontinent, Egypt, the Fertile Crescent, and Europe.[6] The sizable African continent, by contrast, had a much smaller population, perhaps even fewer than 20 million people, half of which was by then concentrated in a single area along the fertile Nile Valley.[7]

Although disease burdens in Europe and Asia were, on average, lower than in Africa, nature eventually reasserted itself in humanity's new habitats outside the continent. Most of today's most prominent infectious diseases, including the predecessors of HIV/AIDS and COVID-19, emerged in the last 11 000 years, following population increases and the rise of agriculture. Larger settlements, such as permanent villages and towns, swept away the spatial limitation on the spread of disease. In particular, introducing domesticated animals, for example dogs, cats, pigs, cattle and horses, increased human exposure to infectious diseases much of which was spread by rats and fleas. Three-quarters of emerging human infectious disease outbreaks are zoonotic, meaning they originate from pathogens infecting animals that then 'jump' species and infect people. Indeed, COVID-19 is a potent modern example of this phenomenon.[8]

Largely because of its low population densities and the ability to continue with hunter-gatherer lifestyles in its vast interior, the technological developments that accompanied the Bronze Age and the Iron Age bypassed much of sub-Saharan Africa. As a result of its relative isolation from global trade and conquest, Africa was also less affected by population bottlenecks (or near extinction events), such as significant famines, genocidal wars or the great plagues that affected the rest of the world, such as the Plague of Justinian, which reduced Eurasian populations by a quarter from CE 541 to 549.[9]



During the bubonic plague, or Black Death, that swept through Asia and Europe in the 14th century, between a quarter and two-thirds of the European population died. However, agriculture was a large enough driver of population growth, and population numbers soon started to increase again.[10]

For a while, it seemed that the African civilisations that had developed in modern-day Ethiopia (such as Aksum) and the west along the Niger River (such as the wealthy Mali Empire) could rival those elsewhere. South of the Sahara, the Bantu people had domesticated cattle and grew sorghum and millet. They had also discovered iron, but they and other groups were, at that point, not technologically advanced enough to resist external intrusion.

More and better food, improved technology and the benefits of trade would see the population of the region today known as sub-Saharan Africa increase to nearly 70 million by the middle of the 15th century, larger than that of Europe and approaching the population size of China but spread over a much larger area. However, in the three centuries that followed, the riches from the conquest of South America and the industrial revolution in Europe and then in North America saw Europe spurt ahead, leaving Africa and much of Asia behind.[11]

But, because of its high disease burden and the result of slavery that reduced productive labour in large tracts of Africa, the continent remained more rural than other regions with significant effects on the provision of safe water, improved sanitation and other basic infrastructure. The impact of these deep drivers of Africa's slow development continue to linger, particularly in considering the linkage between urbanisation and disease.

Urbanisation and disease

In densely populated parts of the world, such as Western Europe and later North America, the pull of industrialisation and the subsequent rise of large cities required authorities to implement closed sewage systems and other measures to combat infectious diseases. But by the time Africa started to urbanise (towards the end of the 19th century), imported modern medicine (vaccines and later antibiotics) allowed for higher population densities without the need, by colonial authorities, to invest in health infrastructure. Larger communities of people were able to live in denser settlements — not because of city planning or appropriate housing laws and adequate municipal water and sewerage infrastructure, as was required elsewhere to contain disease and plague, but because modern medicines served as an effective alternative to keep infectious diseases under control.[12]

Even today, many African countries have poor sanitation, making people more susceptible to the impact of infectious diseases, although access to safe water is steadily improving. The simple but essential act of washing one's hands is difficult without consistent and reliable access to clean water. The situation is particularly bad in rural areas, where more than half of Africa's population live. In 2019, only 79% of Africans had access to improved water supply compared to 96% of the people in the rest of the world. Even the term 'improved' in this context is a low bar as it simply means that, by nature or construction, water is protected from outside contamination, particularly faecal matter. Cholera, an acute diarrhoeal infection primarily caused by contaminated water, has, for example, become endemic in Africa. Over the past four decades, Africa has recorded 79% of global outbreaks, which place significant strain on the healthcare facilities across the continent. This situation will, however, slowly improve. By 2030, access to improved water in Africa will increase to approximately 82%, and to 87% by 2043. Piped water access in Africa, which can guarantee water free from contamination, was much lower in 2019 at 43% of the continent's total population compared to the average for the rest of the world at 70%.

The sustainable development goals (SDGs) target is for 98% of the population in all countries to have access to improved sanitation services by 2030, but is it likely that this will only be possible for less than 63% of Africa's population (up from 57% in 2019). Only about 19% of Africa's population is expected to have access to wastewater collection and treatment

systems in 2030 compared to the average in the rest of the world then, of 47%. Eight African countries (Libya, Morocco, Seychelles, Algeria, South Africa, Botswana, Tunisia and Cape Verde) will be above the average for wastewater connections in the rest of the world (i.e. the world without Africa) in 2030.

Low levels of urbanisation are a drag on the provision of bulk infrastructure and limit the potential for rapid improvement. On the other hand, it likely constrains the spread of infectious diseases such as HIV/AIDS and COVID-19.

The impact of HIV/AIDS

The ancestor of the human immunodeficiency virus (HIV) is the simian immunodeficiency virus (SIV), an infection of African monkeys that spread to chimpanzees and eventually to humans. SIV is several thousand years old and may even have been around millions of years ago. The spread of SIV to humans is no surprise, with several major human infectious diseases all having made the interspecies jump. However, subsequent outbreaks historically did not cause severe epidemics in Africa as population densities were too low to sustain their spread. As a result, the outbreaks died out.

However, as population sizes increased, there was eventually a sufficient number of human hosts to allow SIV to survive and mutate. It eventually evolved into HIV, apparently first in the western equatorial region of Africa (today known as Cameroon and the Democratic Republic of Congo (DR Congo). During subsequent decades, subgroups of the virus infected eastern, southern and western Africa, often spreading along transport routes.

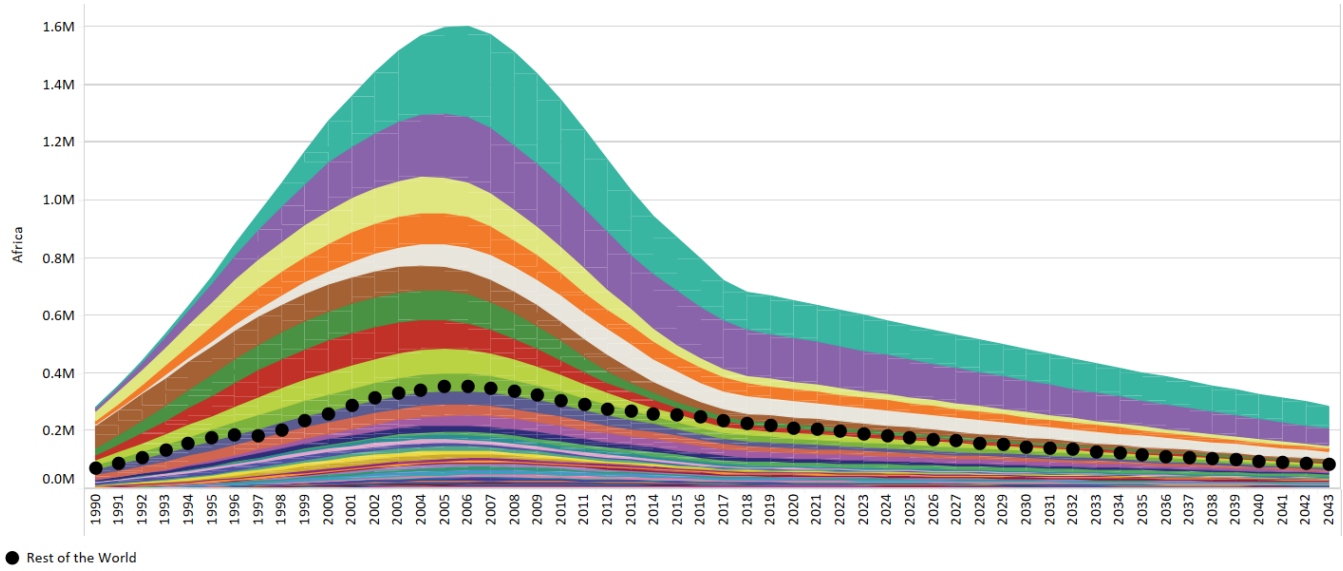
The slow-acting, asymptomatic incubation period of HIV and the eventual appearance of diverse opportunistic infections defied prompt diagnosis and action until it had reached momentous proportions by the mid-1970s.[13] The acquired immunodeficiency syndrome (AIDS) was first recognised as a new disease in 1981 and only by 1983 had HIV-1 been isolated and discovered. In Africa, HIV/AIDS further remained unrecognised and undetected for so long because of the continent's inadequate health systems, poor infrastructure and limited medical research capacity, which allowed it to silently spread across the globe.

Even after HIV/AIDS was recognised as a major health threat, a lack of government capacity, fear, stigma and the denialism of influential leaders such as President Thabo Mbeki of South Africa led to the unnecessary loss of hundreds of thousands of lives. In South Africa, the country with the most significant AIDS death rate globally at the time, Mbeki's stance would eventually contribute to his being ousted as president in 2008 in favour of a flawed replacement, Jacob Zuma.

AIDS is not the first modern pandemic,[14] yet its impact has likely been the most pronounced. Sub-Saharan Africa has suffered a tremendous toll. From 1998 to 2013, more than a million Africans died annually from AIDS, and during the peak of the pandemic (2005/06), more than 1.5 million died each year. By 2019, almost 32 million Africans had succumbed to the disease.

The AIDS pandemic dramatically impacted health outcomes, particularly in Southern Africa. Cumulative AIDS-related deaths over the past three decades have been highest in South Africa, Nigeria, Tanzania, Uganda, Kenya, Zimbabwe, Ethiopia, Mozambique, Malawi and Zambia (see Chart 3). It had a serious effect on economic productivity and a disastrous impact on families and communities. Life expectancy in these countries fell precipitously and has still not recovered to the pre-AIDS trajectory. To date, Eswatini, Botswana, Lesotho, South Africa, Zimbabwe, Namibia, Mozambique, Zambia and Malawi record the highest HIV prevalence rates among their adult populations, placing significant strain on these countries' healthcare services.

Chart 3: AIDS-related deaths, history and forecast, 1990–2043

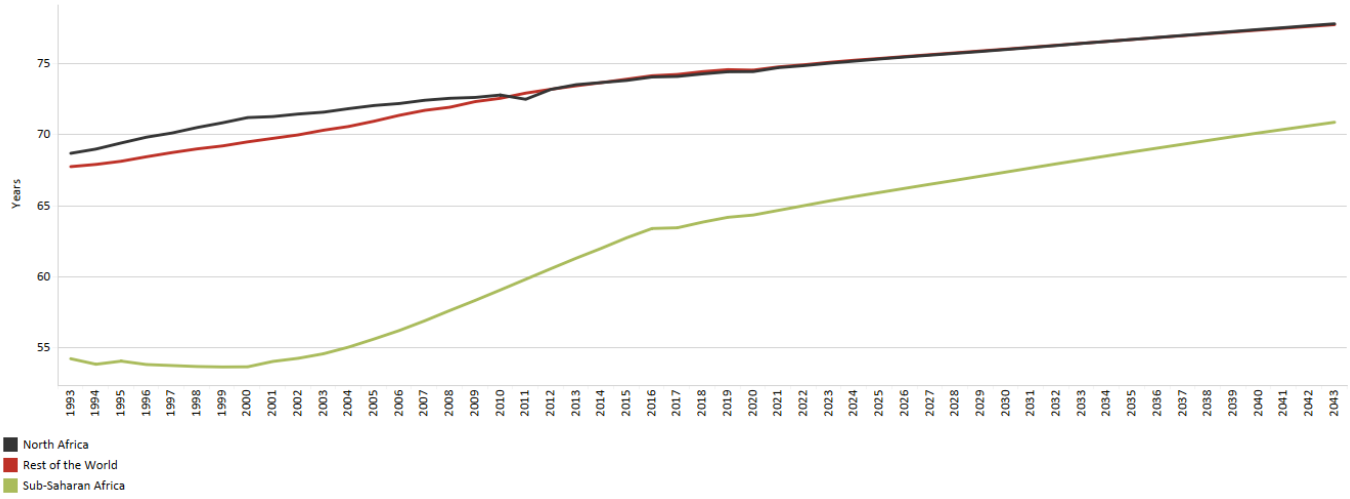


Source: IFs 7.84 initialising from IHME GBE data

The impact of AIDS on life expectancy can be seen in Chart 3. Before the peak of the AIDS pandemic, life expectancy in Southern Africa was significantly above that in East, West and Central Africa, but by 2004 it was below that of all those regions and is now on a similar trajectory to Central Africa. Life expectancy in North Africa, which was not substantially affected by AIDS, is comparable with the global average.

