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Health

Abstract In this chapter Cilliers covers Africa's unique epidemiological history from the early migration of homo sapiens to the devastation of HIV/AIDS and, more recently, the unfolding impact of COVID-19. It explains how humans' proximity to nature, slow urbanisation and Africa's distinct climatic conditions have led to an unusually high burden of communicable diseases, particularly the HIV/AIDS pandemic. The chapter also explains the double-burden of communicable and non-communicable disease evident in Africa. The chapter highlights the central role that infrastructural improvements and urban planning play in supporting better health outcomes and impact that poor basic infrastructure and lack of urban planning has in much of Africa. The chapter places a particular emphasis on the central role of potable water and water-borne sanitation in preventing the spread of disease. Finally, scenario analysis is used to demonstrate the relationship between health and economics.

Keywords Disease · Infectious diseases · Non-communicable diseases · HIV/AIDS · Homo sapiens · Safe water · Sanitation · Urbanisation · Infrastructure · Human development

Learning Objectives

- Understand Africa's unique health challenges in a historical context
- Have a better awareness of origins, spread and impact of the HIV/AIDS epidemic

- Know the difference between communicable and non-communicable disease
- Be able to define the double-burden of disease
- Understand the relationship between urbanisation, infrastructure and health.

Homo sapiens evolved in Africa around 300,000 years ago and, although there is evidence of previous waves of migration, only successfully migrated from Africa some 70,000 years ago. Human DNA and archaeologists confirm that all humans who have ancestors outside of Africa today come from a single small group of migrants and not from earlier waves. About 50,000 years ago, they spread along the southern coast of Asia to Oceania, and eventually to Europe—a process that occurred over several thousand years. In the process *Homo sapiens* eventually displaced Neanderthals and eventually emerged as the dominant species globally. This was not a linear process and there is ample evidence that *Homo sapiens*, Neanderthals and others interbred and even cohabited.¹

Early humans gained an initial health reprieve that lasted for several thousand years when they moved out of Africa for cooler regions with fewer insect-borne diseases and ‘the many parasites and disease organisms that had evolved in parallel with the human species’.² As a result they multiplied rapidly in these new areas.

The development of agriculture and farming was key to humanity’s rapid increase in numbers as it increased food production and allowed much higher population densities although density in turn bred new diseases. Larger population concentrations caused competition and sometimes conflict between people over grazing, land, food and status that required political organisation and further role differentiation. Competition spurred innovation and technological advancement.³

In contrast to the situation that developed elsewhere, large parts of ancient Africa’s interior appears to have been characterised by very low population densities very likely as a result of the scourge of sleeping sickness and

¹Research findings are constantly being updated. For the most recent findings see Harvati, K., Röding, C., Bosman, A. M., Karakostis, F. A., Grün, R., Stringer, C., Karkanas, P., Thompson, N. C., Koutoulidis, V., Mouloupoulos, L. A., Gorgoulis, V. G., and Kouloukoussa, M. Article 2019 Apidima Cave Fossils Provide Earliest Evidence of *Homo Sapiens* in Eurasia. *Nature*, 10 July 2019, <https://www.nature.com/articles/s41586-019-1376-z>.

²Reader, J., 1998. *Africa: A Biography of the Continent*. New York: Penguin Books, p. 234.

³Diamond, J., 2015. *Guns, Germs and Steel: The Fates of Human Societies*. New York City: W. W. Norton & Company, p. 386.

other vector-borne diseases, such as malaria. Geography, and hence climate, therefore limited population growth in Africa compared to other regions.

Vector-borne diseases are illnesses caused by parasites, viruses and bacteria that are transmitted to humans by insects such as mosquitoes, ticks and tsetse flies that are commonly found in tropical and subtropical regions such as in Central Africa and places where access to safe drinking water and sanitation is limited. In temperate zones, such as much of Europe, parts of Asia and North Africa, the annual seasonal fluctuations serves as a natural constraint on the breeding cycle of insects.⁴ In Central, West and East Africa where *Homo sapiens* originated, this cycle is not similarly disrupted, with the result that sub-Saharan Africa has a constant high burden of vector-borne diseases, come summer, autumn, winter or spring.

Malaria, the most deadly vector-borne disease, is particularly prevalent in Africa. The continent also accounts for 34 of the 47 countries prone to yellow fever outbreak and about 40% of the global burden of lymphatic filariasis (elephantiasis).⁵ Today, Africa is still home to 16 of the 30 countries listed by the World Health Organisation (WHO) as having a high burden of tuberculosis, though none are under the top five.⁶ Diseases including yellow fever and sleeping sickness were endemic, and insect-borne diseases also prevented the use of the horse, ox or camel, thereby limiting opportunities for more rapid progress.⁷

The belt of open Savannah south of the Sahara and north of the tropical rain forests in central and western Africa eventually became an exception to the high burden of vector-borne diseases. Higher population densities allowed these regions to experience a modest agricultural revolution, although not on the same magnitude as seen elsewhere in the world.⁸

Nature eventually reasserted itself into humanity's new habitats outside of Africa. In fact, most of today's most prominent infectious diseases only emerged in the last 11,000 years, following the rise of agriculture. Larger

⁴Wolfe, N. D., Dunavan, C. P., and Diamond, J., 2012. Origins of Major Human Infectious Diseases. In: *Institute of Medicine. Improving Food Safety Through a One Health Approach: Workshop Summary*. Washington: National Academies Press. Also Reader, J., 1998. *Africa: A Biography of the Continent*. New York: Penguin Books, p. 242.

