

ICSU Regional Office for Africa

AFRICA SCIENCE PLAN

Health and Human Well-being



Strengthening international science
for the benefit of society



**INTERNATIONAL
COUNCIL FOR SCIENCE**
REGIONAL OFFICE
FOR AFRICA

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We wish to express our appreciation to Dr Lydia Aziato, School of Nursing, University of Ghana, for her critical review of the revised document.

* Sadly Professor Rasoanaivo passed away in July 2016. His role in the development of this Plan was deeply appreciated.

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Published by:
ICSU Regional Office for Africa
Pretoria, South Africa
+27 (12) 349 7731
www.icsu.org/africa

© ICSU Regional Office for Africa
January 2017
ISBN 978-0-620-74576-5

Editor:
Hanlie Griesel, University of Pretoria and freelance writer/editor

Design, layout and printing:
Garnett Design Studio, Pretoria

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Preamble

The International Council for Science (ICSU) is a non-governmental organisation with a global membership that includes 112 National Scientific Bodies, and 29 International Scientific Unions and affiliated bodies. The long-term ICSU strategic vision is for a world where science is used for the benefit of all, excellence in science is valued, and scientific knowledge is linked effectively to policy-making.

The ICSU Strategic Plan 2006–2011 showed its contribution in strengthening international science for the benefit of society in three overlapping areas:

- *International research collaboration* – ICSU plans and coordinates major research programmes in key areas, such as a) global environmental change; b) monitoring and observation of the Earth System; and c) collection, preservation, and dissemination of scientific data and information.
- *Science for policy* – ICSU seeks to ensure that science is integrated into international policy development and that relevant policies take into account both scientific knowledge and the needs of science. Consequently, ICSU represents the science community in important intergovernmental forums, such as the a) 2002 (Johannesburg) World Summit on Sustainable Development; b) 2003 (Geneva) and 2005 (Tunis) World Summits on the Information Society; c) United Nations (UN) Commission on Sustainable Development; and d) Earth Observation Summits.
- *The universality of science* – The principle of the universality of science is embodied in ICSU's statutes: 'The practice of science should be equitable and without discrimination.' Thus the primary aim of ICSU is to enhance the pluralism of science and reach out to all countries, by a) ensuring that scientists can associate and communicate freely; b) providing equitable access to data and information; c) enabling equitable access to research materials and facilities; d) building scientific capacity; and e) bringing nations and disciplines together.

The ICSU Regional Office for Africa (ICSU ROA) was inaugurated on 1 September 2005 for the purpose of promoting and coordinating the activities of the ICSU family in Africa. Such an undertaking will always consider the priorities and the specific realities of this region. In April 2006, the ICSU Regional Committee for Africa (ICSU RCA) selected four priority areas on which its Regional Office would focus its activities in the period 2006–2011 (and beyond). These are: a) sustainable energy; b) health and human well-being; c) natural and human-induced hazards and disasters; and d) global environmental change.

Four Scoping Groups consisting wholly of African experts were established by the ICSU RCA to prepare the four Africa Science Plans that would address the numerous challenges that are embodied in the priority areas outlined. In drawing up the Science Plans, the authors took into consideration the ICSU Strategic Plan 2006–2011, the AU/NEPAD Africa's Science and Technology Consolidated Plan of Action, the UN Millennium Development Goals, reports from the ICSU interdisciplinary bodies, and joint initiatives.

The ICSU ROA convened its 2nd Regional Consultative Forum for Africa in Boksburg, South Africa, on 25–27 September 2006, to provide a platform for the four draft Science Plans to be evaluated critically by the broader scientific community. Participants from Africa and international partners had in-depth discussions on the proposed flagship projects and/or identified priority research themes for each of the four priority areas. The four Scoping Groups had an opportunity to meet just after the Forum to incorporate the suggestions provided by the Forum's participants as well as comments received electronically, and to make improvements to the documents. The final Science Plans were presented for approval by the ICSU Regional Committee for Africa (ICSU RCA) on 5–6 March 2007, at a meeting in the Seychelles. Some of the proposed flagship projects cut

across the four priority areas, and therefore a multi- and interdisciplinary approach is absolutely essential for achieving the objectives of the four Science Plans of the ICSU ROA.

The African Science Plans Steering Committee (ASPSC), at its maiden meeting in March 2014, recommended that each ICSU ROA Science Plan be reviewed and updated to reflect current and emerging trends in scientific research at global, regional and national levels. In so doing, it was envisaged that the Science Plans would be aligned with new developments in the global research agenda and new approaches to promoting transdisciplinary collaborative research, as well as new international programmes, especially the Future Earth initiative. The review was also expected to take into consideration the post Rio+20 Agenda, the Sustainable Development Goals (SDGs), and the Science, Technology and Innovation Strategy for Africa 2024 (STISA, 2024).

The review process of the Health and Human Well-being Science Plan, which commenced as an electronic consultation between the original authors as well as other newly identified active Health and Human Well-being scientists from within and outside the continent at the beginning of 2015, ended with a two-day workshop in Pretoria, South Africa on 9–10 June 2015.

After several months of compilation, critical reviews by individuals and members of the ICSU Regional Committee for Africa, and professional editing, we are proud to have produced this revised version of our African Science Plan on Health and Human Well-being in Africa. The Plan encapsulates appreciably the envisaged blueprint of the African Science Plans Steering Committee, the ICSU Regional Office for Africa and the ICSU Regional Committee for Africa for promoting and accelerating the application of science, engineering, technology and innovation (SETI) in solving Africa's socio-economic problems, feeding into the African Union's Agenda 2063 and the United Nations Sustainable Development Goals (SDGs).

ICSU believes that science provides the critical underpinning for innovation and technological development. It offers necessary, although not sufficient, input to ensure the sustainable socio-economic development of societies. At the same time, it gives a vital base for rational and prudent public policy formulation and decision-making. Accelerated development of scientific knowledge and skills are therefore key factors in the reduction of poverty and improvement of the quality of people's lives in Africa.

Dr Daniel Nyanganyura

Regional Director, ICSU Regional Office for Africa

Executive Summary

This document which is a revised version of the first edition of 2007 intends to capture the current status of health and human well-being in Africa as a whole. In doing so, shortcomings, especially in terms of policy, research, funding, data collection, human resources, training and education, and public awareness are identified, and solutions to improve health and human well-being in Africa are proposed.

Areas identified by the authors as being important in health and human well-being on the continent include: the burden of disease; health systems; public health; emerging and re-emerging diseases; food and nutrition security; water and sanitation; and contextual factors. Many of these factors are linked to poverty in Africa, which is a direct cause of reduced life expectancy, hunger, high infant mortality rates, and communities ravaged by disease. Many of these problems can be solved, however, if African governments spend more of their financial and intellectual resources on addressing the issues relating to the health and human well-being of their citizens. Immunisation, basic food and nutrition, and proper and adequate healthcare facilities as well as access to potable water can greatly improve living conditions on the continent.

Communicable diseases such as HIV/AIDS, malaria, and tuberculosis (TB) also threaten the economies of African countries as these illnesses continue to be a major burden to Africa even though the rest of the world has controlled or contained them. In addition, the effects of non-communicable diseases such as cancer, diabetes, cardiovascular diseases (CVDs), and mental ill-health have been largely overlooked in Africa. This Science Plan also appraises other leading causes of death/debilitation on the continent such as Sickle Cell Diseases (SCD) and the Neglected Tropical Diseases (NTDs). Africa is therefore suffering from the double burden of the impact of both communicable and non-communicable diseases. There is an urgent need for Africans to re-strategise research in these areas, and to set up operational and genuinely multidisciplinary collaborative centres of research on the continent.

Healthcare in Africa is based on a dual system in which most of the population depends on traditional and complementary medicine and a small proportion makes use of modern biomedicine. Systems need to be put in place to scientifically validate traditional and complementary medicine, in order to improve and enhance its efficacy. Accreditation programmes for traditional healers and greater interaction with trained health professionals are essential in the African context.