Since the peak of the AIDS pandemic in 2005/06, improvements in awareness and treatment (particularly in the mass roll-out of antiretrovirals) and prevention campaigns have reduced the impact of the disease. Life expectancy has consequently partially recovered but it has still not caught up with the rest of the world. By 2019, the gap in life expectancy between sub-Saharan Africa (64.2 years) and the global average (73.1 years) was almost nine years. At that time, life expectancy was almost 70 years in South Asia and 76.6 years in South America, the two other regions most comparable with Africa.

Chart 4: Life expectancy for selected regions, 1993–2043



Source: IFs 7.84 initialising from IHME GBE data

HIV/AIDS dealt sub-Saharan Africa (in particular Southern Africa) a devastating blow and its effect was accentuated by what

has subsequently become known as vaccine apartheid—the fact that antiretroviral drugs for HIV in bulk reached low- and middle-income countries 10 years after their discovery, resulting in the prolongation of the HIV crisis in the Global South. The pandemic hit Africa at a time when the continent had shown signs of a turnaround from the declining economic growth prospects in the 1980s and 1990s. An important reason for Africa's low economic growth at that time was the decline in the proportion of working-age persons to dependants, examined in the theme on demographics.

The impact of HIV/AIDS continues to linger in Africa, although mortality levels have declined by more than 55% since 2010. In 2021, an estimated 65% of all AIDS-related deaths occurred in Africa.

COVID-19

COVID-19, the disease caused by the SARS-CoV-2 virus, came to international prominence after it was first detected in the Wuhan Seafood Wholesale Market in Hubei province in China in December 2019. It spread rapidly and globally thereafter.

At the height of the COVID-19 pandemic, the UN described it as 'the greatest test that we have faced since the formation of the United Nations.' The International Monetary Fund (IMF) categorised it as 'the worst economic fallout since the Great Depression.' Globally, trillions of US dollars have been committed to fighting both the direct and indirect effects of the pandemic. By September 2021, the US alone had spent and allocated more than US$8 trillion and, by some estimates, much more.

Whereas HIV/AIDS had a dramatic impact on mortality and hence life expectancy, the economic impact of the COVID-19 pandemic far outweighs its effect on mortality.

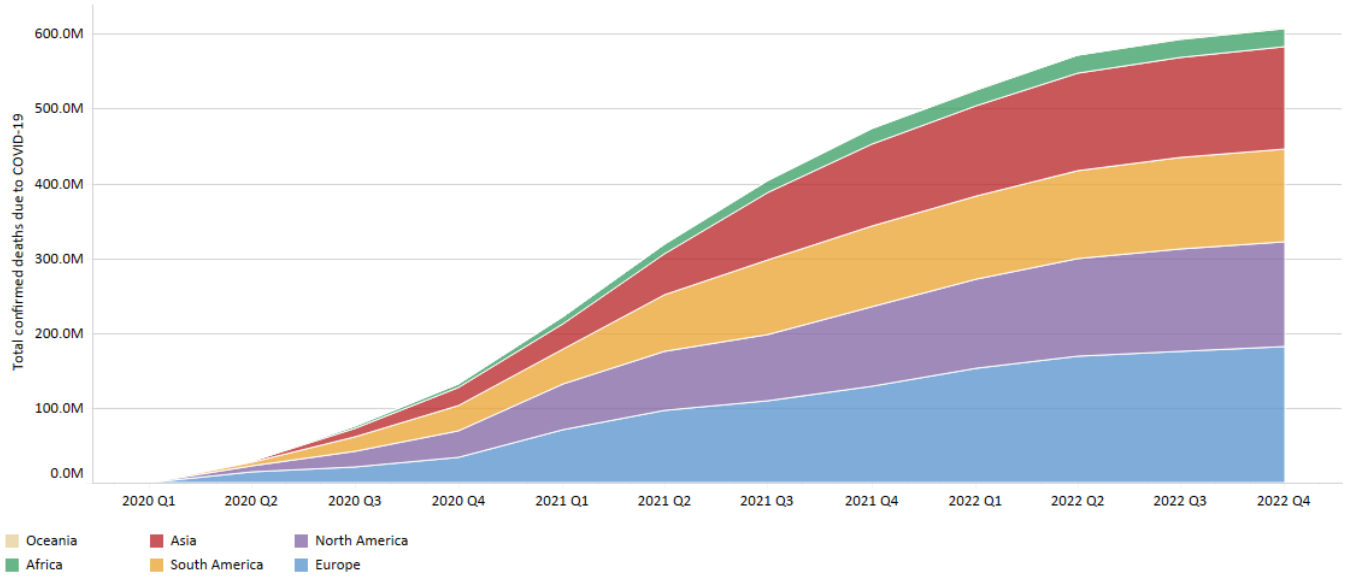
Compared with HIV/AIDS, recorded infections and mortality in Africa due to COVID-19 are lower by a factor of five than in the Americas, Europe and even, marginally, Asia. This is due to Africa's smaller fraction of elderly people, which translates into lower rates of obesity, diabetes and other non-communicable comorbidities than in developed countries. The pandemic spread particularly rapidly in upper-middle-income countries such as South Africa, as well as in a number of Southern African Development Community (SADC) countries, and in North African countries (Tunisia, Egypt and Morocco), where comorbidities—such as hypertension, diabetes, chronic obstructive pulmonary disease, HIV and obesity—increased the severity and risk of mortality in COVID-19 affected patients.

Other reasons for the lower infection and mortality rates (not yet conclusive) include:

- a tuberculosis vaccine (BCG) routinely given to children in many African countries, which may have reduced the likelihood of deaths from COVID-19
- prior exposure to other coronaviruses, including those that cause the common cold, providing a degree of resistance in some of the very communities once thought to be most vulnerable, and
- the spatial and temporal clustering of population groups contributing to slower transmission rates.

However, subsequent research found that COVID-19 numbers of cases and deaths in Africa were under-reported by a factor of 8.5 with large country-to-country variations due to the weakness of the health systems at country level.

Chart 5: Cumulative deaths by region due to COVID-19



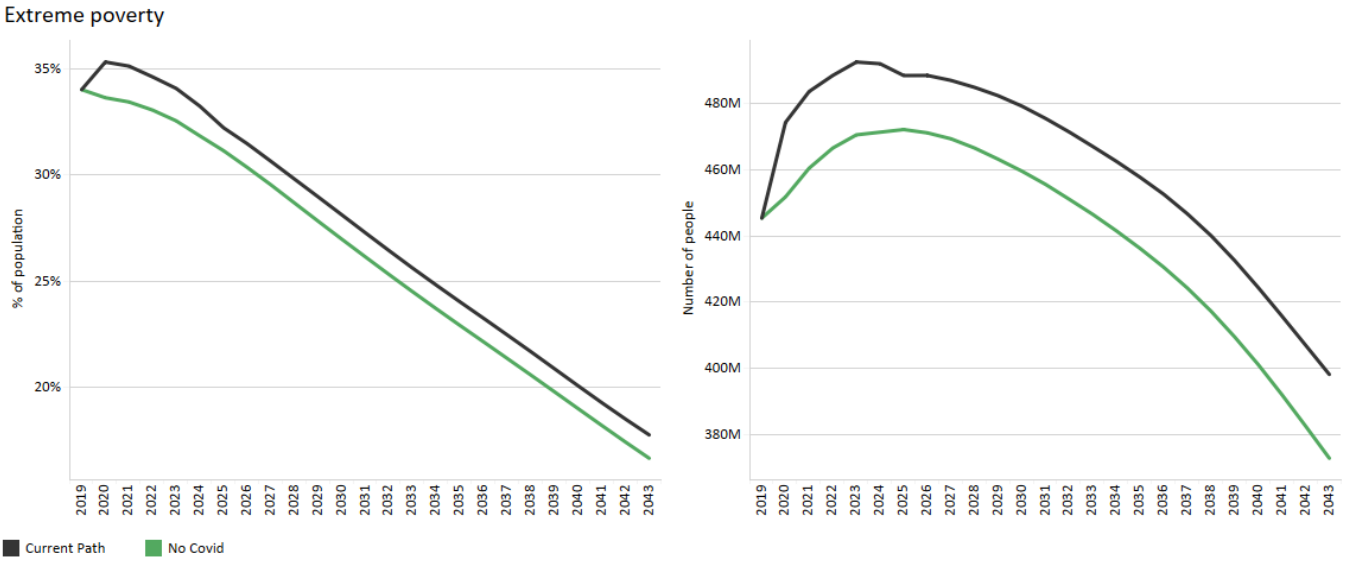
Source: COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University

Africa (and much of the rest of the developing world) vaccinated slowly, initially because of a lack of vaccines. Reflecting on their experience during the HIV/AIDS pandemic, African leaders, including the South African and former Kenyan presidents, have spoken out against a repeat of the vaccine apartheid that characterised the early years of the HIV/AIDS pandemic. At the height of the COVID-19 pandemic, there were fears that Africans could be stigmatised and excluded from international travel and business while they waited for vaccination even as the rest of the world moved on.

Vaccination inequity allows the evolution of possible new vaccine-resistant strains, which could undo the vaccination efforts in the rest of the world. This has led to calls for intellectual property restrictions concerning vaccine development to be waived so that vaccine production can be boosted in developing countries to somewhat equalise its distribution. The US belatedly indicated its support for the move, only to be blocked by opposition from countries in Europe where many of the large pharmaceutical companies are based.

The economic impact of COVID-19 and the associated countermeasures (lockdowns, disrupted trade chains, etc.) on Africa outweighed the health damage. Shown in Chart 6, COVID-19 probably condemned 24 million to 25 millions more Africans to extreme poverty in 2020 and 2021, and incomes declined. Using the GDP per capita as a measure, the Current Path forecast shows that Africa will likely return to its 2019 average only by 2023. Many people will succumb to a lack of food as the efforts to constrain infection rates reduced economic activity and job security. Eventually, more Africans may die of the secondary effects of COVID-19, such as reductions in treatment available for other diseases due to health spending being diverted to combat COVID-19, than from the virus itself.

Chart 6: Impact of COVID-19 on extreme poverty (<US$1.90 per day) and GDP per capita (PPP) in Africa



Source: IFs 7.84 initialising from PovcalNet and WDI data

The associated global recession hit Africa very hard, particularly given the commodity dependence of many of its economies even before Russia's invasion of Ukraine and Western responses to that unprovoked war added to the pain.

In addition, the economic impact of COVID-19 has reduced government revenues (by US$73 billion in 2020), meaning less money is available for to provide security, build schools and develop infrastructure and healthcare services. The result has been an increase in instability, riots and protests.

The world is learning to live with COVID-19, much like it has learnt to live with HIV/AIDS and the additional security that disrupted international travel after 9/11. The pandemic has, however, also had many other effects, including greater awareness of global interdependence, the rise of remote work and a change in how we spend leisure time. It has boosted the service sector and underlined the importance of food security.

COVID-19 is only the latest in a series of pandemics, and luckily less deadly than many of its antecedents. West Africa may become a hotspot of zoonotic pathogens, given the density of humans, poultry, pigs and ruminants. The increase in human activity and its impact on the environment means that the frequency and severity of epidemics caused by wildlife zoonoses are increasing. A recent estimate puts the probability of a future zoonotic spillover event resulting in a pandemic of a similar magnitude to COVID-19 at 22% to 28% in the next 10 years, and at 47% to 57% in the next 25 years.