⁵World Health Organization, 2018. *Lymphatic Filariasis*. [Online] Available at: <https://www.who.int/news-room/fact-sheets/detail/lymphatic-filariasis>; World Health Organization, 2018. *Yellow Fever*. [Online] Available at: <https://www.who.int/news-room/fact-sheets/detail/yellow-fever>.

⁶World Health Organization, 2018. *Global Tuberculosis Report 2018*. Geneva: World Health Organization.

⁷Aydon, C., 2009. *A Brief History of Mankind: An Introduction to 150,000 Years of Human History*. Philadelphia: Running Press, p. 125.

⁸John Reader argues that this relates to the poor and hard soils on great parts of the continent that would not have allowed ploughing. Reader, J., 1998. *Africa: A Biography of the Continent*. New York: Penguin Books, p. 99.

settlements in the form of permanent villages and towns swept away the spatial limitation on the spread of disease. In particular the introduction of domesticated animals such as dogs, pigs, cattle, horses and cats increased human exposure to infectious diseases mostly spread by rats and fleas, very much like it did at the end of 2019 when the SARS-CoV-2 virus spread from Wuhan city, Hubei province in China, to become a global pandemic within a matter of months.⁹

Large populations (estimated at around 20 million people each at around 1000 years BC) eventually appear to have grouped in five regions globally: in China, the Indian subcontinent, Egypt, the Fertile Crescent¹⁰ and Iran, and in Europe.¹¹ Perhaps half of Africa's much smaller population was by then concentrated in a single area along the fertile Nile Valley.

Largely because of its low population densities and hence ability to continue with hunter-gatherer lifestyles, the technological developments that had accompanied the Bronze and the Iron Ages essentially bypassed much of sub-Saharan Africa. Because of its relative isolation from global trade and conquest, Africa was also less affected by the great plagues that affected the rest of the world such as the Plague of Justinian that reduced Eurasian populations by a quarter from 541 to 542 AD.¹²

During the bubonic plague or Black Death that swept through Asia, Europe in the fourteenth century, anything between a quarter and two-thirds of the European population died. However, such was the momentum provided by agriculture, that population numbers recovered and soon again started to increase.¹³

For a while, it seemed that the African civilizations that had in the meanwhile developed in modern-day Ethiopia (Aksum) and in the west along the Niger River and that these could come to rival those elsewhere. South of the Sahara, the Bantu people had domesticated cattle and were growing sorghum

⁹Wolfe, N. D., Dunavan, C. P., and Diamond, J., 2007. Origins of Major Human Infectious Diseases. *Nature*, 447, pp. 279–283. At the time of writing the origins of COVID-19 is still 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. Hassanin, A., 2020. Coronavirus Origins: Genome Analysis Suggests Two Viruses May Have Combined. World Economic Forum. [Online] Available at www.weforum.org/agenda/2020/03/coronavirus-origins-genome-analysis-covid19-data-science-bats-pangolins/.

¹⁰Iraq, Israel/Palestine, Syria, Lebanon, Egypt and Jordan as well as the southeastern fringe of Turkey and the western fringes of Iran.

¹¹Aydon, C., 2007. *The Story of Man*. Philadelphia: Running Press, p. 71.

¹²Regions isolated from Eurasian plagues such as Japan, the Central and South America and parts of sub-Saharan Africa did not suffer the same fate.

¹³Austin Alchon, Suzanne, 2003. *A Pest in the Land: New World Epidemics in a Global Perspective*. University of New Mexico Press. p. 21. ISBN 978-0-8263-2871-7. The third, much more recent plague in the late nineteenth and early twentieth century, was largely confined to Asia.

and millet. They had also discovered iron but they and other groups were not technologically advanced enough to resist external intrusion. During the centuries of African slavery that followed from around 1500, first Muslim slave traders, and later the Atlantic slave trade denuded the continent of much of its ability to pursue farming since, without sufficient labour and the ability to store foodstuffs, it was not possible to identify and cultivate crops and domesticate animals—both prerequisites of farming.

The growth of large cities that agriculture had enabled had required authorities to give attention to water-borne sewage and other measures to combat communicable diseases. But by the time that Africa started to become more urbanized towards the end of the nineteenth century, its higher population densities was partially enabled by imported modern medicine (vaccines and later the discovery of penicillin) that allowed for the prevention and treatment of these diseases. Larger communities of people were now able to live in larger settlements not because of city planning, housing laws, adequate municipal water and sewerage as was required elsewhere to contain disease and plague, but because modern medicines served as an effective alternative to keep infectious diseases under control.¹⁴

Because of its climate and the much longer time period during which humanity and its predecessors coexisted, Africa has therefore had a significantly larger disease burden than other regions, which partly explains why it is here that human immunodeficiency virus (HIV) and the acquired immunodeficiency syndrome (AIDS) originated.

The Impact of HIV and AIDS

HIV's ancestor is simian immunodeficiency virus (SIV), an infection of African monkeys that has also spread to chimpanzees. SIV is several thousand years old, and may even have been around millions of years ago.¹⁵ That SIV spread to humans is no surprise, for several major human infectious diseases such as the plague, sleeping sickness, yellow fever, various forms of influenza, Creutzfeldt-Jakob's disease and, most recently, ebola, have all done so. Once transmitted to humans, SIV evolved to HIV. Like many other diseases, its origin in Africa is essentially a function of the fact that humanity and its

¹⁴Bollyky, T. J., 2018. *Plagues and the Paradox of Progress Why the World Is Getting Healthier in Worrisome Ways*. Cambridge: MIT Press.