Nutrition in Africa has been largely neglected, although it is the cause of much of the ill-health on the continent. Nutrient deficiency, especially of micronutrients (minerals and vitamins), can result in conditions such as anaemia, goitre, cretinism, and blindness. It is essential to educate the population to understand that food should be eaten not merely to relieve hunger but also for its essential nutrients. Obesity, a serious health issue in developed countries, is increasingly more common in Africa because of unhealthy eating habits. Consequently, in addition to the so-called 'diseases of poverty', Africa has to face the challenges of diseases prevalent in developed countries (CVDs, diabetes, cancer, and others). Infant mortality rates are higher in Africa than anywhere else in the world, mainly due to improper care and feeding practices, poor living conditions, and the absence of adequate food supplies of good nutritional quality for both mothers and children.

The rapid urbanisation in large parts of Africa, together with poor planning and lack of proper service provision such as potable water supply and sanitation, have played a devastating role in the spread of diseases. Africa still has significant numbers of deaths due to diseases such as polio and measles, even though successful vaccination programmes have eradicated these diseases in developed countries. It is crucial for African governments to put programmes in place to provide clean and safe water, adequate sanitation facilities, and vaccination programmes to all communities.

Inadequate follow-up and control in the health sector in Africa have resulted in the emergence or re-emergence of many diseases – such as epidemic malaria, TB, and haemorrhagic fevers – in previously disease-free areas. Unless these problems are addressed appropriately and quickly, Africa risks a new wave of drug-resistant disease.

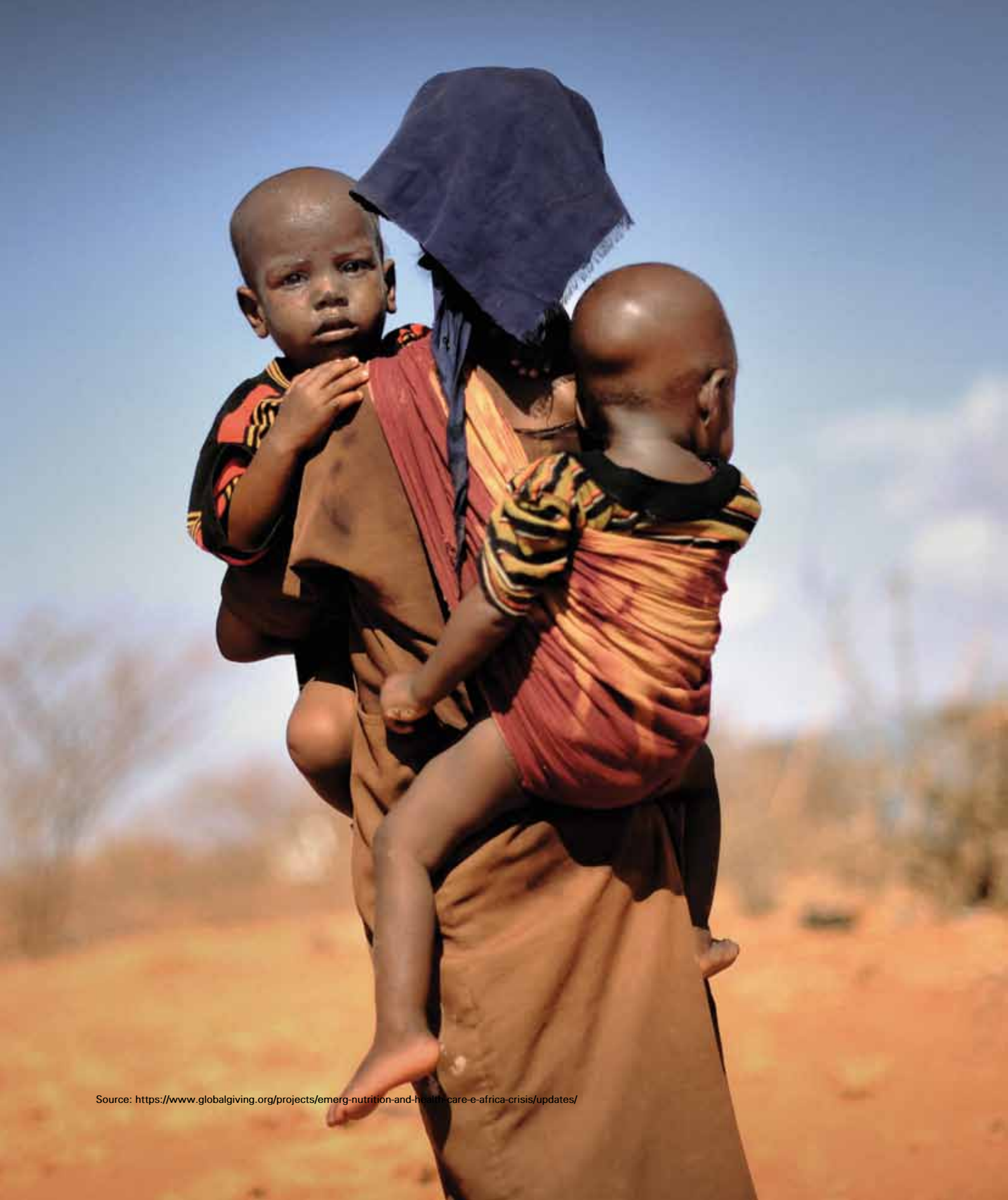
The Millennium Development Goals (MDGs) have come and gone with little evidence of any African countries having been able to achieve them, particularly those related to health and human well-being, by the set deadline. We now have the Sustainable Development Goals (SDGs), many of which directly or indirectly seek to address health and human well-being issues. In order to meet most, if not all of the relevant goals by the set deadline, African governments need to invest more financial and human resources to address them.



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Source: <https://www.globalgiving.org/projects/emerg-nutrition-and-health-care-e-africa-crisis/updates/>

Introduction

Africa faces many social and economic constraints as a result of inadequate attention being paid to health and human well-being. Of the 53 countries on the continent, only Botswana and South Africa spend a significant amount of their gross domestic product (GDP) on medical research. This document intends to capture the current status of health and human well-being in African countries, identify the problem areas, and make recommendations to address the challenges.

Priority areas identified here as being important in the health and human well-being sector in Africa are: the burden of disease, health systems, public health, emerging and re-emerging diseases, food and nutrition security, water and sanitation, and the social, political and environmental contexts that often exacerbate problems associated with achieving health and well-being. Many of these problems are linked to poverty, which leads to reduced life expectancy, high rates of infant mortality, and increased vulnerability to disease. It is important that African governments commit themselves to increasing their *budget allocations* for the problems of health and well-being on the continent, especially in implementing effective immunisation, nutrition, water and sanitation programmes, and in providing adequate healthcare facilities.