In addition to its historically high burden of communicable diseases, Africa will imminently face a second challenge: the early evidence of expensive non-communicable disease.

Sub-Saharan Africa's epidemiological transition and its approaching double burden of disease

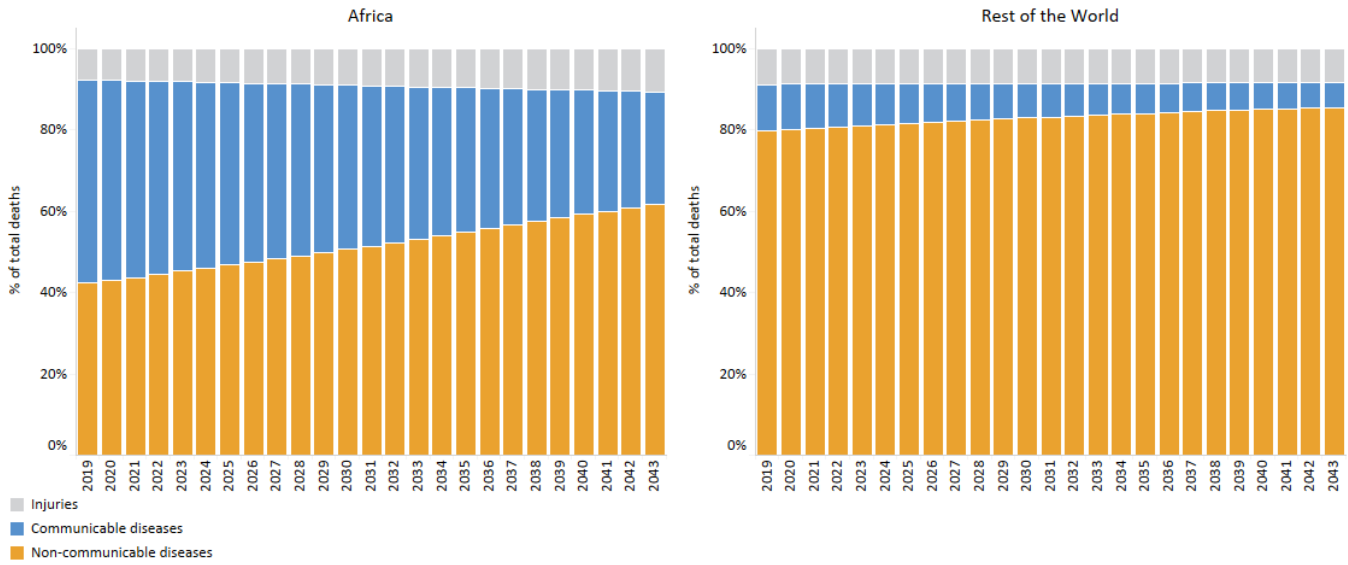
The typical evolution of the disease burden over time is that countries first experience a declining burden of infectious diseases and later experience an increased incidence of non-communicable diseases. That is, lifestyle diseases typical of older, sedentary population cohorts and those who consume processed foods inevitably increase as populations age. The change in the typical prevalence has important cost implications since treating and preventing infectious diseases, such as

influenza and mumps, is less expensive than treating non-communicable diseases, such as heart disease and diabetes, common among older populations.

The so-called epidemiological transition occurs when improved food security and innovations in public health and medicine result in infectious (or communicable) diseases being replaced as the dominant cause of death by chronic conditions, such as cancer.

Chart 7 presents death rates in Africa as a percentage of total deaths for the three major categories used in the Global Burden of Disease database, namely communicable diseases,[15] non-communicable diseases[16] and injuries,[17] compared to the rates for the rest of the world for the period 2019 to 2043. The data reflects Africa's high but declining communicable disease burden and the rapid increase in the continent's death rates from non-communicable diseases.

Chart 7: Deaths by major ICD categories, per cent of total: 2019 to 2043



Source: IFs 7.84 initialising from IHME GBE data

In 2019, Africa accounted for 47% of all infectious disease deaths worldwide, despite making up only 17% of the global population. It is partly because of this high (but declining) communicable disease burden that the current average life expectancy at birth in Africa (66 years) is much lower than that in the rest of the world (75 years). The 8.8-year gap in average life expectancy in 2019 between Africa and the rest of the world will decline to a six-year gap in life expectancy in 2043, largely because improvements in the prevention and treatment of communicable diseases are cheaper and easier to achieve.

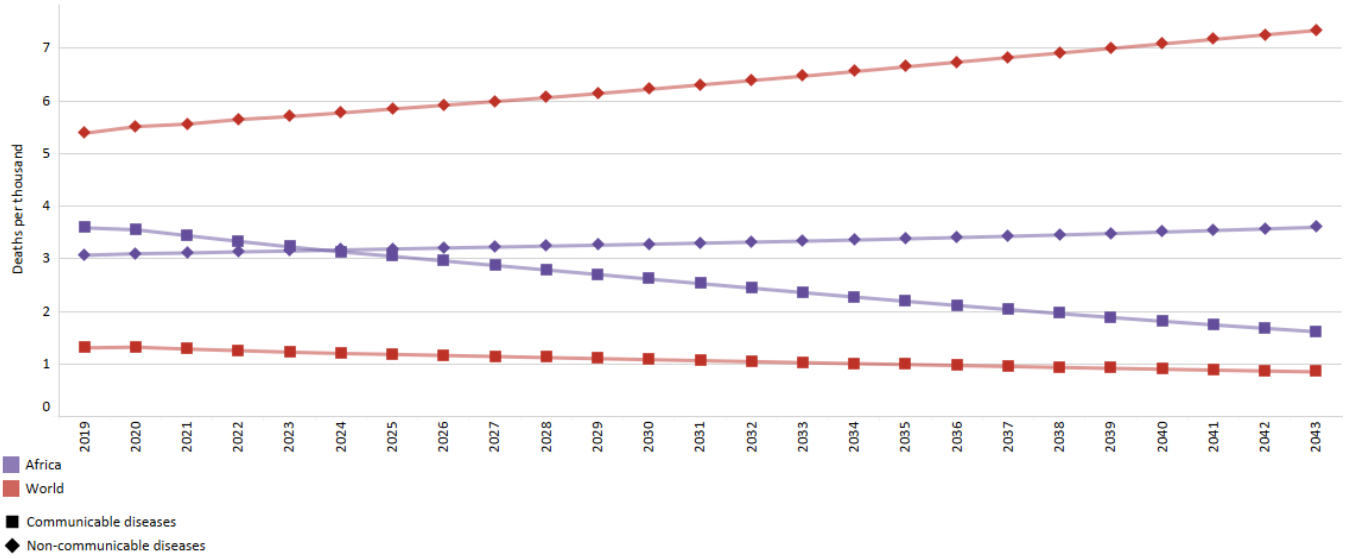
Africa's much higher infectious (communicable) disease burden reflects that it has a median age below 19 years compared to 33 years in the world without Africa. The effect of the median age is also reflected within the continent where the median age in North Africa is ten years higher than in sub-Saharan Africa, which inevitably experiences a much higher communicable disease burden. Infants and children, who are much more numerous in sub-Saharan Africa, are especially susceptible to communicable diseases. Poor living conditions, including unsafe water, poor housing and inadequate sanitation in sub-Saharan Africa, all create an environment conducive to the spread of communicable diseases. For example, in 2019 the Central African Republic (CAR) and Lesotho both recorded more than seven deaths per 1 000 people from communicable diseases, while Tunisia and Libya had rates below 0.3.

Two infectious diseases are particularly prevalent in Africa: in 2019, the continent experienced almost 90% of malaria deaths and about 75% of HIV/AIDS deaths worldwide.

The Current Path forecast is that annual fatalities from malaria and HIV/AIDS will decline due to better prevention and treatment, even as global populations grow. Compared to 556 000 deaths from malaria globally in 2019, fatalities in 2043 will halve. By 2043, deaths from HIV/AIDS globally will likely also be less than half that in 2019, but Africa will continue to bear a disproportionate higher burden.

At some point, as populations age and the nature of illnesses change, deaths from infectious diseases are overtaken by deaths from non-communicable diseases. The transition occurred more than a century ago in Europe and North America. In Latin America and the Caribbean, it happened in South Asia around the start of the current century. It is currently happening in North Africa and will only occur in 2030 in sub-Saharan Africa with its very young population.

Chart 8: Deaths rates for communicable and non-communicable diseases for selected regions, 2019–2043



Source: IFs 7.84 initialising from IHME GBE data

In sub-Saharan Africa, the transition to deaths due to 'diseases of affluence' is happening at lower levels of income and urbanisation than elsewhere. The transition will present health systems with higher costs as they navigate increasingly complex public health landscapes. Africa's low average incomes translate into limited state budgets and capacity to provide the necessary healthcare to treat non-communicable diseases. Hence, Africa's epidemiological transition will occur at a point when incomes are still quite low compared to the point at which the transition occurred elsewhere.

The increasing prevalence of chronic non-communicable diseases such as obesity, hypertension, diabetes and heart diseases, on top of the battle to deal with infectious diseases such flu, has come to be termed a 'double burden of disease'.

The result of sub-Saharan Africa's approaching double burden of disease will be more sick adults, requiring more resources to prevent and treat than non-communicable conditions, as well as present a more complex problem. Pollution and tobacco are also proving to be a challenge, as tobacco companies are now actively targeting the next generation of smokers, all of whom are in the developing world. Health expenditure per person in North Africa is already almost four times that in sub-Saharan Africa, and Europe, with its much older population, spends several times more still per capita on health compared to North Africa.

Finally, an important underlying cause of child deaths in low- and middle-income countries can be attributed to macro- and micronutrient undernutrition; whereas excessive intake of calories is one of the main common factors causing cardiovascular diseases, diabetes, high blood pressure, etc. Thus, undernutrition of children and over (and wrong)

nutrition of adults is resulting in high rates of obesity in countries such as South Africa, establishing a link in some countries between poverty and obesity. Africa's approaching double burden of disease is therefore compounded by a double burden of malnutrition. According to Ivana Koli:

A driving force behind the shift from undernutrition in childhood to overnutrition in adulthood in low- and middle-income countries (LMIC) was the rapid increase in economic development, globalisation, and urbanisation, leading to tremendous changes in lifestyle marked predominantly by changes in diet and physical activity and under- and overnutrition occurring simultaneously among different population groups.

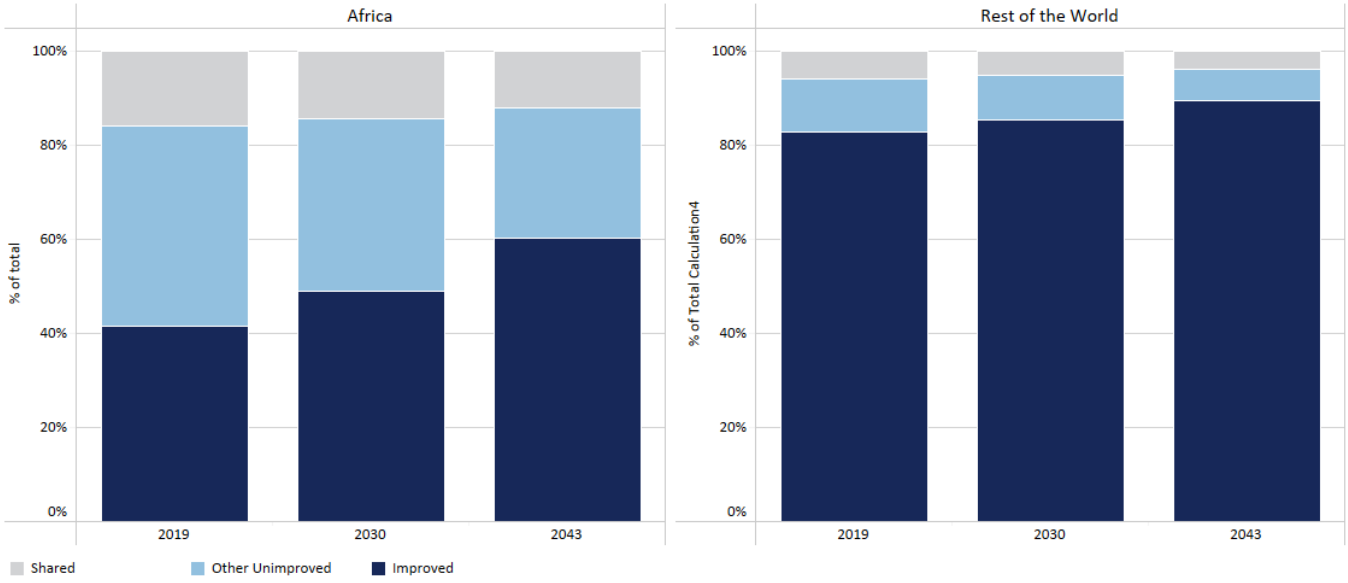
WaSH infrastructure, health and human development

Sub-Saharan Africa is approaching its epidemiological transition with a severe lack of essential infrastructure that is able to provide clean water and proper sanitation(i.e. where drinking water is not contaminated by faecal matter that is hygienically separated from human contact).