¹⁵Dolgin, E., 2010. *Nature*. [Online] Available at: <https://www.nature.com/news/2010/100521/full/news.2010.259.html>.

primate predecessors have had a longer and closer relationship here than anywhere else.

Scientists believe that the HIV virus originated in the western equatorial region of Africa (today known as Cameroon and the Democratic Republic of Congo) in the first half of the previous century. During the subsequent decades, subgroups of the virus were carried away from the epicentre to infect eastern, southern and western Africa. As a result, by the time that the epidemic was discovered, it had already silently spread across large areas. Its slow-acting, asymptomatic incubation period and the eventual appearance of diverse opportunistic infections defied prompt action until such time as it had reached momentous proportions.¹⁶ By the mid-1970s, HIV/AIDS was a true pandemic.

HIV/AIDS remained silent and unrecognised for so long because it affected the immune system, meaning that people were apparently dying from a variety of opportunistic infections that take advantage of a weak immune system and not from a single disease. It remained undetected because of Africa's poor health systems, bad infrastructure and limited medical research capacity and silently spread across the continent. Africa has consistently shouldered between 75 and 85% of the global AIDS burden, which peaked in 2004–2005. In each of these years, more than 1.5 million Africans died from AIDS, although the actual number of people who passed away in the 1960s, 1970s and 1980s will likely never be known.¹⁷ AIDS is, of course, not the first modern pandemic. The Spanish influenza killed 40–50 million people in 1918. Asian flu killed two million people in 1957 and Hong Kong influenza killed one million people in 1968.

The AIDS pandemic had a dramatic impact on Africa's ability to improve health outcomes relative to other developing regions, with a serious knock-on effect on economic productivity and disastrous impacts on families and communities. For example, between 1980 and 2000, life expectancy in sub-Saharan Africa improved by only about 2.5 years, compared to an increase of about 5.5 years globally and close to nine years in South Asia.

The first known case of HIV was eventually traced to a man who died in 1959 in the Democratic Republic of the Congo. Initially global attention focussed on young homosexual men but, by 1982, it was understood that the 'slim disease', a condition previously considered to be a wasting disorder linked to malnutrition, was in fact HIV/AIDS.

¹⁶Iliffe, J. 2006. *The African AIDS Epidemic: A History*. Oxford: James Currey, pp. 4–5, 158–159.

¹⁷For a helpful timeline see Pickrell, J., 2006. *NewsScientist*. [Online] Available at: <https://www.newscientist.com/article/dn9949-timeline-hiv-and-aids/>.

Once it was identified, lack of government capacity 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. Mbeki's stance, in the country with the largest AIDS death rates globally at the time, would eventually contribute to his ouster as president in 2008 in favour of a flawed replacement, Jacob Zuma.

While life expectancy in Africa has recovered to a certain extent in the last decade, it has still not caught up with the rest of the world. In 2018, the gap in life expectancy between Africa and the global average was about eight years—in spite of the fact that the ready availability of medicines for most communicable diseases should allow Africa to make much more rapid progress. By 2040 the gap in life expectancy between Africa and the global average should be slightly below five years.

In contrast, South Asia more than halved the gap in life expectancy between itself and the rest of the world—from 11 years in 1960 to less than four years today.

HIV/AIDS dealt sub-Saharan Africa a devastating blow. It came at a time when the continent had shown signs of a turnaround from the declining economic growth prospects in the 1980s and 1990s that were discussed in Chapter 2. This change in fortune was the result of various factors, including a determined effort by some in the international community to place poverty alleviation at the core of global concerns—an occurrence that was facilitated by the end of the Cold War.

It remains to be seen what the medium and long-term impact of the COVID-19 virus will be in Africa. At the time of writing it is still too early to responsibly model the interplay between competing variables including Africa's much younger population (the virus affects elderly people more seriously resulting in much higher levels of morbidity), low levels of urbanisation (providing rural people with a degree of initial protection meaning it could spread more slowly here), the challenge of comorbidity (given the continent's high communicable disease burden such as from HIV/AIDS and tuberculosis) and a host of other factors including low levels of testing, the very limited public health capacity, and low levels of access to potable water and water-borne sewage. And then there are the climatic and seasonal impacts that are all still speculative.

The damage that COVID-19 will inflict in the short term cannot, however, be disputed. Millions more Africans will be condemned to extreme poverty, incomes will decline and many will succumb to lack of food as the efforts to constrain infection rates reduce economic activity, jobs and impact upon livelihoods. The unfolding global recession will hit Africa

very hard particularly given the commodity dependence of many of its economies. The result will be to constrain growth and economic improvements—but eventually the deep drivers of economic growth in Africa will reassert themselves.

Africa's Approaching Health Transition

Looking back over time, it is clear that Africa's high communicable disease burden partly explains its unique development trajectory. More concerning, because Africa has such low levels of safe water and poor sanitation, it is potentially more susceptible to the impact of new viruses such as COVID-19 although the virus generally affects younger populations less severely.