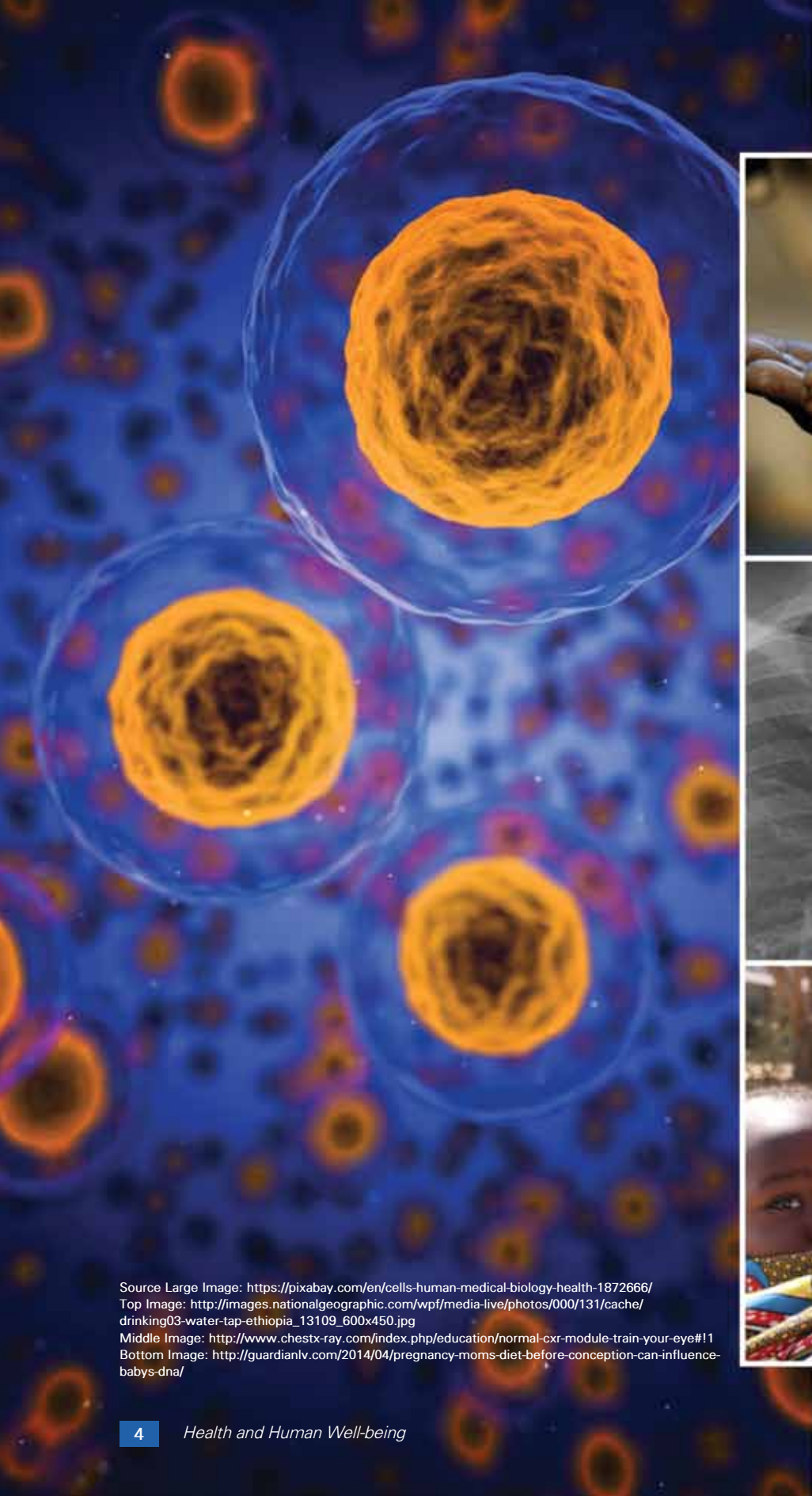
Basic research in the understanding and treatment of disease is important as the aetiology of diseases differs among continents. It is therefore important for African scientists to be adequately equipped to tackle problems associated with health and well-being on their home ground. For example, inadequate healthcare delivery is exacerbated by the fact that malnutrition is more prevalent in Africa than elsewhere in the world. It is within the power of African governments to address this problem.

HIV/AIDS has been identified as a major communicable disease on the continent, yet simple educational programmes that can limit the spread of the disease are, tragically, either non-existent or given insufficient priority. This disease has also resulted in a rapid increase in the prevalence of tuberculosis (TB) and, more seriously, in the evolution of strains that are multidrug-resistant. Both HIV/AIDS and TB continue to be a burden to Africa, whereas the rest of the world has controlled or contained these communicable diseases. The control of other communicable diseases, such as malaria, will rely either on the development of new drugs or vaccines, or on the control of their vectors. The situation is exacerbated by the emergence of new diseases and the resurgence of old ones. All these issues highlight the need for Africans to spearhead basic research for understanding these diseases and to set up functional and genuinely multidisciplinary regional and international partnerships.

The necessity for African governments to increase their investment in research and development in order to address the health problems facing Africa cannot be over-emphasised.

This Science Plan proposes to address the following objectives:

- To identify gaps in the current status of Health and Human Well-being in Africa, and point out the priority areas for intervention, research and development.
- To mobilise and synergise interdisciplinary Pan-African collaboration through organisations involved in health and human well-being projects and programmes.
- To mobilise sufficient financial and human resources in this sector, and to urge African governments to increase their *budget allocations* for improved healthcare facilities.
- To educate and sensitise African peoples regarding healthy lifestyles – for example, the practice of balanced nutrition, physical exercise and personal hygiene.
- To recommend better mechanisms of interfacing between scientific knowledge and policy- and decision-making processes.



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Bottom Image: <http://guardianlv.com/2014/04/pregnancy-moms-diet-before-conception-can-influence-babys-dna/>

2. Review of the Current Status of Health and Human Well-Being in Africa

2.1 Burden of Disease

Communicable and infectious diseases

According to the World Health Organisation's (WHO) figures, the five top killers in Africa in 2012 were HIV/AIDS, lower respiratory tract infections, diarrhoeal diseases, malaria, and strokes. WHO Group 1 category (i.e. communicable diseases, perinatal, maternal, and nutritional causes) accounted for 5.9 million (61.7%) of all deaths in Africa in 2012 (Daily Maverick, 2015). On the other hand, WHO Group 2 category (non-communicable diseases), accounted for 2.7-million deaths (28.6%). The three principal causes in this category are heart diseases (293,000), cancers (426,000) and diabetes (175,000). Furthermore, deaths resulting from WHO Group 3 category (injuries) were 939,000 (9.8%). Non-communicable and lifestyle diseases are the top killers in high-income countries, accounting for 67.8% of deaths in 2012. Evidently, the top causes of death in Africa include lower respiratory tract infections, tuberculosis, diarrhoeal disease and malaria. All these top killers are preventable and treatable if adequate healthcare systems and resources are made available. Some examples of communicable and infectious diseases are discussed below.

AIDS-related deaths

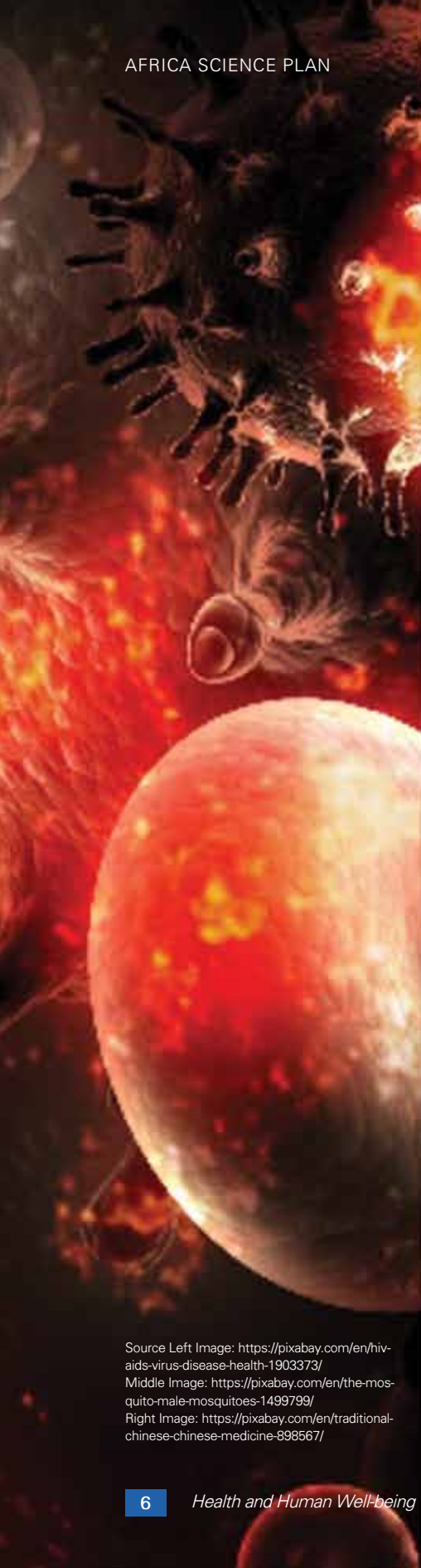
Although the number of deaths in the region due to AIDS-related illnesses dropped by 22% between 2001 and 2012, the number of deaths was 70% of global AIDS-related deaths. Over 2.1 million new infections occur each year, with two thirds occurring in women and 240 000 in children. In heavily affected countries, HIV infection rates have only stabilised at best: the annualised acquisition rates in persons in their first decade of sexual activity average 3-5% yearly in southern Africa. In 2015, HIV epidemics were still expanding in two geographic regions: The Middle East/North Africa, and Eastern Europe/Central Asia — largely due to challenges in implementing evidence-based HIV policies and programmes. However, there have also been many advances in the management of HIV from diagnosis, to treatment and prevention, which have resulted in the reduction of paediatric HIV and improved survival outcomes.