In 2019, only about 57% of Africa's population had access to an improved sanitation facility (50% in sub-Saharan Africa), while the average for the rest of the world (the world without Africa) was approximately 89%. For clean water, the rates are only slightly improved, with about 79% of people in Africa having access (76% in sub-Saharan Africa) compared to more than 96% in the world without Africa. In comparison, about 74% of people in South Asia had access to an improved sanitation facility in 2019, and about 95% of the region had access to potable water.

In the Current Path forecast, only 58% of sub-Saharan Africa's population will have access to an improved sanitation facility by 2030 and just over 75% will have reliable access to clean drinking water. Although almost 85% of the population in sub-Saharan Africa is set to have access to improved water in 2043, it will still be thirteen percentage points short of the 98% 2030 SDG target. Similarly, despite improved sanitation projected to be available to 58% of the population — a vast improvement from the current figure — it is far from the 2030 goal of near universal access.

Chart 9: Proportional access to WaSH facilities on the Current Path, 2019, 2030 and 2043



Source: IFs 7.84 initialising from JMP / UNICEF

In 2019, 224 million people in the DR Congo, Ethiopia and Nigeria alone were living without access to improved sanitation facilities. This number will increase to about 255 million by the time the SDGs are meant to be achieved (2030). It will likely decline to 159 million in 2043, with much of that improvement in Ethiopia only. Nigeria's rapid population growth will

continue to put pressure on basic infrastructure as it will have 109 million people without sanitation in 2043 compared to 101 million in 2030. Despite their massive economic potential, these large populations seem likely to suffer from a lack of proper sanitation for the foreseeable future; even Ethiopians will have to wait for decades for their expected improvement.

The picture is similar to nearly any other measure of access to infrastructure or services. For example, in 2019 about 97% of global populations outside of Africa had access to electricity, whereas in Africa, the figure was approximately 54% (and 46% in sub-Saharan Africa). The use of solid fuels instead of electricity for cooking and heating is also a significant source of indoor air pollution with all kinds of associated health complications. This lack of access to physical infrastructure and basic services constrains Africa's ability to develop its human potential fully and thus capitalise on its future demographic dividend.

WaSH infrastructure supports the development of broader human potential through its strong forward linkages to other vital aspects of the SDGs, such as poverty, education and gender equality. Improved WaSH infrastructure generally translates into sizable gains in the overall development of a country as it improves on the human capital contribution to economic growth.

For example, children who do not have adequate access to WaSH facilities are more vulnerable to undernutrition. Malnourished children are not only highly susceptible to infectious diseases, with diarrhoeal diseases being among the most frequent and severe examples, but may also suffer other lifelong effects such as stunting (low height for age).

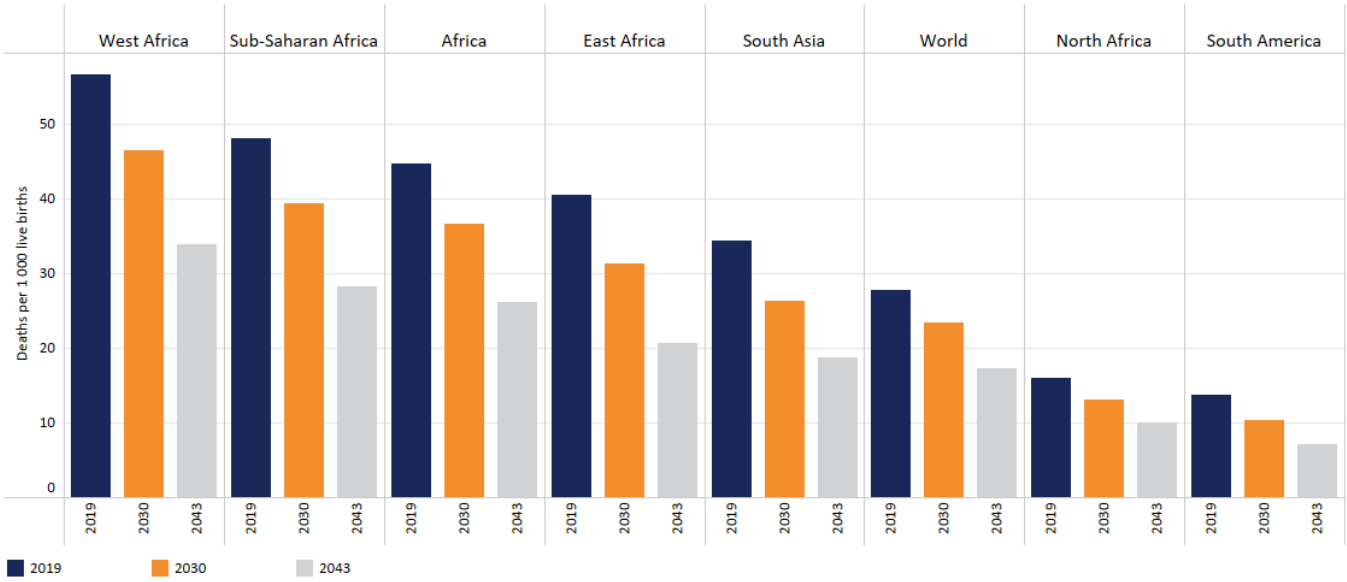
Stunting impairs both physical and cognitive development. According to the WHO, stunted individuals suffer from 'poor cognition and educational performance, low adult wages, lost productivity and, when accompanied by excessive weight gain later in childhood, an increased risk of nutrition-related chronic diseases in adult life.' Put bluntly: stunting is an irreversible condition that inhibits the potential of the affected individual or community for life. Although the overall rate in sub-Saharan Africa is 'only' about one-fifth (with only a modest decline forecast to 2043), about one-third of children below 5 years are stunted.

Insufficient WaSH access leaves all children vulnerable, but as they mature, the negative impacts disproportionately affect girls and women. Poorly maintained or non-existent WaSH facilities are one of the main causes of the high rate of school dropout among teenage girls, who lack menstrual hygiene services, for example. This, in turn, could lead to a large disparity in educational attainment between men and women and significantly diminish the economic opportunities for women, translating to lower growth for society as a whole.

There are immense challenges to advancing access to WaSH infrastructure in sub-Saharan Africa given the extent of rural populations that make the provision of bulk infrastructure expensive. Even upper-middle-income countries in Africa are struggling to expand access to WaSH infrastructure. Of Africa's seven upper-middle-income countries, only Mauritius and Libya were above the global sanitation access average for countries in this category (about 92%) in 2019. Modern technology, particularly the provision of decentralised off-grid electricity supply, provides many opportunities, however.

Infant mortality rates[18] illustrate the exceptional situation in Africa (Chart 10). At 48 infant deaths per 1 000 live births in 2019, infant mortality in sub-Saharan Africa recorded more than double the average for the world without Africa (which was at 20), and is more than three times higher than in South America (which was at 14).

Chart 10: Comparison of infant mortality in different regions, 2019, 2030 and 2043



The Demographics and Health scenario

This section explains the structure of a Demographic s and Health scenario which could set the continent on a different human development trajectory from the Current Path forecast.

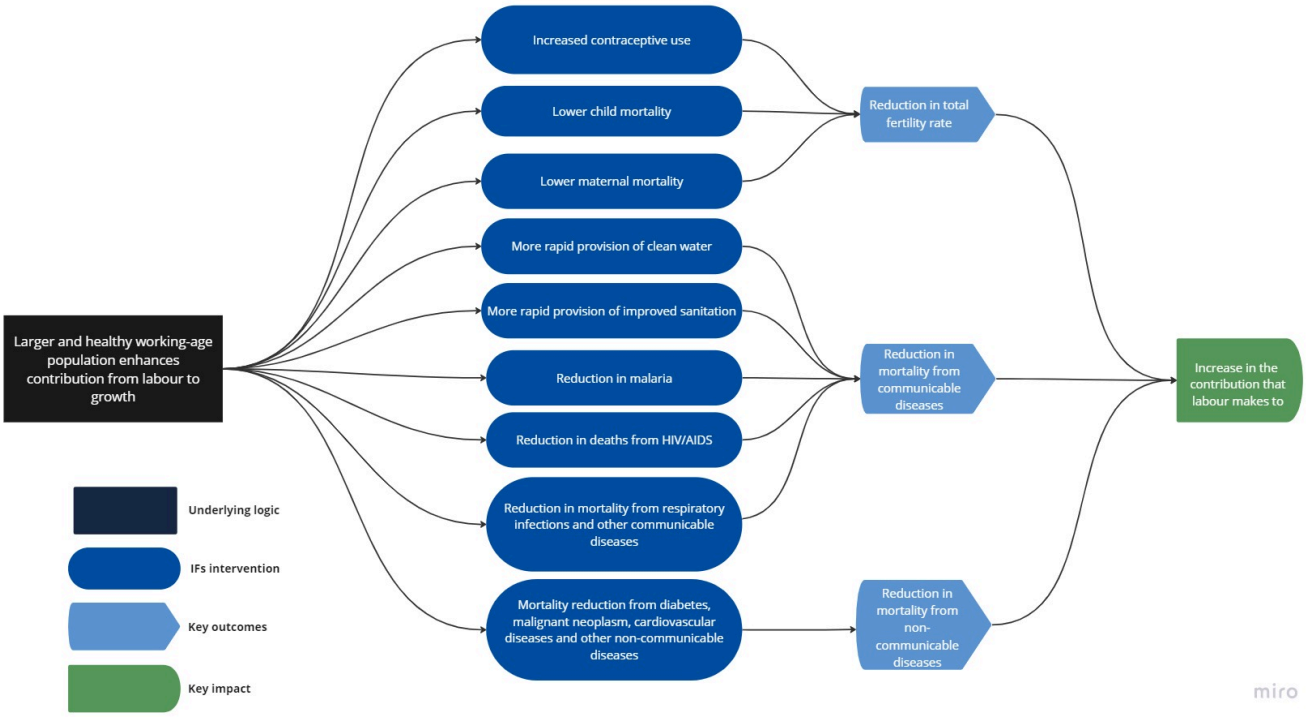
The parameters that impact on demographics (Chart 11) consist of the following country-level interventions, benchmarked to reflect reasonable but ambitious targets for countries at similar levels of development:

- The first intervention is the large-scale roll-out of modern contraceptives in sub-Saharan Africa since total fertility rates in North Africa are already low. In 2019, only 31% of fertile women in sub-Saharan Africa were using modern contraceptives, ranging from 84% in Seychelles to below 6% in South Sudan. No interventions are made for Namibia, South Africa, Botswana, Libya, Seychelles and Mauritius as they all have relatively high levels of contraceptive use and low total fertility rates. The impact of the scenario is that contraceptive use among fertile women in Africa is, on average, 16 percentage points higher in 2043 than in the Current Path forecast (51% versus 67%).

- A second intervention consist of the reduction in under-five and maternal mortality[19] from communicable diseases. A high under-five mortality rate translates into families having more children. We push aggressively for improvements to basic healthcare to reduce child and maternal mortality rates. The interventions are most aggressive in low-income African countries and least aggressive in middle-income countries.
  - Under-five mortality declines to 29 deaths per 1 000 live births in Africa by 2043 instead of 40 deaths in the Current Path forecast, with large country-to-country variations.