To an extent the HIV/AIDS pandemic occurred as part of a long-term characteristic of Africa's high burden of communicable diseases compared to other regions that have first experienced a declining burden of communicable diseases and only later an increased incidence of non-communicable diseases. Sub-Saharan Africa has a much younger population than other regions in the world. With a median age below 19 years it naturally suffers from a much higher communicable (or infectious) than non-communicable disease burden because children are especially susceptible to the former. The median age in Asia is 27 and in Europe it is 43 years. Poor living conditions including unsafe water, poor housing and inadequate sanitation also create an environment for pathogens to propagate.

Infants and children often die of infectious diseases while elderly people generally die of chronic diseases or die from communicable diseases after living for a while with non-communicables. As incomes rise, people live longer, eat more processed foodstuffs and more readily develop heart disease, high blood pressure, diabetes and cancer.

The so-called epidemiological transition takes place when improved food security and innovations in public health and medicine result in infectious diseases, such as influenza, being replaced as the dominant cause of death by chronic diseases, such as cancer. This transition is generally associated with age and income as it relates to lifestyle, and is often used as an indicator of the transition from developing to developed nation.

In Europe and North America the transition from communicable to non-communicable diseases as the main cause of death occurred more than a century ago. In Latin America and the Caribbean the transition happened around 1970 and in North Africa around 1980. In South Asia it occurred around 2000 but is only set to occur around 2030 in sub-Saharan Africa.

The nature of the epidemiological transition is, however, changing. Modern medicine means that people in sub-Saharan Africa are now living long enough to succumb to non-communicable afflictions, with the result that many people in poor countries are contracting the ‘diseases of affluence’ at younger ages. So in sub-Saharan Africa the transition is happening at lower levels of income and urbanisation than elsewhere. At the same time, the burden of communicable diseases remains high, resulting in the so-called double-burden of disease. This will present health systems with very large cost implications as they navigate increasingly complex public health landscapes. The high costs associated with non-communicable diseases will pose a major problem for many African countries as their comparatively low average incomes translate into limited state budgets and capacity to provide the necessary health care. Providing a US\$2 mosquito nets to every vulnerable person in Africa every two years is one thing, but ensuring that every African has reliable access to insulin (annual cost more than US\$300 per person¹⁸), cancer screenings and dialysis is quite another.

The result of the approaching double-burden of disease will be more sick adults, leading poor countries to have to devote more resources to preventing and treating costlier non-communicable diseases. Pollution and tobacco are also proving to be a huge challenge, as tobacco companies are now actively targeting the next generation of smokers, all of whom are in the developing world.

Still, communicable diseases continue to have a disproportionate and devastating impact on Africa, by any standard. In 2018, about 90% of malaria deaths worldwide occurred in Africa—for HIV/AIDS the figure was about 80%. The continent accounts for nearly 50% of all communicable disease deaths worldwide, despite making up only 16% of the global population, as shown in Fig. 3.1. In other words, people in Africa are about four and a half times more likely to die from a communicable disease than people elsewhere.

This trend is forecast to continue beyond 2040 in the Current Path. By then, Africa is projected to account for about 95% of global malaria deaths, 80% of global AIDS deaths and almost half of total communicable disease deaths worldwide. It is partly because of this disease burden that the average life expectancy at birth in 2018 in Africa (at 66 years) is so much lower than that in the rest of the world (at 75 years) and is also forecast to remain significantly below global averages beyond the 2040 time horizon.

Addressing Africa’s disproportionate communicable disease burden is obviously a high priority, but any progress in this regard will inevitably mean

¹⁸Ewen, M., Joosse H.-J., Beran, D., and Laing, R., 2019. Insulin Prices, Availability and Affordability in 13 Low-income and Middle-income Countries. *BMJ Global Health*, 4, p. e001410.

Fig. 3.1 Population and deaths from communicable disease in 2018 (Source IFs v 7.45 using United Population Division and Institute for Health Metrics and Evaluation data)

a greater prevalence in non-communicable causes of morbidity. Africa's epidemiological transition will hence occur at a point when incomes are still quite low compared to other parts of the world that have already gone through the transition.

Non-communicable diseases are more difficult and expensive to diagnose, treat and manage than communicable diseases, and many health systems will likely struggle to respond effectively. In fact, almost one-third of all deaths in sub-Saharan Africa are already categorised as non-communicable, a share which is forecast to rise to more than 50% by 2040, even in the absence of additional interventions.¹⁹

Urbanisation and Health Services

Whereas the transition in Western Europe and North America was largely as a result of infrastructure investments, such as closed sewage systems and clean water supply by public utilities in the nineteenth century, and later by vaccines and the discovery of penicillin, in Africa different dynamics are at play since poor people are generally moving to cities without the prospect of a job or an improved lifestyle, but to escape the destitution in rural areas. The

¹⁹IFs use three main ICD categories—communicable, non-communicable and injuries. The calculations were done as a portion of the total of all three.

result is massive increases in large, sprawling slum cities, some of which are already evident in places such as Lagos, Dar es Salaam and Nairobi.

Chapter 2 noted that Africa is urbanising much later compared to other regions, and that urbanisation is accompanied by the rapid growth of slum cities that do not have the required basic infrastructure such as safe water and water-borne sewage to cope with the influx and natural population growth. Earlier sections in this chapter noted that it is access to modern medicine that is helping to keep urban epidemics ill health at bay.

According to the Current Path forecast, Africa only becomes predominantly urban at around 2038 and sub-Saharan Africa several years later. This means that Africa remains the most rural continent in the world, although the absolute increase in growth of the urban population is large.