Actions that Africa can take to reduce HIV/AIDS and associated problems include:

- The development and evaluation of point of care viral load and CD4 count monitoring
- Public funded drug development programmes to identify new antiviral compounds
- The development and evaluation of HIV vaccines
- The development and evaluation of microbicides
- Countries contributing to the Global HIV Cure agenda, particularly in the field of paediatrics.

Lower respiratory tract infections

Lower respiratory tract infections are caused by viruses or bacteria which target the lungs and airways leading to pneumonia, influenza and bronchitis. Pneumonia is a leading cause of death in children, accounting for 18% of global deaths in children under the age of five, most of them in Africa and South Asia. In 2012, lower respiratory tract infections were the second highest cause of deaths in Africa, accounting for just over 1 million or 11.5% of deaths in the region. Although tuberculosis is one of the lower respiratory tract infections, it is categorised separately in the WHO cause of death statistics. Pulmonary TB mostly attacks the lungs, but its extra pulmonary variant affects other parts of the body, including the brain, spine, kidneys, and bones.



Source Left Image: <https://pixabay.com/en/hiv-aids-virus-disease-health-1903373/>
Middle Image: <https://pixabay.com/en/the-mosquito-male-mosquitoes-1499799/>
Right Image: <https://pixabay.com/en/traditional-chinese-chinese-medicine-898567/>

Diarrhoeal diseases

Diarrhoeal diseases are caused by bacterial, viral and parasitic organisms, and affect mainly children under the age of five. According to the WHO, there are an estimated 1.7-million cases of diarrhoeal disease in the world each year, leading to 780,000 deaths of children through dehydration. In sub-Saharan Africa, in particular, about 644,000 people died from diarrhoea in 2012, accounting for 6.7% of deaths. Yet these deaths are preventable. According to the United States (US) Centers for Disease Control, 88% of diarrhoeal deaths are the result of unsafe water and inadequate sanitation and hygiene.

Malaria

Despite strong efforts to control it, malaria is still a serious problem in Africa and the risk exists throughout the region. One continuous threat is malaria epidemics which frequently affect highlands and semi-arid areas of Africa where populations are immunologically vulnerable. Malaria immunity is developed over years of exposure, and while it never gives complete protection, it does reduce the risk that malaria infection will cause severe disease. In the East Africa highlands, malaria transmission is unstable due to fluctuations in temperatures that are normally low, and this leads to loss of immunity. Unstable highland malaria affects Ethiopia, Eritrea, western Kenya, south-western Uganda, the highlands of Tanzania and Madagascar, Rwanda and Burundi. Semi-arid areas, on the other hand, have mostly warm climates, and epidemics are associated with anomalous rainfall or natural disasters, which cause increases in vector breeding and survival.

In 2012, malaria killed 618,000 people globally and accounted for 5.9% of deaths in Africa. Of the 568,000 malaria-related global deaths, 92% occurred in Africa. Children are particularly vulnerable to malaria: in 2012, deaths in children under the age of five accounted for 41% of malaria deaths in sub-Saharan Africa. The tragedy is that malaria is treatable and preventable. An increase in malaria interventions – the provision of insect-repellent mosquito nets and indoor spraying with insecticides, for example – has reduced malaria-related deaths in Africa to illustrate, out of the 3.3-million lives saved through such interventions between 2000 and 2012, 3 million were children under the age of five. In spite of the progress achieved in the control and treatment of malaria, it is still endemic in all six WHO regions. Some of the challenges encountered in eliminating malaria are:

- The lack of robust, predictable and sustained international and domestic financing.
- The double threat regarding the emergence of parasite resistance to antimalarial medicines and of mosquito resistance to insecticides.
- Weak health systems with marked low performances, poor management of supply chains, regulation marred by corruption, inefficiency and inadequate laboratory equipment, thereby allowing the use of ineffective antimalarial medicines or vector control tools.
- Weak health systems lead to the absence or inadequacy of surveillance, monitoring and evaluation, thereby compromising the ability to track gaps in programme coverage and changes in disease burden.
- Inadequate technical and human resource capacities to sustain and scale up efforts.
- The disproportionate risk of malaria among hard-to-reach populations, including high-risk occupational groups, migrants, people in humanitarian crises, and rural communities with poor access to health services.
- The lack of adequate tools to diagnose and treat effectively infections due to *P. vivax* and other non-falciparum malaria parasites. Furthermore, in some situations, the density of parasitaemia is so low in a substantial proportion of individuals that it cannot be detected with current routine diagnostic tools. New diagnostic tools are needed.

- Many people infected with malaria parasites are asymptomatic or undiagnosed and are therefore invisible to the health system. Such people constitute an infectious parasite reservoir who unwittingly contribute to the cycle of malaria transmission.
- The lack of effective malaria vaccines. The most advanced vaccine, RTS,S (also known as Mosquirix™), has given a rather disappointing results (Heppner, 2013).

In response to the above challenges, the WHO proposed the Draft Global Technical Strategy for Malaria 2016-2030, endorsed by the World Health Assembly in May 2015 (Figure 1). The vision of the Global Technical Strategy for Malaria is to rid the world of malaria. It is assumed that a powerful and coordinated global response, together with continued investment in research and development, will rid entire continents of the disease and eventually eradicate malaria from the world.