Average maternal mortality in Africa (at 450 deaths per 100 000 live births in 2019) declines to 131 deaths in 2043 compared to 194 in the Current Path forecast.

Chart 11: Demographics and Health scenario



The parameters that impact on health consists of the following interventions that are all done at a country level and are benchmarked to reflect reasonable but ambitious targets for countries at similar levels of development:

- The first intervention is the more rapid provision of basic infrastructure (clean water and improved sanitation), which pushes on the drivers of Africa's high communicable disease burden as well as indirectly on improving productivity given a generally healthier workforce.[20]
  - In the Current Path forecast, several countries (e.g. Ethiopia, the Republic of the Congo and Togo) expect substantial improvements in sanitation provision by 2043. The push by the combined scenario is largest in the poorest countries, which are the least connected to improved sanitation in the Current Path, translating to improvements of up to 27% in Chad, 21% in Madagascar and 16% in Sudan by 2043. The average for Africa in 2043 is 4% above the Current Path forecast, translating into 70 million additional Africans with access to improved sanitation (1.730 billion instead of 1.667 billion).
  - The earlier and more rapid improvement in access to safe water is that, by 2043, 44 million more Africans will have access to safe water in the combined scenario—an improvement of 2.5% above the Current Path forecast, equivalent to 30 million more people with access.

- The second intervention is large reductions in the incidence of HIV/AIDS and malaria in the countries most affected by these diseases on the back of expectations of rapid progress in prevention and treatment. The intervention accelerates the rapid decline in both diseases already reflected in the Current Path.
  - In 2019, roughly 638 500 Africans died from malaria. In the Current Path forecast, 429 300 will die in 2043 but the number declines to 171 600 in the Demographics and Health scenario. In October 2023 the WHO announced that it recommended a new vaccine, R21/Matrix-M, the second malaria vaccine to win such approval on top of the RTS.S vaccine recommended in 2021, with the potential to close the large demand-and-supply gap.
  - Instead of 285 400 AIDS-related deaths in 2043, only 173 900 deaths occur in 2043—much lower than the 664 400 deaths in 2019.

- Mortality is also reduced in countries with high levels of respiratory infections, respiratory diseases and the category of

'other communicable diseases'.

- Modest reductions in the incidence of non-communicable diseases, namely diabetes, malignant neoplasm and cardiovascular diseases, in most highly affected countries, and the category of other non-communicable diseases, also based on ongoing improvements in medical technology.

The result of these interventions is a 37% reduction in deaths in the broad category of 'communicable diseases' in Africa by 2043 and a 1.5% reduction in non-communicable disease deaths, much of the latter in North Africa.

Given how far behind Africa is on these indicators compared to other regions, the Demographics and Health scenario does not get Africa to achieving the respective SDGs by 2030. Rather, they reflect a determined and ambitious push against what was historically achieved in South America and South Asia—the two regions most comparable to Africa. Although Africa has registered substantial improvements in a handful of targets (notably reducing AIDS-related deaths), the continent is likely to miss all the health-related SDG targets, often by substantial margins.[21]

Where to find the impact of the Demographics and Health scenario

The two scenario components, demographics and health, are presented separately in most of the geographic reports elsewhere on the website and their combined application is being phased in over time.

Separate sections below discuss the combined impact of the Demographics and Health scenario on poverty, the GDP per capita, on sanitation and water access, the disease burden, and on infant mortality and life expectancy.

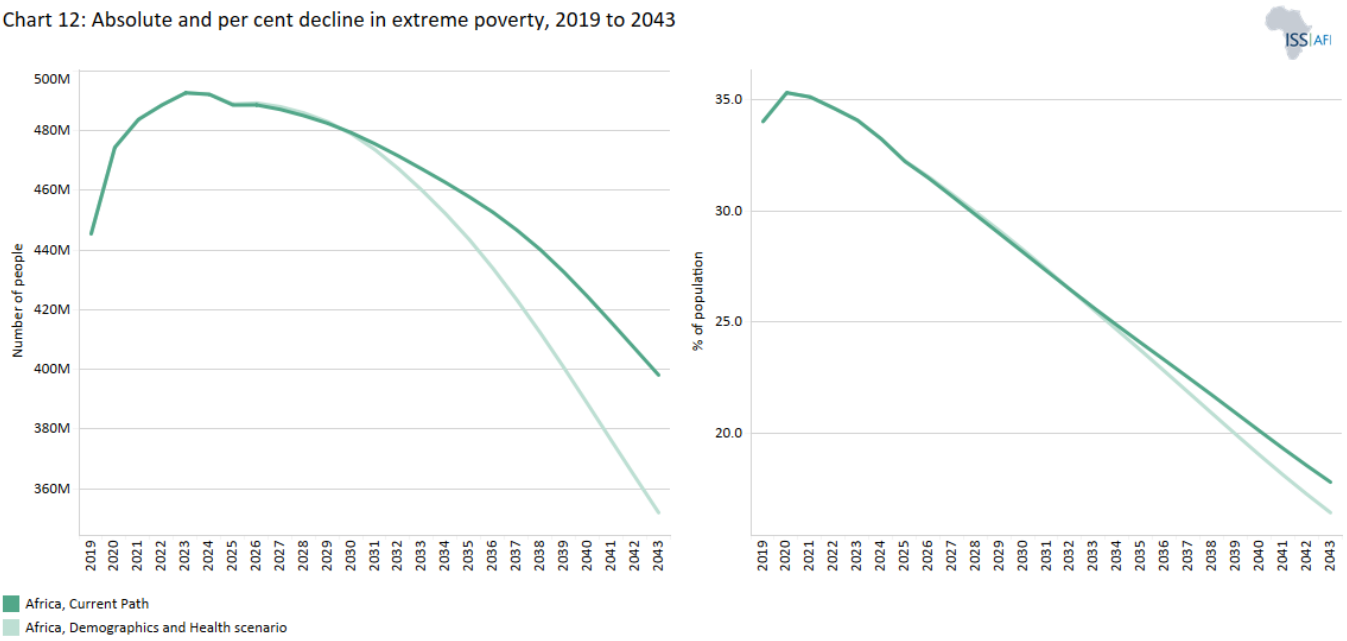
The theme on Africa's Demographic Dividend presents the combined impact of the Demographics and Health scenario on fertility rates, population structure, the African economy and global and African population forecasts.

Impact of the Demographics and Health scenario on poverty

The Demographics and Health scenario is projected to reduce the number of extremely poor Africans by 50 million to 348 million in 2043 (using the US$1.90 extreme poverty line) compared to the Current Path. This figure includes 14.2 million people in Nigeria, 6.2 million people in the DR Congo and 3.7 million people in Madagascar. Instead of an extreme poverty rate of 18%, it could decline to 16.5%—a remarkable testament to the contribution that family planning and better healthcare can make to Africa's fortunes.

Chart 12 shows the decline in extreme poverty in millions per year for each African country and region (using US$1.90) that would follow the Demographics and Health scenario compared with the Current Path forecast. Because the scenario reduces the communicable disease burden rapidly in Nigeria (meaning a larger population) before the larger uptake in contraceptives has an effect, the initial impact is that extreme poverty in Nigeria is above the Current Path forecast until 2033 after which it declines. By 2043, Nigeria would have 15% fewer extremely poor people.

Chart 12: Absolute and per cent decline in extreme poverty, 2019 to 2043



Source: IFs 7.84 initialising from PovcalNet data

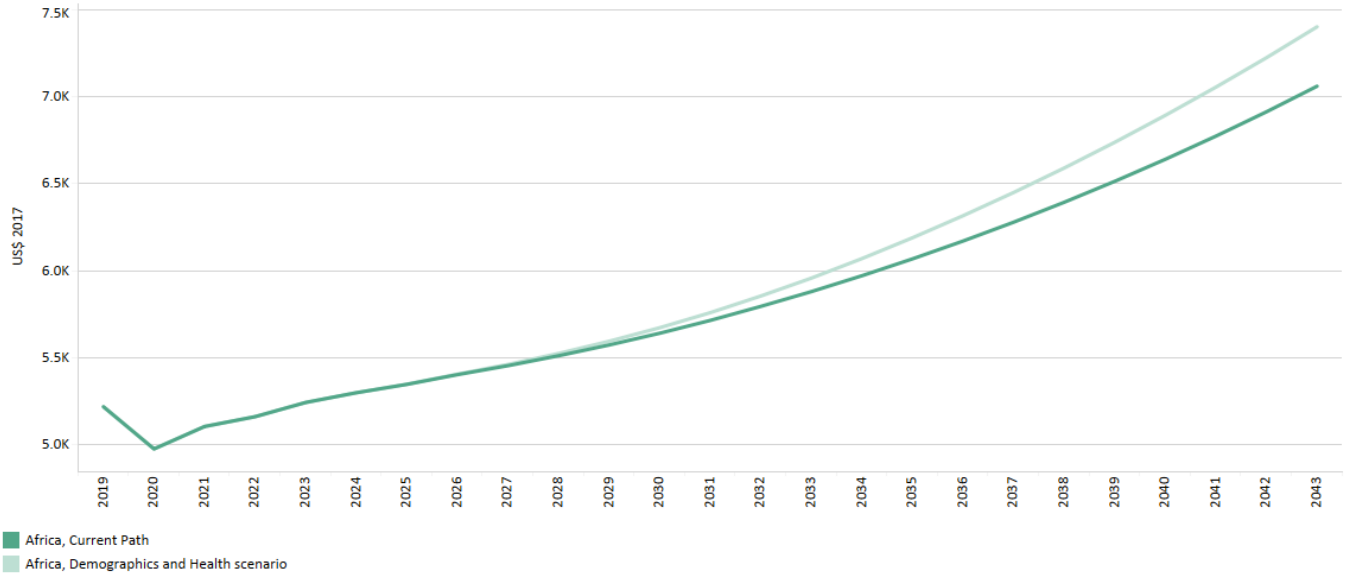
Health expenditure declines in most countries in the Demographics and Health scenario, except in a few countries such as Egypt and Algeria where the treatment of non-communicable diseases, such as cardiovascular and malignant neo-plasma afflictions, consume significant resources. On the back of a population that is 111 million smaller in 2043, cumulatively, African governments will spend US$150 billion less on health from 2023 to 2043. The required investment in WaSH infrastructure is US$64 billion, less than half that amount translating into a saving of US$86 billion.

These results reflect the benefits over long-term horizons that can be gained from investments in demographics and health on the back of medical breakthroughs with regard to AIDS and malaria, amongst others.

Impact of the Demographics and Health scenario on GDP per capita

Chart 13 presents the impact of the Demographics and Health scenario on the GDP per capita compared to the Current Path forecast. In absolute terms, Mauritius gains the most by 2043, with its GDP per capita improving by US$1 081, followed by Egypt by US$1 047—improvements of 6% and 4% above the Current Path forecast, respectively. However, it is always more reasonable to calculate the per cent improvement, according to which Morocco, Cape Verde, Libya, Tunisia and Seychelles gain less than a 1% improvement in the GDP per capita by 2043, while Madagascar, Malawi, Lesotho and Zimbabwe all gain more than 8%.