The continent's urban population is forecast to more than double by 2050, adding more than 800 million people to Africa's cities. The UN Population Division (UNPD) anticipates that, between 2018 and 2035, all ten of the world's fastest growing cities will be in Africa—and 21 of the top 30.²⁰ Twelve of these 30 cities are in West Africa, four of which are in Nigeria. The four Nigerian cities alone are projected to add about 200 million people to urban areas in Africa by 2050.

Since most African governments don't have the means to invest in the vast and dense network of transport systems required for such sprawling cities, poorly constructed and poorly maintained roads are crowded with cars and other means of private transport. The result is that the city sprawls out further and further, lowering urban density and increasing the potential cost of providing the required additional infrastructure. Consequently, instead of increasing productivity and access to services—one of the main advantages of urbanisation—it actually starts to decrease.²¹

African cities from Nairobi to Cape Town are already known for their slums. Slums and informal townships present a number of problems, largely because they develop in the absence of planning. Housing units are almost exclusively self-constructed and neighbourhoods are organised independently of the central governing authority.

Some governments even go out of their way to avoid acknowledging that these places exist. Until 2009 the Kibera, one of the largest slums in Africa, was officially designated by the Government of Kenya as a lake next to the

²⁰United Nations Department of Economic and Social Affairs, 2018. *United Nations Population Division*. [Online] Available at: <https://population.un.org/wup/>.

²¹Collier, P., 2016. *African Urbanisation: An Analytic Policy Guide*. London: International Growth Centre, p. 23.

Nairobi Dam—an illustration of the chasm between the demand for basic services and the ability of the government to provide them.

Current Path: Access to Basic Infrastructure

Previous sections have noted that Africa appears to be approaching its epidemiological transition despite a serious lack in basic services such as clean water. Even so, poor access to safe water and sanitation present a major crisis. In actual fact, WASH access serves as a useful proxy for a government's ability to fulfil the basic needs of its people and for this reason, unlike other forms of infrastructure like electricity, reliable access to safe water is a basic human right—as proclaimed by the UN General Assembly in 2010.²²

Hypothetically speaking, the centralization of service delivery points for water, sanitation and health in urban areas should make service delivery easier compared to the challenge of, for instance, rolling out health care or sanitation in sparsely populated rural areas. However, as discussed, most of Africa's cities are poorly designed, congested and growing rapidly.

It is therefore not surprising that Africa's urban citizens have some of the lowest levels of access to basic services worldwide. In 2018, only about 40% of the continent had access to an improved sanitation facility, while the global average was approximately 70%. For clean water, the rates are only slightly improved, with about 77% of people in Africa having access, while in the rest of the world that figure was more than 97%. In comparison, about 53% of people in South Asia had access to an improved sanitation facility in 2018, and about 94% of the region had access to potable water.

The picture is similar for nearly any other measure of access to infrastructure or services. For instance, in 2018 about 95% of global populations outside of Africa had access to electricity. In Africa, the figure was approximately half of that, at 53% (44% in sub-Saharan Africa). The use of solid fuels for cooking and heating instead of electricity is also a large source of indoor air pollution. This lack of access to physical infrastructure and basic services constrains Africa's ability to fully develop its human potential and thus to capitalise on its future demographic dividend.

Partly as a result of these differences, people in South Asia can expect to live on average about six years longer at birth and receive more than a full year of additional education relative to their counterparts in sub-Saharan Africa.

²²General Assembly resolution 64/292, The human right to water and sanitation, A/64/L.63/Rev.1 and Add.1 (28 July 2010). [Online] Available at: https://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/64/292.

Infant mortality is about 50% higher in sub-Saharan Africa than in South Asia, and the rate at which African children under the age of five die is nearly twice as high.

WASH infrastructure supports the development of broader human potential through its strong forward linkages to other important aspects of the SDGs such as poverty, education and gender equality. In other words, improvements in WASH infrastructure generally translates into sizable gains in the overall development of a country since it improves the human capital contribution.

For example, children that do not have adequate access to WASH facilities have difficulty absorbing nutrients and are more vulnerable to the negative consequences of undernutrition. Malnourished children are highly susceptible to communicable diseases with diarrheal diseases being among the most frequent and severe examples. UNICEF estimates that, of the roughly 1600 children that die from diarrheal disease each day globally, about half are attributable to a lack of WASH access.²³ In recognition of this, in 2015 the World Health Organization (WHO) and UNICEF's Joint Monitoring Project recognised access to WASH facilities as 'fundamental to good health, dignity and quality of life'.²⁴

Children who don't succumb to diarrheal disease may suffer other life-long effects, like stunting, generally recognised as low height for age.²⁵ Although stunting is commonly described in physiological terms, it also significantly impairs the development of the human brain. 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'.²⁶ Put bluntly, stunting is an irreversible condition that inhibits the potential of the affected individual or community for life and the rate in Africa is at a quarter of its population and for a very modest decline to 2040.

²³UNICEF, 2015. *How WASH Relates to Health, Education and Development*. [Online] Available at: https://www.unicef.org/wash/index_healthandeducation.html.

²⁴WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP), 2012. *WASH Post-2015: Proposed Targets and Indicators for Households, Schools and Health Centres*. Washington: JMP.

²⁵Stunting is a medical condition that is reached when a child's height-for-age ratio is more than two standard deviations below the World Health Organization's (WHO) Child Growth Standards median. WHO, 2006. *WHO Child Growth Standards Length/Height-for-Age, Weight-for-Age, Weight-for-Length, Weight-for-Height and Body Mass Index-for-Age: Methods and Development*. Geneva: WHO Press.