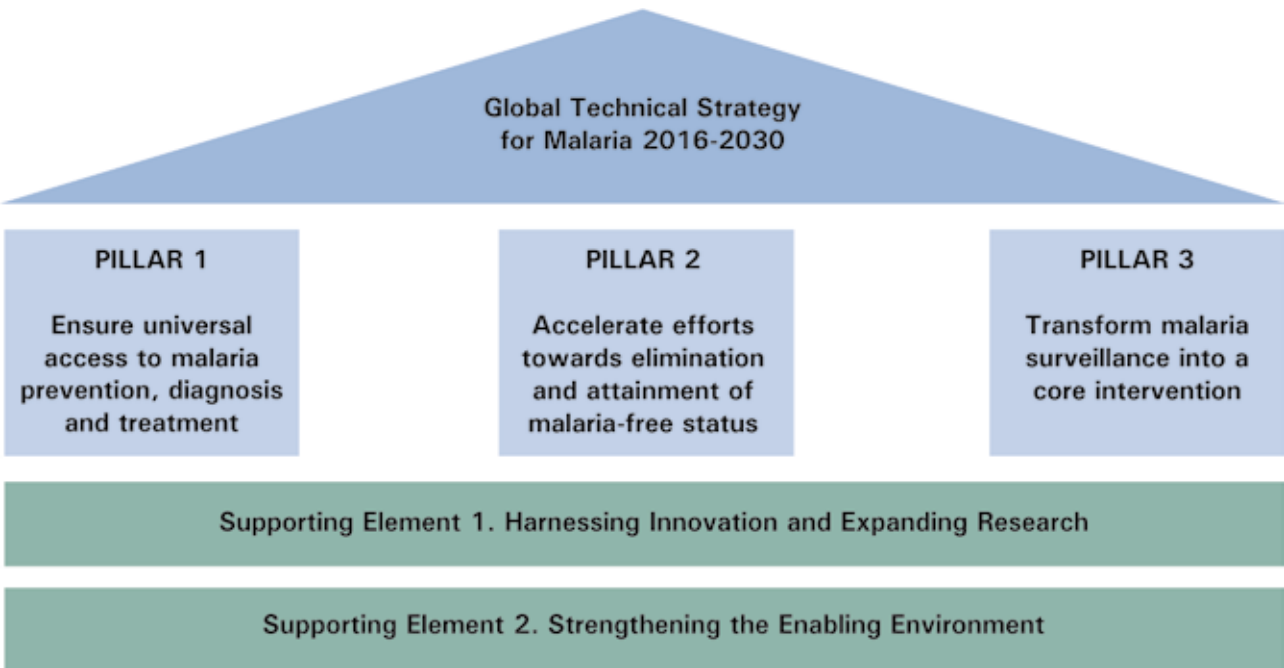


Figure 1. Structure of the WHO Global Technical Strategy for Malaria

Non-communicable and lifestyle diseases

Nutrition is becoming one of the major modifiable determinants of chronic diseases, with scientific evidence increasingly supporting the view that alterations in the diet have powerful effects, both positive and negative, on health throughout life. Diet-related non-communicable diseases (NCDs) include cardiovascular diseases (CVDs), obesity, adult-onset diabetes, osteoporosis, high blood pressure, and some cancers. The NCDs cause many deaths and much disability globally, and account for more than 50% of deaths in Africa. Yet they are generally overlooked in international health agendas.

About 60% of all deaths around the world and 47% of the burden of disease are attributable to diet-related chronic diseases. About two-thirds of deaths linked to these diseases occur in developing nations, where the key risk factors are poor diet, physical inactivity, and obesity. The prevalence of these diseases is increasing so rapidly, even in poor countries, that the phenomenon has been dubbed 'the nutrition transition'. Like other

types of malnutrition, diet-related chronic diseases have their origin in early childhood, often in the womb. In low-income countries, they are strongly associated with both low birth weight and stunting. Most important, dietary adjustments may not only influence present health, but may also determine whether or not an individual will develop such diseases as cancer, cardiovascular disease (CVD), and diabetes much later in life.

The period 1999–2002 showed a steady increase in the number of cases of CVDs, neuropsychiatric disorders and diabetes. Although malignant neoplasias shows an apparent decline, the collection of statistical data is poor in Africa so these figures are, at best, conservative estimates. In general, NCDs had been considered to affect mainly the developed world. However, developing countries are plagued by the double burden of communicable diseases combined with NCDs, and all these diseases are generally associated with poverty, low literacy levels (which make it difficult to carry out effective disease prevention and control), poor sanitation, malnutrition, poor governance, and disadvantageous gene–environment interactions. The result of these factors is that the developing world bears 90% of the global burden of disease. A few examples of NCDs are discussed below.

Cancers

Between 1990 and 2002, deaths from lung cancer rose by 30%, mainly due to the recent increase in smoking in developing countries.

Trends in obesity in Africa

It is pertinent to observe that research, and development policies and programmes, in many countries in Africa have focused principally on under-nutrition and food security. Consequently, trends in obesity are documented in only a few African countries. It is evident that obesity does exist in developing countries (see Table 1), as well as in more developed countries, especially among women. In developing countries, rural adults living a traditional lifestyle gain little or no weight as they grow older. Economic development in some African countries, however, has resulted in higher incomes and a tendency to adopt urban lifestyles, which may include a diet high in fat, sugar and salt, and lower levels of physical activity.

Cardiovascular diseases

Cardiovascular diseases include coronary heart disease (CHD), strokes and peripheral arterial disease. Strokes and CHD account for a large proportion of deaths in most industrialised countries, and their incidence is increasing in developing countries. Death rates due to CVDs in developing countries are almost double those recorded in developed countries, whilst other diseases such as rheumatic heart disease follow a similar trend. Obesity predisposes an individual to several cardiovascular risk factors including hypertension, raised cholesterol and impaired glucose tolerance. Longer-term prospective data, however, now suggest that obesity is also important as an independent risk factor for CHD-related morbidity and mortality.

Almost 10% of the global burden of disease is accounted for by CVDs, as measured by a combination of death and disability, and this proportion is expected to rise to nearly 15% by the year 2020. Data on the economic cost of CVDs in developing countries are limited, but these diseases are more likely to affect adults in their productive middle years than is the case in developed countries. In a seven-country study, CVD death rates were significantly higher among the working-age population (aged 35–64 years) in low- and middle-income countries than in the USA and Portugal (Colombia University, 2004). About 41% of all CVD-related deaths in South Africa and 35% in India occur among the working-age groups (Mayor, 2004). Among the young and middle-aged adults, CVDs now account for as many deaths as HIV/AIDS. This situation has a profound and adverse impact on households, families and society.

Table 1. Prevalence of obesity (BMI* \geq 0) in some African countries/populations

| Country/ Population | Year of study | Age (years) | Prevalence of obesity (%) | |
|---------------------------------------|------------------|----------------|------------------------------|-------|
| | | | Men | Women |
| Ghana | 1987–1988 | 20+ | 0.9 | |
| Mali | 1991 | 20+ | 0.8 | |
| Mauritius | 1992 | 25–74 | 5 | 15 |
| South Africa, Cape Peninsula (blacks) | 1990 | 15–64 | 8 | 44 |
| Tanzania | 1986–1989 | 35–64 | 0.6 | 3.6 |

* BMI: Body Mass Index (Source: WHO, 2000b)

Given the enormous advances in the prevention and treatment of CVDs, there is hope that the conditions are controllable. Risk factor prevention programmes and low-cost case management are feasible and cost-effective ways of reducing CVD mortality and disability. In most developing countries, however, implementation of these approaches and programmes is hampered by the lack of awareness of cost-effective CVD control options. There is also the perception that investment in CVDs will detract from efforts to control communicable diseases, or to improve perinatal and nutritional disorders. It is important, therefore, to develop community outreach programmes to facilitate informed understanding of the growing threat that CVDs pose to developing countries, and of the need for research and development to provide effective, affordable, and widely applicable responses to this threat. The trend and projection of CVDs are presented in Table 2.

Table 2. The Disability-Adjusted Life Years (DALYs) of cardiovascular diseases (millions) projected to 0 0

| Region/DALYs | 990 | 00 | 005 | 0 5 | 0 0 | 0 0 |
|-------------------------|------|------|------|------|-------|------|
| China | 22.9 | 25.4 | 25.4 | 25.5 | 26.1 | 27.1 |
| India | 23.4 | 30.7 | 32.2 | 35.2 | 37.4 | 41.6 |
| sub-Saharan Africa | 11.6 | 11.7 | 12.7 | 16.1 | 17.97 | 22.8 |
| Latin America/Caribbean | 7.8 | 8.6 | 9.1 | 10.3 | 10.91 | 12.1 |

Sources: Murray and Lopez, 1996; WHO, 2004a; Mathers and Loncar, 2006

Hypertension and strokes

Obesity increases the risk of developing hypertension, especially in women. The reason for the association between increased body weight and elevated blood pressure is unclear. One possibility is that obesity is linked to higher insulin circulation, and consequently with enhanced renal retention of sodium, resulting in increased blood pressure. As exercise improves insulin sensitivity, this could explain why exercise also reduces blood pressure.

Although strokes are the second leading cause of death globally after coronary heart disease (6.7 million deaths in 2012), they account for 4.4% (427,000) of deaths in Africa.