Chart 13: The impact of the Demographics and Health scenario on GDP per capita compared to the Current Path forecast



Source: IFs 7.84 initialising from WDI data

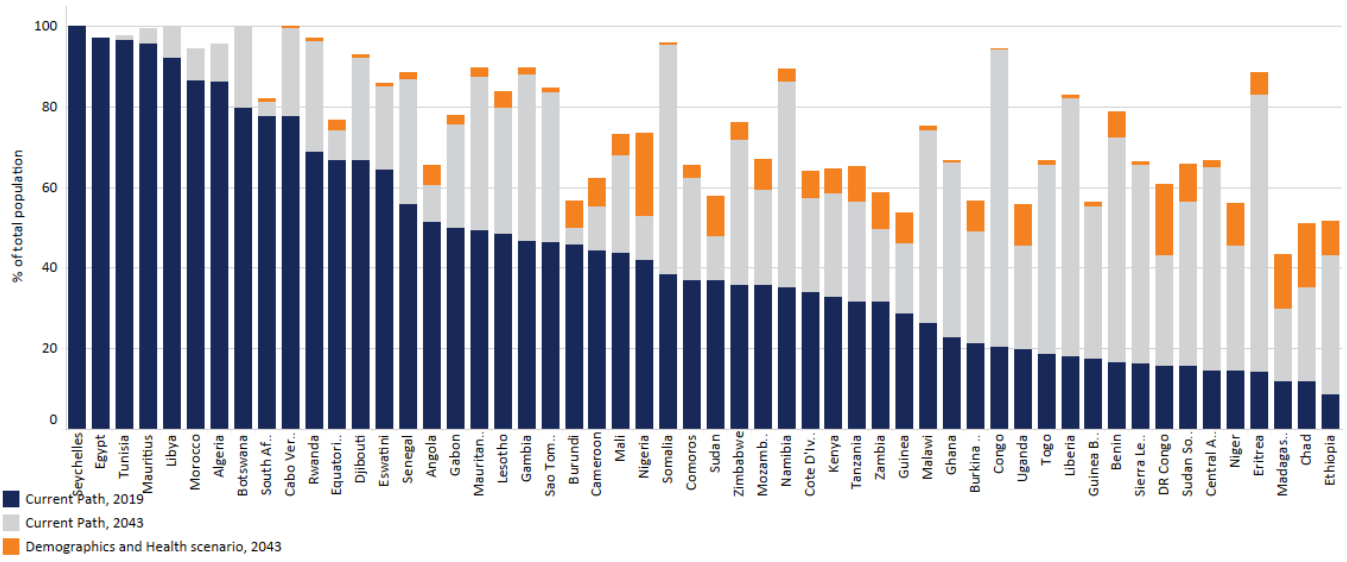
The average improvement for Africa is US$441 in 2043, or more than 6% above the Current Path forecast.

Impact of the Demographics and Health scenario on improved sanitation and safe water

The Demographics and Health scenario represents an ambitious push for improved sanitation access in Chad and Nigeria, increasing it by 25% by 2043 compared to the Current Path forecast, see Chart 14.

The data in the chart is sorted in descending order, using percentage of access to improved sanitation in 2019. An additional column segment representing the progress by 2043 on the Current Path is added, and then, on top of that, a final column segment represents the improvement from the Demographics and Health scenario by 2043 for each country.

Chart 14: Access to improved sanitation by African countries in 2019 and 2043



Source: IFs 7.84 initialising from JMP / UNICEF

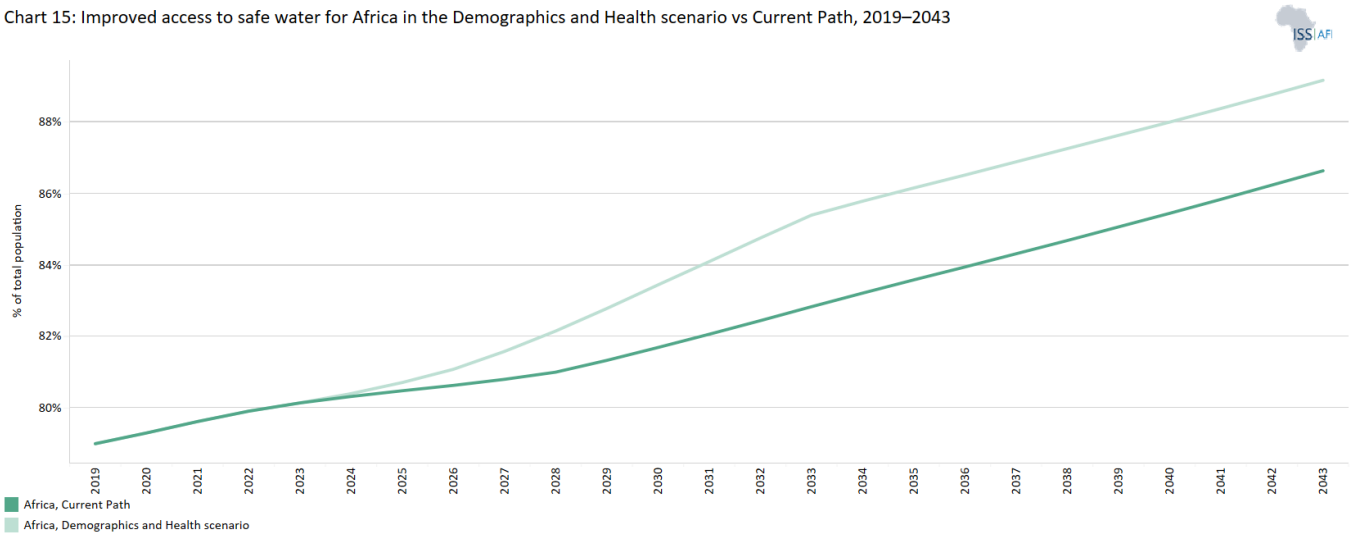
Despite aggressive improvements in the Demographics and Health scenario, CAR, South Sudan, Guinea Bissay, Madagascar, Ethiopia and Chad will not even achieve 50% access to improved sanitation by 2030, although all will get well beyond that by 2043. Disappointedly, Africa's most diversified economy, South Africa, is forecast to experience an improvement of only two percentage points over the forecast horizon and will be unable to reach full access by 2043, showing very little improvement compared to its peers. This represents a lost opportunity and, perhaps, poor allocation and management of resources.

Almost 1.5 billion Africans will be connected to improved sanitation services by 2043 (70% of the total population), but with 12% still using shared sanitation and the remainder using so-called 'unimproved' sanitation facilities such as open pit and bucket latrines. Although the continent will not achieve the 2030 SDG target, a push to combat communicable diseases and improve WaSH infrastructure would still have significant benefits for human and economic development.

Even with the significant push on WaSH infrastructure in this scenario, many Africans will not have reliable access to clean water by 2043. At that point, 207 million Africans will still depend on water connections that do not adequately protect the water source from contamination, in particular faecal matter.

Technological advances will undoubtedly help the drive for improved basic infrastructure at a lower cost. For example, since 2011, the Bill and Melinda Gates Foundation has invested more than US$200 million in the 'Reinvent the Toilet' challenge. Among the early successes was the Tiger Toilet, which costs about US$350 to install and requires no traditional sewer system. Instead, it uses Tiger worms (*Eisenia fetida*), which feed on human faeces. Once a person has used the toilet, they flush their waste down into the worm-filled compartment below using a small bucket of water. The process removes 99% of pathogens and leaves behind no more than 15% of the waste by weight, much better performance than a septic tank. The leftover product is also an excellent fertiliser. After five years, the first Tiger Toilets have yet to require maintenance. The market for this new toilet technology is estimated to amount to US$6 billion a year by 2030, which is more than the current GDP of 16 African countries.

Chart 15: Improved access to safe water for Africa in the Demographics and Health scenario vs Current Path, 2019–2043



Source: IFs 7.84 initialising from JMP / UNICEF

Impact of the Demographics and Health scenario on disease burden

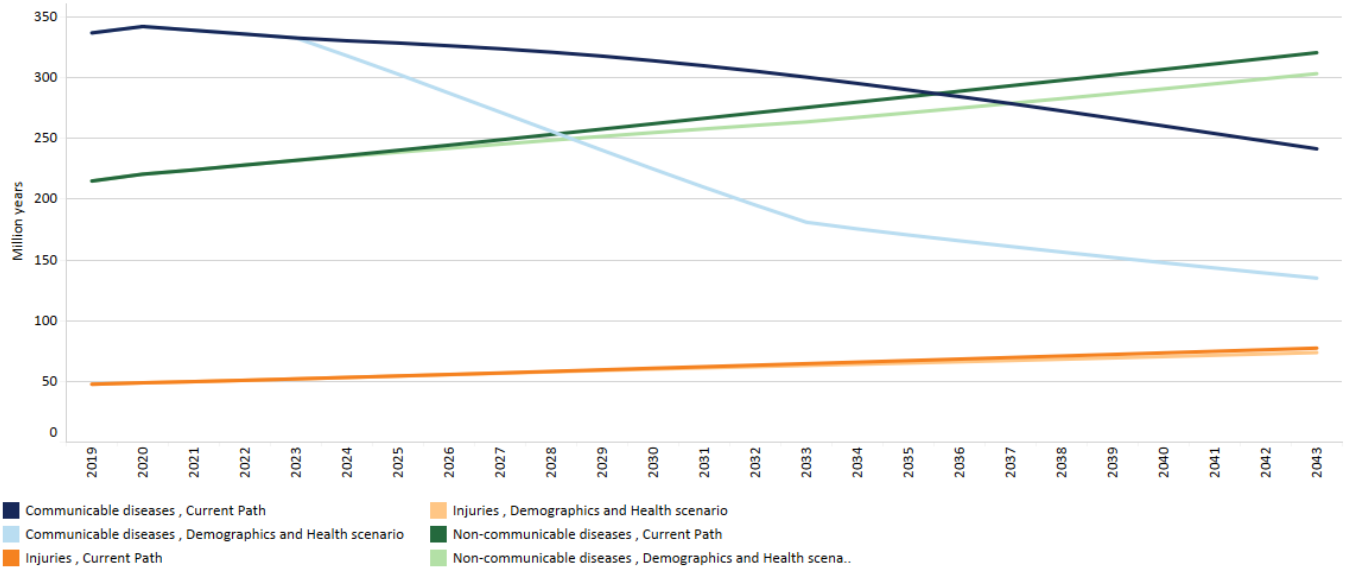
Another way of measuring the impact of the Demographics and Health scenario is to use disability-adjusted life years (DALYs), a standard metric for capturing a country or region's disease burden. This metric offers a way of accounting for the difference between a current situation and an ideal situation, where everyone lives up to the life expectancy in Japan (the country with the longest life expectancy globally), free of disease and disability. Early death translates to years of life

lost and sickness translates to years lost due to disability. One DALY therefore represents the loss of the equivalent of one year of full health.[22] For example, in 2019 Africa is estimated to have lost around:

- 337 million years of life as a result of its high communicable disease burden
- 215 million years as a result of non-communicable diseases, and
- 48 million years due to injuries.

In the Demographics and Health scenario, Africa gains 112 million DALYs in 2043 from a lower communicable disease burden, almost 19 million DALYs from a lower non-communicable disease burden (Chart 16) and almost 4 million DALYs from fewer injuries. In addition to the intrinsic value of healthy human life, this also means millions more productive years and contributions to the continent's development.

Chart 16: Disability-adjusted life years in Africa in the Demographics and Health scenario and the Current Path, 2019–2043

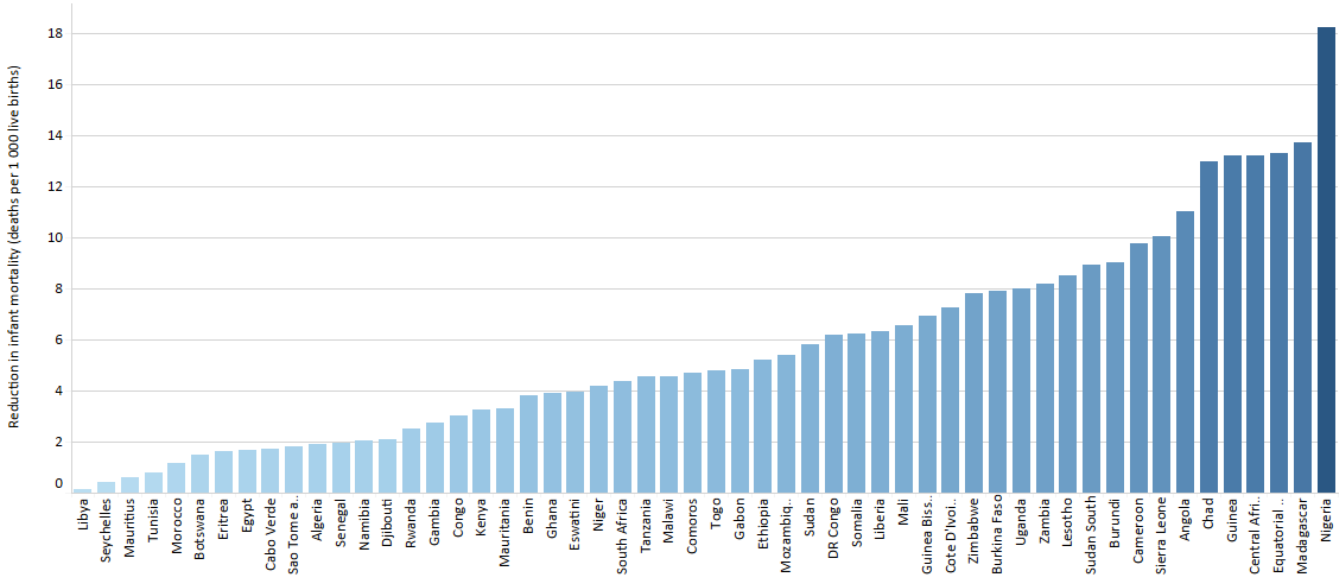


Source: IFs 7.84 initialising from IHME GBE data

Impact of the Demographics and Health scenario on infant mortality and life expectancy

Africa is already on its way to reducing infant mortality significantly from its 2019 average: from almost 47 deaths per 1 000 live births to 36 by 2030 and to 26 by 2043. The Demographics and Health scenario reduces those rates to 28 in 2030 and to 17 in 2043. The reduction in country-level rates is presented in Chart 17. Libya gains the least by 2043 and Nigeria the most, followed by Madagascar and Guinea.