²⁶WHO, 2015. *Stunting in a Nutshell*. [Online] Available at: https://www.who.int/nutrition/healthygrowthproj_stunted_videos/en/.

Insufficient WASH access leaves all children vulnerable, but as they mature, the negative impacts begin to stack up disproportionately against women and girls. Poorly maintained or non-existent WASH facilities are one of the main causes of high school dropout rates among teenage girls who lack menstrual hygiene services, for example.²⁷ This in turn could lead to a large disparity among educational attainment between men and women and significantly diminish the economic opportunities for the latter, translating to lower growth for society as a whole.

However, there are immense challenges to advancing access to WASH infrastructure in sub-Saharan Africa.²⁸ Even upper-middle-income countries in Africa are struggling to expand access to WASH infrastructure fast enough, in particular sanitation facilities. Of Africa's eight upper-middle-income countries only Mauritius, Libya and Algeria register access rates above the global average for countries in this category (about 80%).²⁹

In the five remaining upper-middle-income African countries with below-average access levels—South Africa, Namibia, Botswana, Equatorial Guinea and Gabon—about 19 million people were still living without access to an improved sanitation facility in 2018. It is likely no coincidence that four of these five countries, namely South Africa, Namibia, Botswana and Equatorial Guinea, rank among the twelve most unequal countries in the world according to the Gini index. In South Africa alone, nearly 15 million people live with increased vulnerability to water-borne illness and other negative health consequences due to lack of access to an improved sanitation facility.

Unfortunately, looking to the future, the picture is not likely to improve much. On the Current Path forecast, only half of Africa's population is projected to have access to an improved sanitation facility and just over 80%

²⁷A study from Malawi, for instance, found that only 46% of girls who reached menarche before age 14 completed primary school, compared to 70% who reached it after 16 years of age due to a lack of appropriate menstrual hygiene management resources. Sommer, M., 2013. Menarche: A Missing Indicator in Population Health from Low-Income Countries. *The National Center for Biotechnology*, 128(5), pp. 399–401. In many instances, women and girls also face an increased risk of sexual assault when using these facilities at night, in part due to the absence of decent lighting. In fact, a 2015 study in Khayelitsha conducted by Yale University found that simply increasing the number of toilets could lead to a reduction in sexual violence against women and girls. When the 'social cost' of sexual violence, including tangible costs like medical expenses, legal adjudication and correctional time, but also intangible costs like trauma and risk of homicide, is taken into account, erecting more toilets could actually save costs, too. Gonsalves, G. S., Kaplan, E. H., and Paltiel, A. D., 2015. Reducing Sexual Violence by Increasing the Supply of Toilets in Khayelitsha, South Africa: A Mathematical Model. [Online] Available at: <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0122244>.

²⁸Markle, A., and Donnenfeld, Z., 2016. Refreshing Africa's Future: Prospects for Achieving Universal WASH Access by 2030. *African Futures Paper*, June 2016.

²⁹This average is calculated using a bivariate regression with GDP per capita as the independent variable, fit to a log distribution to obtain an expected value for a given level of income.

is forecast to have reliable access to clean drinking water in 2030. In 2018, 297 million people in the DRC, Ethiopia and Nigeria alone, were living without access to improved sanitation facilities. This number is projected to increase to about 350 million by the time the SDGs are meant to be achieved in 2030.

Modelling the Impact of Better Health and WASH Infrastructure: The Improved Health Scenario

Although a coordinated cross-sectoral approach is necessary to overcome the negative impact that poor health outcomes have on development in Africa, a push on the most immediate health and infrastructure priorities would have significant and visible effects on the health situation on the continent. It will also improve productivity and economic growth prospects.

Given how far behind Africa is on these various indicators compared to other regions, the interventions in the Improved Health scenario that follow are not calibrated to represent Africa achieving the SDG goals by 2030 (Goals 3 and 6 are dedicated to health and WASH infrastructure, respectively). Those ambitions appear to be out of reach. 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.

The Improved Health scenario simulates a combination of three sets of improvements. The first is the more rapid provision of basic infrastructure (clean water and improved sanitation) that particularly push on the drivers of Africa's very high communicable disease burden as well as indirectly improving productivity given a generally healthier workforce. The second is large reductions in the incidence of HIV/AIDS and malaria on the back of expectations regarding rapid progress in prevention and treatment. The third is modest reductions in the incidence of non-communicable diseases such as diabetes based on ongoing improvements in medical technology.³⁰ In all instances the interventions accelerate the expectation in the Current Path forecast that things will steadily improve in all these dimensions.

Access to clean water is improved by 9% points above the 2030 Current Path forecast and by 15% points in the case of improved sanitation. The associated additional burden on government consumption required by these improvements in basic infrastructure is steep and comes to US\$6.5 billion in 2030 alone.

³⁰Includes malignant neoplasm, cardiovascular, digestive, respiratory, other non communicable diseases, diabetes and mental health.

On their own, i.e. without the additional push from the other two sets of interventions, more clean water and better sanitation reduce rates of infant mortality to 23 deaths per thousand by 2040 instead of 25. The result, among others, is that births start declining from around 2025 as society reacts to the fact that more infants are surviving. By 2040, Africa would cumulatively have 6.5 million less births, meaning that the total population of the continent will decline by about a million people. Average life expectancy also increases by a few months by 2040. From an economic productivity point of view Africa will experience an increase in its average growth rate of 0.1% from 2020 to 2040 with the result that the African economy will be US\$164 billion larger in 2040 than in the Current Path. The benefits from the other two sets of interventions, on HIV/AIDS and malaria, and reductions on non-communicable diseases amplify these already impressive results.