During a stroke, blood carrying oxygen is cut off from the brain, potentially leading to brain damage, disability or death. Family history, age, gender and race can be determining factors for stroke. Additional risk factors include obesity, diet, diabetes, smoking, hypertension and cholesterol.

Other leading causes of death in Africa

Following on the five top killers in Africa in 2012 – HIV/AIDS, lower respiratory tract infections, diarrhoeal diseases, malaria and strokes – the leading causes of death were: preterm birth complications, birth asphyxiation and trauma, malnutrition, coronary heart disease, and meningitis.

Brief descriptions are given below of other diseases prevalent in Africa.

Sickle Cell Disease

Sickle cell disease (SCD) is a serious disorder in which the body makes sickle-shaped red blood cells which easily move through the blood vessels. Sickle cells contain abnormal haemoglobin called sickle haemoglobin or haemoglobin S. Sickle cells are stiff and sticky. They tend to block blood flow in the blood vessels of the limbs and organs which can cause pain and organ damage. When sickled red blood cells get stuck in small blood vessels, tissues and organs are deprived of oxygen which can lead to organ damage, especially the lungs, kidneys, spleen and brain. A particularly serious complication of sickle cell disease is high blood pressure in the blood vessels that supply the lungs (pulmonary hypertension). Pulmonary hypertension occurs in about one-third of adults with sickle cell disease and can lead to heart failure. Sickle cell disease can also raise the risk for infection. When red blood cells sickle, they break down prematurely, which can lead to anaemia. Anaemia can cause shortness of breath, fatigue, and delayed growth and development in children. The rapid breakdown of red blood cells may also cause the yellowing of the eyes and skin, which are signs of jaundice.

Sickle cell disease affects millions of people worldwide, especially black population groups. It is estimated that about 80% of children under the age of five years die in villages in Africa from the SCD-related complications.

Globally, hydroxyurea is used to manage SCD but is not safe, and requires constant monitoring of patients by specialists and laboratory investigations. Although Africa is home to about 80% of SCD cases in the world, hydroxyurea is expensive and often not accessible. Moreover, facilities for monitoring patients are limited and, in Africa, most of the health facilities do not have laboratories to diagnose SCD. Diagnostic facilities should ideally be established at district levels and blood test for SCD after childbirth should be made mandatory. In most countries in Africa, for example, SCD is a stigma which leads to many patients dying without access to the appropriate management of the disease. Policies must be articulated and implemented to address this situation.

With respect to efforts to develop alternative drugs to combat SCD, NIPRISAN was developed at the National Institute for Pharmaceutical Research and Development, Abuja, Nigeria, from indigenous food plants. Although accorded 'orphan drug' status by USA Federal Drug Administration and European Medicine Evaluation Agency, NIPRISAN is not yet widely available in Africa. NIPRISAN had been subjected to Phases IIA and IIB clinical trials with outstanding outcomes regarding safety and efficacy. However, due to funding constraints, it is yet to undergo Phase III clinical trials.

Diabetes mellitus (type II)

Diet is an important determinant of obesity and also influences insulin resistance. It therefore plays an important role in the development of type II diabetes mellitus (DM), which is generally associated with a high-calorie, high-fat and low-carbohydrate diet, and lack of physical exercise. Excess energy intake alone promotes insulin resistance, even before significant weight gain occurs. A diet rich in energy and low in fibre promotes weight gain and insulin resistance, even in low-risk populations.

A worldwide epidemic of DM is likely in the first quarter of the 21st century. The prevalence of DM in the adult population worldwide is estimated to rise from 4.0% in 1995 to 5.4% in 2025, thus a 35% increase. As shown in Table 3, the number of adults with DM will rise from 51 million to 72 million in the developed countries, and from 84 million to 228 million in developing countries (King *et al.*, 1998). This implies that more than 48% of the people with DM will be in developing countries.

Table 3. The prevalence, numerical estimates and projections of diabetes

| | World | | Developed countries | | Developing Countries | |
|----------------------------|-------|-----|---------------------|-----|----------------------|-----|
| | 995 | 0 5 | 995 | 0 5 | 995 | 0 5 |
| Diabetes prevalence % | 4.0 | 5.4 | 6.0 | 7.6 | 3.3 | 4.9 |
| Number of cases (millions) | 135 | 300 | 51 | 72 | 84 | 228 |
| % Increase | 35 | | 27 | | 48 | |

Source: Adapted from King *et al.*, 1998

Maternal and reproductive health

There is a vast gap in economic terms between developed and developing nations, and this disparity is reflected in matters of health as well. Maternal and infant well-being forms a substantial part of the health gap between the rich countries and the resource-deficient economies of developing countries. Alongside maternal death is infant mortality (Table 4).

Table 4. Risk of maternal death and neonatal mortality

| Income status | Maternal death | Neonatal mortality (per 1 000 live births) |
|-------------------------|----------------|--|
| High-income countries | 1 in 4 000 | 4 |
| Middle-income countries | 1 in 61 | 33 |
| Low-income countries | 1 in 17 | 50 |

Conception, gestation and parturition are natural physiological processes. The resultant neonate ought to survive, with minimum support, on basic balanced nutrition and healthcare support, largely through programmed immunisation. Yet maternal and infant mortality statistics paint a grim picture in Africa. The 20 countries with the highest neonatal mortalities are located in Africa. Some of them, such as Ethiopia, Sierra Leone and Liberia, have experienced internal political instability and civil wars.

The UN Millennium Development Goals (MDGs) challenged developing countries to reduce child (up to 5 years of age) mortality by two-thirds and reduce maternal mortality by three-quarters by the year 2015. Many African countries did not meet these targets.

Maternal and child health has in recent years been gravely compromised with the rise in malaria. Women who contract malaria during pregnancy become anaemic and tend to give birth to underweight babies with a greater risk of disease, disability and death. Malaria in pregnant women has been associated with 20–30% of maternal deaths and a high risk of spontaneous abortion, premature delivery and neonatal death. In 1998, a malaria epidemic in Rwanda, at an altitude of 2300 metres above sea level, led to a four-fold increase in hospital admissions of pregnant women, and a five-fold increase in maternal deaths (Worrall *et al.*, 2004).

HIV/AIDS has also added a new challenge to the problem of maternal and infant mortality. The double tragedy of malaria combined with HIV/AIDS, and their effects on pregnant mothers and foetuses, new-born babies and infants, have reduced any gains made in improving maternal and child healthcare.

It should be recognised that the health sector alone cannot solve or reverse the adverse trends in maternal and child health. Social intervention is needed to promote education, develop food security, support economic empowerment, and eliminate gender biases in employment and remuneration. Equally vital are strong political will, and policies to promote and support family planning, contraception, child immunisation, oral rehydration therapy, basic hygiene, malaria control and eradication, and HIV/AIDS prevention (especially sexual and mother-to-child transmission).

Neglected tropical diseases (NTD)

The WHO African region bears about 40% of the global burden of neglected tropical diseases (NTDs). In all 47 countries that fall under the WHO African region, at least two of the NTDs are endemic, while 36 of them are co-endemic for at least five of these diseases. NTDs disproportionately affect the most vulnerable people and the poorest communities. They lead to chronic and debilitating physical and mental symptoms which affect more than one billion people, including more than 500,000 million children.

The global NTD burden amounts to between 46 and 57 million disability-adjusted life years (DALYs) lost annually. The WHO African region bears about 40% of the global burden of neglected tropical diseases requiring preventive chemotherapy, ranging from 169 million for onchocerciasis (river blindness) to 468 million for lymphatic filariasis (elephantiasis).

Significant progress in recent years in addressing NTDs include:

- Increased political commitment and government leadership to deliver interventions in line with the regional and national NTD agenda, and the regional NTD strategic plan for the period 2014-2020.
- Increased support for bilateral and multilateral agencies, private sector and other agencies.
- Increased mass drug coverage. For instance, the coverage of community-directed treatment (CDTI) for controlling onchocerciasis has reached 80% of the total population in many targeted communities. As a result, onchocerciasis transmission has been interrupted in several focal areas.