Chart 17: Reduction in infant mortality rate due to Demographics and Health scenario, 2043

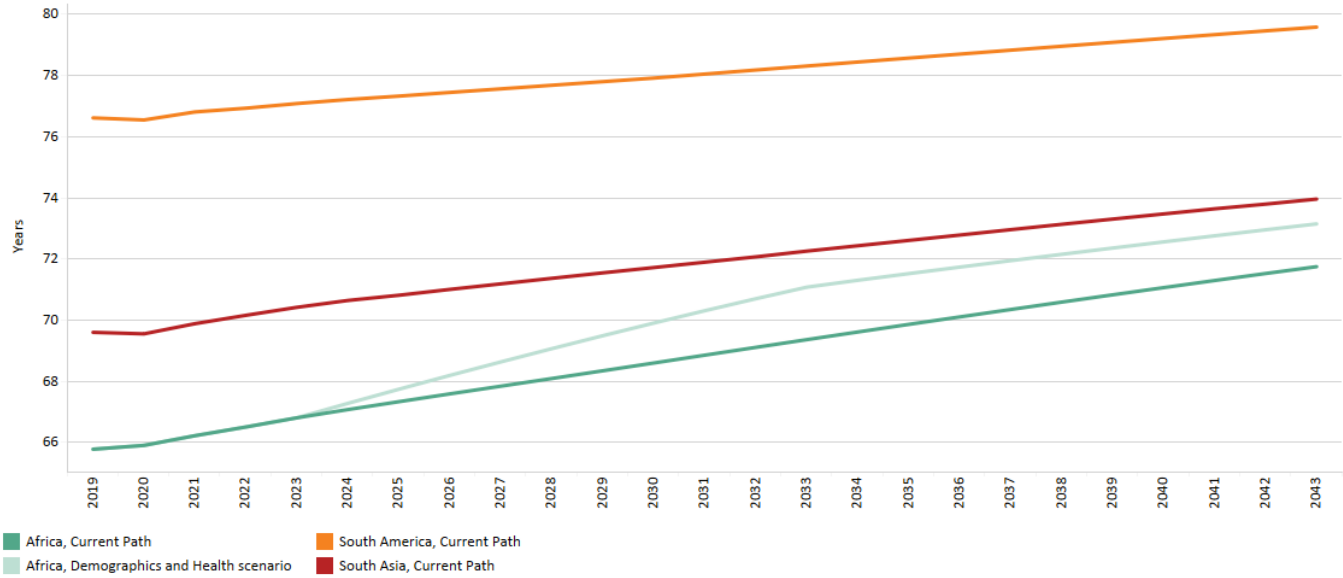


Source: IFs 7.84 initialising from IHME GBE data

By 2043, almost 11 million fewer Africans will be born in the Demographics and Health scenario compared to the Current Path forecast for that year. In fact, the scenario would cumulatively see 131 million fewer births over the forecast horizon.

Chart 18 shows the expected life expectancy in Africa, with trends for South Asia and South America added for comparison. In the Current Path forecast, life expectancy in Africa is projected to improve from 65.8 years in 2019 to 71.8 years in 2043. In the Demographics and Health scenario, life expectancy increases to 73.3 years. Lesotho gains the most (an increase of more than 2.2 years), followed by South Africa, Nigeria, South Sudan and Chad. The countries that gain the least are Comoros, Djibouti and The Gambia, the last of which gains only 6 months.

Chart 18: Life expectancy in Africa, South America and South Asia according to the Current Path forecast and Demographics and Health scenario, 2019–2043



Source: IFs 7.84 initialising from IHME GBE data

Conclusion

Access to water, sanitation and hygiene (WaSH) serves as a helpful proxy for a government's ability to fulfil the basic needs of its people, and access to safe water has therefore been declared a basic human right. SDG 3 speaks to 'ensur[ing] healthy lives and promot[ing] well-being for all at all ages' and targets falling under this goal include:

- reducing maternal, infant and child mortality
- ending the AIDS, tuberculosis and malaria epidemics, and
- reducing mortality from non-communicable diseases such as diabetes and cancer.

A healthier population will also be more productive and, once combined with better education and other enablers, improve economic growth prospects significantly.

This theme started by briefly explaining the historical context for Africa's continued high disease burden. It included an analysis of the impact of the most serious epidemics — HIV/AIDS and COVID-19—on Africa and examined the positive impacts of modern medicines (that partly obviate the requirements for functioning basic infrastructure), and the negative impacts of under-resourced and poorly designed health systems.

The recent COVID-19 crisis has delayed progress towards achieving the targets of the SDGs, as substantial public resources have been diverted away from primary development priorities in fighting the virus. Moreover, the pandemic has rudely exposed the dismal state of Africa's health and associated systems and its dependence on the largesse of others. Currently, the continent imports 99% of its vaccines from abroad and its ability to respond to future pandemics through research and manufacturing of vaccines is abysmal.

Consequently, in April 2021 the Africa Center for Disease Control and Prevention (CDC) and the African Union launched the Partnership for African Vaccine Manufacturing (PAVM) with pledges of support including nearly $3 billion in funding. The initiative aims at equitable access to COVID-19 vaccines as many high-income countries, like the United Kingdom and Canada and the European Union, procured several times the number of doses required for their populations at the height of the pandemic. Going forward, the international community will have to step in to ensure equitable vaccine distribution programmes on top of measures to avert the abuse of vaccine intellectual property rights by pharmaceutical companies even amid a pandemic to then make exclusive deals with rich countries.

It is likely that we underestimate the relationship between health and economic growth, but the inclusion of infrastructure in the Demographics and Health scenario already underscores the imperative to design health programmes that extend well beyond the health sector itself.

In Africa, providing basic infrastructure, such as WaSH facilities and household electricity, reduces the impact of diarrhoeal and vector-borne diseases, as well as the respiratory harm caused by indoor use of traditional fuels like dung and charcoal. There is also a role for the international community although, as we explore elsewhere, aid is no panacea. Installing taps and toilets has historically not been as attractive to donors (and sometimes governments) as, say, eliminating river blindness, but it will have a tremendous impact on livelihoods on the continent if foreign aid providers and African governments were to place more emphasis on WaSH and related infrastructure.

Demographic growth and technological change can work in Africa's favour, but deferred action will be extremely costly. Delays or poor urban planning will result in larger and more dangerous unplanned urban spaces. Urban planning in Africa must emphasise the provision of basic infrastructure, such as clean water, improved sanitation facilities and household electricity, as well as increased access to and the general quality of health and education services.

Africa's health systems are desperately trying to battle the world's worst communicable disease burden with rising rates of non-communicable diseases. This emerging double burden of disease is a complex challenge with many moving parts, but a better understanding of the trade-offs in health policy versus investments like providing basic WaSH infrastructure should lead to better outcomes.

Against this background, improvements in education are an important driver of better health in much of Africa. Awareness and information programmes can contribute greatly to communicating the benefits of good hygiene and preventing the spread of communicable diseases like HIV/AIDS and diarrhoea. They can also instil healthy, lifelong habits regarding the importance of reducing the risk factors which include tobacco consumption, harmful use of alcohol, unhealthy diet and physical inactivity. Improved investment in detection, screening and treatment—notably by ensuring access to health services at the primary level to boost early detection—are other significant measures to lower the growing burden of non-communicable diseases that are expensive to treat, such as type 2 diabetes and heart disease.

Chart 19: Key recommendations

Recommendations

1. A productive economy requires a healthy and appropriately educated population, but Africa has the highest disease burden globally and low levels of education.
2. In recent years, HIV/AIDS had a dramatic impact on mortality/life expectancy, but the economic impact of the COVID-19 pandemic far outweighs its effect on mortality.
3. Given the density of humans, poultry, pigs and ruminants, West Africa may become a hotspot of zoonotic pathogens.
4. Sub-Saharan Africa is rapidly approaching its epidemiological transition - while communicable diseases are coming down, non-communicable diseases are increasing, pointing to an expensive double burden of disease
5. Africa must increase investment in basic healthcare, disease prevention and education on health dangers such as obesity and smoking
6. African governments must invest in understanding the trade-offs between basic health care vs investments in WaSH infrastructure
7. Urban planning must include the provision of basic infrastructure, such as clean water, improved sanitation facilities and household electricity, and increased access to health and education services.
8. Donors and African government must invest in:
    - basic infrastructure such as taps and toilets to reduce communicable diseases
    - early detection, screening and treatment of non-communicable diseases

Annexure

This theme used IFs version 7.84. All interventions start in 2024, interpolate to 2033 and then are maintained at that level unless indicated otherwise.

Interventions and parameters	Adjustment in IFs	Benchmark/Justification/Notes
Contraception use multiplier (contrusm)	To 1.18 by 2033: Cape Verde. To 1.28 by 2033: Algeria, Benin, Cameroon, Comoros, Rep of Congo, Côte d'Ivoire, Djibouti, Ghana, Kenya, Lesotho, Mauritania, Morocco, São Tomé & Príncipe, Senegal, Eswatini, Tanzania,	Forecasts initialise from individual country data. Average contraceptive use for Africa increases by 16.3 percentage points above Current Path in 2043. Instead of gap of 43 percentage points with South

	Tunisia, Zambia, Zimbabwe, Gabon, Egypt. To 1.35 by 2033: Burkina Faso, Burundi, CAR, Eritrea, Ethiopia, Gambia, Guinea, Guinea Bissau, Liberia, Malawi, Madagascar, Mali, Mozambique, Rwanda, Sierra Leone, Somalia, Sudan, South Sudan, Togo, Uganda, Angola, Equatorial Guinea, DR Congo. To 1.4 by 2033: Chad, Niger, Nigeria.	America (2019), gap closes to 22 points in 2019
Mortality multiplier - AIDS (hlmortm - AIDS)	To 0.6 by 2033: Cameroon, CAR, Rep of Congo, São Tomé & Príncipe, Kenya, S Sudan, Botswana, Lesotho, Mozambique, Namibia, South Africa, Eswatini, Zambia, Zimbabwe, Cape Verde, Côte d'Ivoire, Guinea Bissau, Mali, Malawi, Equatorial Guinea, Nigeria, Sudan, DR Congo, Ethiopia, Uganda, Angola.	Africa has the highest AIDS mortality rates globally. Instead of an aids death rate of 0.128/1 000 in 2043 it is 0.081, down from 0.507 in 2019
Mortality multiplier - diarrhoea (hlmortm - Diarrhea))	To 0.9 by 2033: Chad, CAR, S Sudan, Madagascar, Angola, Lesotho, Cameroon, Eritrea, Zambia, South Africa, Nigeria, Guinea Bissau.	Death rates in Africa comparable to South Asia in 2019 but are declining more rapidly although both are much higher than in South America (at 0.027/1 000). In 2019 it is 0.476/1 000 in Africa and declines to 0.228/1 000 in 2043. In the scenario it declines to 0.168 compared to 0.023 in South America and 0.26 in South Asia. In the scenario Africa therefore closes the gap by half with South America.
Mortality multiplier - malaria (hlmortm - Malaria)	To 0.5 by 2033: Equatorial Guinea, Burundi, Burkina Faso, Cameroon, Sierra Leone, Togo, Guinea, CAR, Niger, Mali, Chad, Liberia, Ghana, Côte d'Ivoire, Benin, Uganda, Gabon, Rep of Congo, Angola, Mozambique, Zambia, DR Congo, Nigeria.	Africa has the highest malaria mortality globally. In 2019 it is 0.488/1 000. On the Current Path it declines to 0.192 in 2043. In the scenario it declines to 0.08
Mortality multiplier respiratory infections (hlmortm - RespInfec)	To 0.6 by 2033: Chad, Angola, S Sudan, Zimbabwe, CAR, Somalia, Madagascar, Lesotho, Guinea, Sierra Leone, Cameroon, Nigeria.	Rates of mortality due to respiratory infections in Africa are much higher than other regions globally. In 2019 it was 0.61/1 000. By 2043 it gets to