The interventions on the incidence of malaria and HIV/AIDS are aggressive. In 2040, the Improved Health scenario is that 304,000 fewer Africans will die from malaria and 266,000 less from AIDS, roughly 70% less than the Current Path forecast for 2040 in both instances. Cumulatively 4.7 and 4.5 million less people will succumb to malaria and AIDS from 2020 to 2040. Already in 2019, some 360,000 children a year in Malawi, Ghana and Kenya are to receive a powerful new anti-malaria drug, Mosquirix, as part of a pilot project that will last for several years.³¹ Due to HIV's ability to mutate rapidly, a preventive vaccine doesn't exist yet, in spite of many scientific advances but it surely is only a question of time while treatment has improved immensely.³²

The improvements in infrastructure, also result in a 17% reduction in the broad category of "other communicable diseases" by 2030.³³

The third set of improvements modestly reduces Africa's non-communicable disease burden. The result is that the number of Africans that die from this broad category is reduced by around 470,000 in 2030 and moderates to 450,000 by 2040. Since non-communicable diseases are more prevalent with age, the impact is to increase Africa's average life expectancy

³¹The vaccine triggers the immune system to defend against the first stages of malaria shortly after the parasite enters the bloodstream after a mosquito bite. Deutsche Welle, 2019. *Africa Begins World's Biggest Anti-Malaria Vaccine Campaign*. [Online] Available at: https://www.dw.com/en/africa-begins-worlds-biggest-anti-malaria-vaccine-campaign/a-48436460?utm_source=Media+Review+for+April+23%2C+2019&utm_campaign=Media+Review+for+April+23%2C+2019&utm_medium=email.

³²Pavakis, G. N., and Felber, B. K., 2018. A New Step Towards an HIV/AIDS Vaccine. *The Lancet*, 21 July, 392(10143), pp. 192–194.

³³The category 'other communicable diseases' excludes diarrheal diseases, HIV/AIDS, malaria and respiratory infections.

to almost 74 years by 2040, i.e. an increase of two years above the Current Path forecast.

The Improved Health Scenario illustrates the impact that improvements in one area—basic infrastructure—can have on another sector—health. In interpreting the results it is, however, important to recognise that some of the interventions to improve health outcomes, such as rapid reductions in malaria and HIV/AIDS are modelled to follow medical breakthrough and progress and hence require limited additional funding since the interventions push on the result (less deaths) rather than on the cause, such as rolling out HIV/AIDS treatment, better management and improved treatment facilities.

The implication of the Improved Health scenario is on the one hand to increase government consumption on basic infrastructure (by US\$8.8 billion in 2030) and to reduce government consumption on health (by US\$3.7 billion in 2030). That said, the degree to which the latter offsets the increase in infrastructure related expenditure only increases to 2030. From around 2035 the scenario requires increased expenditure in both categories when compared to the Current Path forecast of African government consumption on infrastructure and health. These results are presented in Fig. 3.2.

Technological advances will undoubtedly help the drive for improved basic infrastructure at 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. Although there has yet to be a technical breakthrough, the level of investment and talent that the challenge is attracting

Fig. 3.2 The difference between government consumption on health and infrastructure in Africa between the Improved Health scenario and the Current Path (*Source* IFs 7.45 initialising from WHO and Africa Country Infrastructure Diagnostic)

is promising.³⁴ Bill Gates estimates that the market for this new toilet technology could be as big as US\$6 billion a year by 2030, more than the current GDP of 16 African countries.

The result of the Improved Health scenario is that there are 1.3 million fewer births on the continent in 2040 (cumulatively 12.1 million over the period 2020–2040) and eleven million fewer Africans in 2040 than would otherwise be the case.

In the Improved Health scenario, about 5 million more Africans receive piped water by 2040 and 78 instead of 68% of the continents people have access to improved sanitation. Even with the significant push on WASH infrastructure in this scenario Africa does not provide reliable access to clean water and approximately 607 million live without access to an improved sanitation facility by the end of the SDGs in 2030.

This scenario also reduces the number of fatalities from AIDS by about 266,000 in 2040 and forecast almost 600,000 fewer instances of fatalities due to malaria compared to the Current Path forecast.

Although this scenario doesn't get the continent quite to the finish line in time for the SDGs, a push to combat communicable diseases and improve WASH infrastructure would still have significant benefits for human and economic development.

Using US\$1.90 the Improved Health scenario decreases extreme poverty by around 18 million people by 2040.

Impact on Disability Adjusted Life Years

One way of measuring the impact of the Improved Health scenario is to use a standard metric for capturing a country or region's disease burden, called disability adjusted life years (DALYs). DALYs are a commonly used, if imperfect, measure of the burden of disease in a society, and are generally used to compare the relative disease and mortality burden across countries and regions. It 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.³⁵ Early death would provide years of life lost while sickness

³⁴Katrina, Y., 2018. *Goats and Soda: Stories of Life in a Changing World*. [Online] Available at: <https://www.npr.org/sections/goatsandsoda/2018/11/09/666150842/why-did-bill-gates-give-a-talk-with-a-jar-of-human-poop-by-his-side>.