A new NTD entity

A WHO Working Group meeting held in Johannesburg, South Africa, on 28–30 April 2015, adopted a new NTD entity. The new entity will contribute to the acceleration of the reduction of the disease burden by providing technical support to countries in their efforts to control, eliminate and eradicate targeted NTDs, and thereby contribute to poverty alleviation, productivity, and improved quality of life of affected people in the Africa. The entity will address all five PC-NTDs (viz. lymphatic filariasis, onchocerciasis, schistosomiasis, soil-transmitted helminthiasis (STH) and trachoma), and function as the operational and technical arm of the WHO Regional Office on PC-NTDs, aimed at improving access to timely, high quality short- and longer- term technical assistance for achieving the PC-NTD goals and targets set for countries in the WHO African region.

The entity will provide coordinated operational and technical support to ensure the achievement of preventive chemotherapy and transmission control (PCT) goals and targets set at country level, in accordance with the Regional Strategic Plan for NTD 2014-2020. Its focus will be on ensuring that the disease-specific targets are met at the national level in support of integrated NTD country programmes.



Source: <http://www.peoplesaw.com/fr/onnews.php?id=1666>

GAPS AND CHALLENGES

1. The third report of the World Health Organization (WHO) on NTDs urges affected countries to enhance their domestic investments in order sustainably to address social and health inequities. Creating conditions to generate the investments needed to overcome these diseases (which blind, disfigure, disable and kill) will provide an essential package of interventions to more than 1.5 billion people worldwide. The key for the successful achievements of the laudable objectives of this new NTD entity is member countries being able to raise adequate domestic funds.
2. The sustainability of the programme until and beyond 2020.
3. Most of the drugs used for the treatment of NTDs were developed over 30 years ago and are generally toxic. The big pharmaceutical companies have not shown interest in developing new more effective and safer medicines for the treatment of NTDs.

Mental health

Neuropsychiatric disorders account for five of the ten most disabling medical disorders worldwide. Although there has been relatively little work on neuropsychiatric epidemiology in Africa, where data are available they conform to this pattern. For example, in South Africa, neuropsychiatric disorders account for the second largest portion of the national burden of disease, after HIV/AIDS (Stein *et al.*, 2006). Neuropsychiatric disorders are associated particularly with HIV/AIDS, depression and anxiety being common early on, and dementia and psychosis often occurring at later stages of the disease. As the economic cost of mental illness to the individual and to society becomes more glaring, the need to devote efforts and resources to address these conditions can no longer be ignored.

As part of the World Mental Health Survey, rigorous large-scale epidemiological studies of common mental disorders were conducted in Nigeria and South Africa in 2002–2004. Anxiety disorders and depression were the most prevalent of the psychiatric disorders, and were associated with significant morbidity. There was also clear evidence in these surveys that psychiatric disorders are under-diagnosed and under-treated (WHO, 2005a). This is not surprising, given the relatively small number of well-trained mental health professionals on the continent. With advances in human rights in Africa, there is now increased scope for arguing that those suffering from mental illness have the same rights as those with other illnesses, and deserve appropriate care.

Fortunately, the significant advances in neuroscience in recent decades provide excellent opportunities for delineating the precise neural and molecular underpinnings of neuropsychiatric disorders. While much of this work is proceeding in the USA and Europe, there are unique opportunities for scientific investigation in Africa. There is room, for example, for examining resilience factors accounting for the apparently lower rates of dementia in some African populations, for investigating the genetic basis of neuropsychiatric disorders in discrete African populations (such as the Afrikaner in South Africa), and for conducting clinical trials in an African context (very few real-world randomised controlled trials of mental illness have been undertaken in Africa).

2.2 Health Systems

Traditional and complementary medicine

Tremendous progress has been achieved by member states of the WHO Africa region with respect to the implementation of Regional Traditional Medicine Strategy (2000–2012) (Figure 2). For example, in 2000, only eight countries had adopted national policies on traditional medicine, compared to 40 countries in 2012.

Furthermore, in 2000 only one country had a legal framework for the practice of traditional medicine in the WHO African region. By 2012, 29 countries had adopted legal frameworks for the practice of traditional medicine.

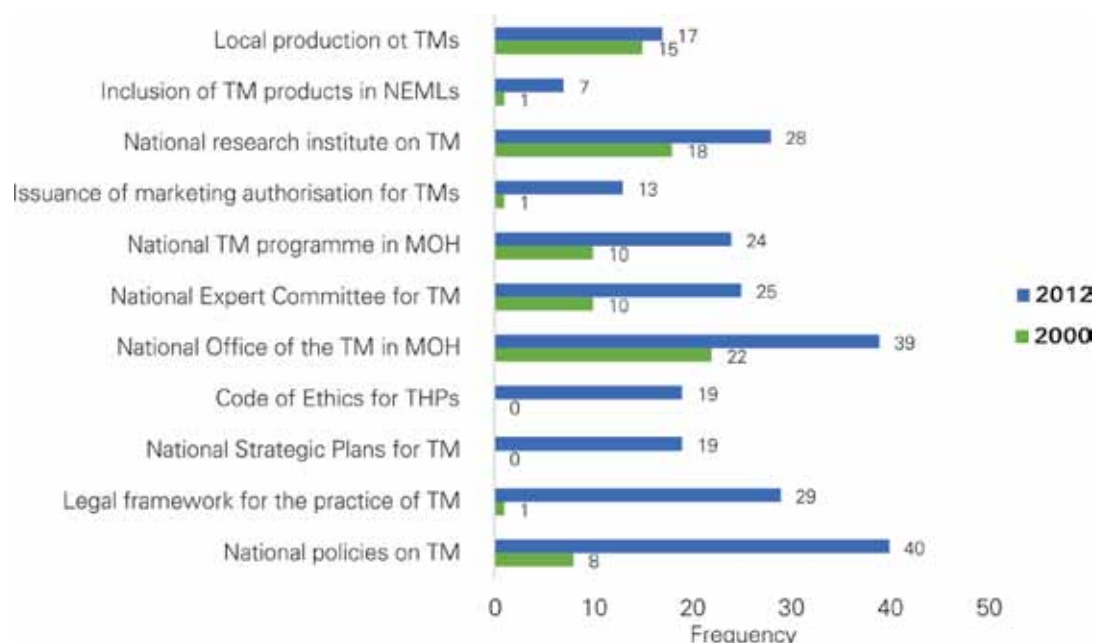


Figure 2. Summary of country progress in the implementation of the WHO Regional TM Strategy (2000–2012)

In view of the great success regarding the implementation of the first Traditional Medicine Strategy, the WHO has published a second Traditional Medicine Strategy (2014–2023) in order to support member states in harnessing the potential contribution of traditional and complementary medicine (T&CM) to health, wellness and people-centered health care, and to promote the safe and effective use of T&CM through the regulation of products, practices and practitioners.

Member states are required to:

- Build the knowledge base that will allow T&CM to be managed actively through appropriate national policies that understand and recognise the role and potential of T&CM.
- Strengthen the quality assurance, safety, proper use and effectiveness of T&CM by regulating products, practices and practitioners through T&CM education and training, skills development, services and therapies.
- Promote universal health coverage by integrating T&CM services into health service delivery and self-health care by capitalising on their potential contribution to improve health services and health outcomes, and by ensuring users are able to make informed choices about self-health care.

Modern biomedical health systems

Health systems consist of a complex network of people, organisations and institutions working together at local, national and regional levels to promote, restore or maintain health. Physical infrastructure, equipment, human and financial resources, essential medicines and vaccines are key inputs to the functioning of health systems. The overall mission of the WHO is to ensure that all people attain the highest possible level of health, with special emphasis on closing the gaps within and between countries. The fulfilment of this mission is

highly dependent on the stewardship and performance of health systems in member nations. Unfortunately, the performance of health systems varies greatly within and among countries and is reflected in the disparity in health and resources for health in Africa. Poorly structured, badly managed, inefficiently organised and inadequately funded health systems can do more harm than good to the health of consumers (WHO, 2000c).