		0.207 in the scenario instead of 0.291, comparable to rates in South Asia
Mortality multiplier - diabetes (hlmortm - diabetes)	To 0.8 by 2033: Mauritius. To 0.9 by 2033: Lesotho, South Africa, Eswatini, Botswana, Djibouti, Gabon, Morocco, Namibia, Libya, Seychelles, Tunisia, Equatorial Guinea.	Mortality from diabetes in Mauritius is more than double that in the next highest African country (1.401/1 000 vs 0.675/1 000 in Lesotho). Instead of declining to 2.383 it declines to 1.97 in 2043 in the scenario. Other countries with a larger burden are South Africa, Eswatini, Botswana, Djibouti, Gabon, Morocco, Namibia, Libya, Seychelles, Tunisia and Equatorial Guinea.
Mortality multiplier - cardiovascular (hlmortm - CarioVasc)	To 0.9 by 2033: Mauritius, Algeria, Morocco, Tunisia, Seychelles, Cape Verde, Egypt	Intervention on mortality rates from Cardiovascular disease are applied to countries with a higher burden and with slow decline over the forecast horizon.
Mortality multiplier - malignant neoplasm (hlmortm MaligNeoPl)	To 0.9 by 2033: South Africa, Seychelles, Mauritius, Lesotho, Cape Verde.	Intervention on mortality rates from malignant neoplasm are applied to countries with a higher burden and with slow decline over the forecast horizon.
Mortality multiplier - respiratory (hlmortm Respiratory)	To 0.9 by 2033: South Africa, Lesotho, Mauritius, Eswatini, São Tomé & Príncipe, Seychelles.	Intervention on mortality rates from respiratory diseases are applied to countries with a higher burden and with slow decline over the forecast horizon.
Mortality multiplier - other communicable diseases (hlmortm OthCommunDis)	To 0.9 by 2033: Burkina Faso, Burundi, CAR, Ethiopia, Guinea, Guinea-Bissau, Liberia, Madagascar, Mali, Niger, Sierra Leone, Somalia, S Sudan, Uganda, Angola, Zambia, Zimbabwe, Côte d'Ivoire, DR Congo, Nigeria. To 0.95 by 2033: Equatorial Guinea.	Intervention on mortality rates from other communicable diseases are applied to countries with a higher burden and with slow decline over the forecast horizon.
Mortality multiplier - other non communicable diseases (hlmortm OtherNonComm)	To 0.85 by 2033: Lesotho, Mauritius, Egypt, Seychelles.	Intervention on mortality rates from other non-communicable diseases are applied to countries with a higher

		burden and with slow decline over the forecast horizon.
Communicable disease mortality multiplier for children under 5 (hlmortcdchldm)	To 0.72 by 2033: Burkina Faso, Burundi, CAR, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Sierra Leone, Somalia, Sudan, S Sudan, Togo, Uganda, DR Congo. To 0.78 by 2033: Algeria, Angola, Benin, Cameroon, Cape Verde, Chad, Comoros, Rep of Congo, Côte d'Ivoire, Djibouti, Ghana, Kenya, Lesotho, Mauritania, Morocco, São Tomé & Príncipe, Senegal, Eswatini, Tanzania, Tunisia, Zambia, Zimbabwe, Equatorial Guinea, Gabon, Nigeria. To 0.8 by 2033: Egypt. To 0.84 by 2033: Botswana, South Africa. To 0.86 by 2033: Namibia. To 0.89 by 2033: Libya.	Rates in Africa are much higher than for other comparable regions. The intervention moves Africa closer to South America. In 2019 under 5 mortality was 66.68/1 000 in Africa compared to 14.10 in South America and 38.10 in South Asia. By 2043 Africa gets to 26.73 in the scenario instead of 39.96 in the Current Path forecast. South America gets to 7.56 and South Asia to 20.69
Maternal mortality ratio multiplier (matmortratiom)	To 0.73 by 2033: Burkina Faso, Burundi, Eritrea, Ethiopia, Gambia, Guinea Bissau, Liberia, Malawi,Mali, Mozambique, Niger, Rwanda, Sierra Leone, Somalia, Sudan, Togo, Uganda, DR Congo, Nigeria. To 0.75 by 2033: Mauritania. To 0.78 by 2033: Madagascar, Algeria, Angola, Benin, Cameroon, Chad, Cape Verde, Comoros, Rep of Congo, Côte d'Ivoire, Djibouti, Equatorial Guinea, Ghana, Kenya, Lesotho, Morocco, São Tomé & Príncipe, Senegal, Eswatini, Tanzania, Tunisia, Zambia, Zimbabwe, CAR, S Sudan. To 0.8 by 2033: Gabon. To 0.84 by 2033: Botswana, South Africa.	Rates in Africa are much higher than for other comparable regions. The intervention moves Africa closer to South America. In 2019 maternal mortality was 449.8/100 000 live births in Africa compared to 70.26 in South America and 148.2 in South Asia. By 2043 Africa gets to 127.1 in the scenario instead of 193.5 in the Current Path forecast. South America gets to 39.04 and South Asia to 57.25.

	To 0.86 by 2033: Namibia.	
Sanitation, improved, percent of population (sanitationm)	To 0.75 by 2033: Cameroon, Kenya, Côte d'Ivoire, Mali, Guinea, Guinea-Bissau, Zambia, Tanzania, Sudan, Benin, Uganda, Mozambique, Eritrea, Niger, S Sudan, Madagascar, Chad. To 0.8 by 2033: Senegal, Ghana, Angola, Zimbabwe, Lesotho, Burundi, Namibia, Ethiopia. To 0.85 by 2033: Gabon, Equatorial Guinea, Djibouti, Gambia, Mauritania. To 0.9 by 2033: South Africa, Cape Verde.	Rates in Africa are much lower than for other comparable regions. The intervention moves Africa closer to South America. In 2019 improved access was at 57.43% in Africa compared to 91.22% in South America and 76.1% in South Asia. By 2043 Africa gets to 81.63% in the scenario instead of 72.35% in the Current Path forecast. South America gets to 93.07% and South Asia to 87.75%.
Water source safe, percentage of people (watsafem)	To 0.95 by 2033: South Africa, Morocco. To 0.9 by 2033: Malawi. To 0.85 by 2033: Gabon, Ghana, Namibia, Mauritania, Somalia, Mali, Rwanda, Liberia, Eritrea, Togo, Guinea Bissau, Sierra Leone, Ethiopia, Niger, Angola, Madagascar. To 0.8 by 2033: Equatorial Guinea, Nigeria. To 0.75 by 2033: Senegal, Sudan, Burundi, Côte d'Ivoire, Guinea, Lesotho, Benin, Uganda, Zimbabwe, Burkina Faso, Cameroon, S Sudan, Kenya, Zambia, Mozambique, Chad.	Rates in Africa are much lower than for other comparable regions. The intervention moves Africa closer to South America. In 2019 improved access was at 79.32% in Africa compared to 96.73% in South America and 94.51% in South Asia. By 2043 Africa gets to 89.17% in the scenario instead of 86.69% in the Current Path forecast. South America gets to 97.39% and South Asia to 97.85%.
Sanitation, improved, percentage of population with access to (sanitationm improved)	To 1.5 by 2033: DR Congo, Nigeria.	In place of reduction in unimproved that is used for other countries.
Water source safe, percentage of population with access to (watsafem othimproved)	To 1.2 by 2033: DR Congo.	In place of reduction in unimproved that is used for other countries.
Water source safe, percentage of population with access to (watsafem	To 1.05 by 2033: Tanzania.	In place of reduction in unimproved that is used for other countries.

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Endnotes

1. J Reader, *Africa: A Biography of the Continent*, New York: Penguin, 1998, 234
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4. C Aydon, *A brief history of mankind: An introduction to 150,000 years of human history*, Philadelphia: Running Press, 2009, 125.
5. Large populations are estimated at approximately 20 million people each out of a world population estimated at between 260 million and 300 million.
6. C Aydon, *The Story of Man*, Philadelphia: Running Press, 2007, 71.
7. A Maddison, *The world economy: A millennial perspective*, Paris: Organisation for Economic Co-Operation and Development, 2003.
8. ND Wolfe, CP Dunavan and J Diamond, Origins of major human infectious diseases, *Nature*, 447, 2007, 279–83. At the time of writing, the origins of COVID-19 are not fully clear, but apparently it is a recombination of two different viruses, likely from bats and pangolins, that had simultaneously infected the same organism and from there infected and spread among humans
9. Regions isolated from Eurasian plagues, such as Japan, Central and South America and parts of sub-Saharan Africa did not suffer the same fate.
10. SA Alchon, *A pest in the land: New World epidemics in a global perspective*, Albuquerque: University of New Mexico Press, 2003, 21. The third, much more recent plague in the late 19th and early 20th century was largely confined to Asia.
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12. TJ Bollyky, *Plagues and the paradox of progress: Why the world is getting healthier in worrisome ways,* Cambridge: MIT Press, 2018.
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14. Spanish influenza killed 40 million to 50 million people in 1918, Asian flu killed 2 million people in 1957, and Hong Kong influenza killed 1 million people in 1968.
15. Includes HIV/AIDS, malaria and tuberculosis together with maternal deaths, neonatal deaths and deaths from malnutrition.
16. These are often chronic, long-term illnesses and include cardiovascular diseases (including stroke), cancers, diabetes and chronic respiratory diseases (such as chronic pulmonary disease and asthma, but excluding infectious respiratory diseases such as tuberculosis and influenza).
17. Injuries are caused by road accidents, homicides, conflict deaths, drowning, fire-related accidents, natural disasters and suicides.
18. Infant mortality is the death of an infant before its first birthday. Rates are typically expressed as the number of infant deaths for every 1 000 live births.
19. Maternal mortality rate is a measure of the number of women who die while pregnant or within 42 days of the termination of pregnancy.
20. The intervention reduces the proportion of people who have unimproved water access. The IFs algorithm then allocates the improvements to the category of 'other improved' water access and access to piped water.
21. There are exceptions, of course. Private healthcare in South Africa is among the best globally, although expensive and thus only available to a small portion of the population. Only four African countries — Mauritius, Tunisia, Seychelles and Libya — are set to meet the 2030 target to reduce infant mortality to fewer than 12 deaths per 1 000 newborns.
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Dr Jakkie Cilliers is the ISS's founder and former executive director. He currently serves as chair of the ISS Board of Trustees and head of the African Futures and Innovation (AFI) programme at the Pretoria oce of the Institute. His 2017 best-seller Fate of the Nation addresses South Africa's futures from political, economic and social perspectives. His three most recent books, Africa First! Igniting a Growth Revolution (March 2020), The Future of Africa: Challenges and Opportunities (April 2021), and Africa Tomorrow: Pathways to Prosperity (June 2022) take a rigorous look at the continent as a whole.

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