³⁵Murray, C. J., and Lopez, A. D., 1997. Global Mortality, Disability, and the Contribution of Risk Factors: Global Burden of Disease Study. *The National Center for Biotechnology Information*, 17 May, pp. 1436–42.

would translate into years lost due to disability. The two are added together to provide the DALY—a combined measure of mortality (or death) and morbidity (poor health).

Using Japan as a benchmark, the World Health Organization (WHO) currently defines standard life expectancy as 81 years for men and 87 years for women. So a man who dies at 70 would add 11 years to a country's DALY count, while a woman who died at 70 would account for 17 years. Illness is measured on a scale where 0 represents perfect health, and 1 represents a condition equivalent to death.³⁶

Even relative to other developing regions, Africa stands out in rates of DALYs. In per capita terms, DALYs are about 75% higher in sub-Saharan Africa than in South Asia, and more than twice as high as in Latin America and the Caribbean or in East Asia and the Pacific.

In the Improved Health scenario, Africa suffers from almost 30% fewer DALYs caused by communicable disease by 2040, and 9% fewer DALYs from non-communicable diseases. With a reduced disease burden on top of significant investments in basic infrastructure, the Improved Health scenario increases Africa's economic growth rate by an average of almost 0.3% from 2020 to 2040 which translates into an increased GDP—measured at market exchange rates—to US\$8.36 trillion instead of US\$7.92 trillion in 2040. Furthermore, the scenario drives a US\$230 increase in GDP per capita to US\$7370 by 2040—measured at purchasing power parity.

The infant mortality rate also declines by almost five deaths per thousand live births (to 18.9) by 2040 compared to the Current Path forecast of 24.8.

In the intervening years, the gap between Africa and the average male life expectancy in the rest of the world would have decreased from 8.1 to 3.4 years. That of women would have decreased from almost 10 to 5.2 years.

So in terms of life expectancy, Africa is slowly reducing the gap with global averages and the rate of catch up increases with the Improved Health scenario. However, one must bear in mind that it is of course much easier to make rapid progress at lower levels of life expectancy.

³⁶The measure is actually designed in reverse, where 1 represents a state of perfect health and 0 represents a state equivalent to death, which makes more sense logically, but it is inverted for the purposes of accounting. Murray, C. J., and Lopez, A. D., 1997. Global Mortality, Disability, and the Contribution of Risk Factors: Global Burden of Disease Study. *The National Center for Biotechnology Information*, 17 May, pp. 1436–1442.

Conclusion: Planning Comprehensively and Long-Term

This chapter started by briefly explaining the impact of the extended period of time during which humans have interacted with nature in Africa on the continent's ongoing high disease burden. It included an analysis of the impact of the most serious epidemic, HIV/AIDS, on Africa, and examined the positive impacts of modern medicines (that partly obviate the requirements for functioning basic infrastructure), under resourced and poorly designed health systems.

It is quite likely that we underestimate the relationship between health and economic growth, and in Chapter 16, I compare the fiscal and economic impact of the Improved Health scenario with other scenarios. The analysis reflects findings in other studies, such as one that found a one-year increase in life expectancy could be associated with a 4% increase in GDP.³⁷ Another by the UN Economic Commission for Africa found that the impact of the Ebola epidemic reduced the GDP of Guinea, Liberia and Sierra Leone by between 2 and 5% compared to the Current Path.³⁸

Moreover, the inclusion of infrastructure in the Health scenario underscores the imperative to design health programmes that extend well beyond the health sector itself. In Africa, providing basic infrastructure like WASH facilities and electricity reduces the impact of diarrheal 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. Installing taps and toilets has historically not been as attractive to donors (and sometimes governments) as say, eliminating river blindness, but it would have a tremendous impact on livelihoods on the continent.

Demographic growth and technological change can work in Africa's favour, but deferred action will be extremely costly. Delays in urban planning will only result in larger and more dangerous unplanned urban spaces. In addition to provision for roads, railways and ports, urban planning in Africa must emphasise the provision of basic infrastructure like clean water, improved sanitation facilities and electricity, as well as increasing 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

³⁷Bloom, C. E., Canning, D., and Sevilla, J., 2004. The Effect of Health on Economic Growth: A Production Function Approach. *World Development*, 32(1), pp. 1–13.

³⁸United Nations Economic Commission for Africa, 2014. *Socio-economic Impacts of Ebola on Africa*. Addis Ababa: Economic Commission for Africa.

diseases. This 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, getting more rapidly to Africa's demographic dividend and improvements in education—the subject of the next two chapters—may be among the most important drivers of better health in much of Africa, among its various other obvious benefits. Awareness and information programmes can contribute greatly to communicating the benefits of good hygiene and preventing the spread of communicable diseases like HIV/AIDS. They can also instil healthy, lifelong habits around the importance of exercise and healthy diets, which could help to prevent or at least delay the onset of expensive lifestyle diseases like type-2 diabetes and heart disease.

Spending more money on WASH and health requires more rapid progress in moving Africa through its demographic transition, which is discussed next.

Further Reading

- Yuval Noah Harari, 2015. *Sapiens: A Brief History of Humankind*. New York: Harper.
- Pepin, J., 2011. *The Origin of AIDS*. Cambridge: Cambridge University Press.
- Progress on household drinking water, sanitation and hygiene 2000–2017: Special Focus on Inequalities, 2019. New York: United Nations Children's Fund (UNICEF) and World Health Organization (WHO). [Online] Available at <https://washdata.org/sites/default/files/documents/reports/2019-07/jmp-2019-wash-households.pdf>.

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