Physical infrastructure

The health system of a country depends on infrastructure, which is that part of the system that helps health providers to perform their function of promoting, restoring and maintaining health.

Most physical health facilities in Africa are concentrated in urban areas. Since the majority of the population (>70% in most countries) live in rural areas, they are left without adequate access to health facilities. Geographic access to health facilities is defined as living within five kilometres or within one hour's walking distance from a health facility. In many countries, such as Chad, Senegal, Niger, Mozambique, Mali and Ethiopia, less than 50% of the population has access to health facilities in terms of this definition.

In addition to the problem of access, conditions in existing health facilities are in disrepair. For example, a survey of 15 publicly funded hospitals in Kenya revealed that 40% of the buildings were in poor or unsatisfactory condition. Hospitals such as Tres de Agosta in Guinea-Bissau have crumbled beyond repair, and health facilities in many countries, such as in Côte d'Ivoire, Mozambique and Somalia, were severely damaged during civil wars.

Even where facilities are available, their use differs by location (urban/rural) and ownership (public/private). In a study of emergency obstetric care services, conducted in 129 facilities in six districts in northern Tanzania, it was found that pregnant women tended to use volunteer agency services more than government services in rural areas, whereas the government facilities had a higher burden of workload in urban areas (Olsen *et al.*, 2005).

The practice of cost-sharing or user-fees schemes deters most people from using the available health facilities, as they are often unable to afford these fees. It was found that the poorest socio-economic quartile in a southeast Nigerian population was more likely to use low-level providers (such as patent medicine dealers, shops and herbalists) and was least likely to use primary healthcare (PHC) facilities (Onwujekwe, 2005). Furthermore, availability of good services, proximity of the centres to the homes, and the professionalism of health workers had an influence on the use of PHC facilities.

Properly functioning *equipment* is as important as the availability of, and access to, physical facilities, competence and readiness of staff, and timely supplies for the provision of healthcare. Although public and private healthcare providers purchase equipment to improve the functioning of healthcare facilities, little attention is directed towards the management and maintenance of this equipment.

Many developing countries increasingly depend on donor assistance to meet the equipment needs of their health systems. However, there should be measures to ensure that any donation meets the mutual benefits of both donors and recipients, and that there is no dumping of obsolete or sub-standard equipment in recipient countries.

Human resources for health

The prospects for achieving 80% coverage of measles immunisation and for the presence of skilled attendants at births are generally improved where health worker density exceeds 2.5 workers per 1,000 people. However,

the frontline workers of health systems in Africa are overburdened and overstressed. Africa is at the epicentre of the global workforce crisis. In most countries in the region, the number of healthcare workers is insufficient to meet the demands of their health systems. Many African nations have only about one doctor for every 10 000 people, compared to 26 for every 10 000 people in the USA. Table 5 shows the bulk of health workers to be in Europe and the Americas, where the health worker density per 1 000 (18.9 and 24.8, respectively) exceeds by far the global average of 9.3 per 1 000. Africa is the worst off, with a health worker density of 2.3 per 1 000 people. Chad and Tanzania, for example, have less than half the workforce they require to meet their essential healthcare needs (Kurowski *et al.*, 2003).

Training of healthcare personnel in the world as a whole, and especially in Africa, currently falls short of the population's needs. The world's 1 691 medical schools, 5 492 nursing schools, and 375 public health schools do not produce enough staff. More training institutions are required to ensure a more appropriate mix of opportunities. Although the cost of starting new training institutions may appear high in the short term, in the case of Africa this should be weighed against the cost of training people overseas, and the rate of return of health workers trained in foreign institutions.

Migration of health workers takes place within countries from rural to urban areas, within regions from poorer to better-off countries, and across continents. A better life and livelihood are at the root of the decision to migrate. Classically, this is provoked by growing discontent or dissatisfaction with existing working/living conditions (so-called push factors) as well as awareness of the existence of, and desire to find better jobs elsewhere (so-called pull factors) (WHO, 2006). A study from sub-Saharan Africa points to the significance of both push and pull factors (Awases *et al.*, 2004). In Zimbabwe, for example, 77% of final-year university students migrate, while over 45% of qualified Ghanaian tertiary level graduates have left the country, many of whom were educated using state funds (Schiff and Ozden (eds.), 2005).

Table 5. Global health workforce by density

| WHO region | Total health workforce | | Health service providers | | Health management and support workers | |
|-----------------------|------------------------|---------------------|--------------------------|-----------------------------|---------------------------------------|-----------------------------|
| | Number (thousands) | Density (per 1 000) | Number (thousands) | % of total health workforce | Number (thousands) | % of total health workforce |
| African | 1 640 | 2.3 | 1 360 | 83 | 280 | 17 |
| Eastern Mediterranean | 2 100 | 4.0 | 1 580 | 75 | 520 | 25 |
| South East Asia | 7 040 | 4.3 | 4 730 | 67 | 2 300 | 33 |
| Western Pacific | 10 070 | 5.8 | 7 810 | 78 | 2 260 | 23 |
| Europe | 16 630 | 18.9 | 11 540 | 69 | 5 090 | 31 |
| Americas | 21 740 | 24.8 | 12 460 | 57 | 9 280 | 43 |
| World | 59 220 | 9.3 | 39 470 | 67 | 19 750 | 33 |

Source: WHO, 2006

Other resources

Finance is a critical determinant of healthcare service delivery. Health systems in developing countries are unable to deliver proper healthcare to the people who need it, owing to inadequate healthcare funding. Many African countries spend less than US\$20 per capita per year on healthcare. This is far below the recommended

per capita expenditure, by WHO, on health for low-income countries. Moreover, in most African countries, the health sector's share of total government expenditure is below 10%. There is high dependence on donor funding to finance healthcare. According to McIntyre and Gilson (2005), the WHO estimates in 2001 showed that external funding accounts for over 25% of the total healthcare spending in about 35% of countries, and that 5% of countries obtain more than 50% of all healthcare funding from external sources.

In the 1980s, user fees in African health service systems were introduced. This practice, which was intended to increase the ability of the health facilities to generate income, resulted in payments exceeding 25% of the total healthcare expenditure in more than 75% of African countries (McIntyre and Gilson, 2005). There is overwhelming evidence of the adverse effects of user fees on households, however, and there are growing calls for its abolition in public health services (Claeson *et al.*, 2001; Burnham *et al.*, 2004). Social or national health insurance has been proposed as an alternative to out-of-pocket payments or other financing options (Claeson *et al.*, 2001; WHO, 2000c, 2005b). However, health insurance is still relatively limited in Africa.

Access to *essential medicines and vaccines* represents the largest government health service cost after personnel, and the largest part of household health expenditure. In Cameroon, 95% of persons feeling ill buy drugs, whereas only 31% consult a physician or other healthcare provider, and half of the average household's health expenditure is on medicines (Commeryras *et al.*, 2005).

A survey of PHC facilities in Uganda showed that 40% of government and private facilities were reported to have run out of some or all vaccines in 1999/2000. Lack of stock sometimes lasted 1–12 weeks. Public–private partnerships have been proposed as a strategy for overcoming the unreliable and inefficient government-operated supply systems. Innovative public–private franchising and accreditation of retail suppliers of medicines have been introduced in Ghana, Kenya and Nigeria. Public–private relationships, such as those with non-profit mission services, have been established in several African countries including Kenya, South Africa, Tanzania, Uganda and Zambia, and have acquired a reputation for reliability in supplying essential drugs. Similar needs for medicines, shared sources of supply, and a lack of national expertise in procurement, all point to the need for greater regional collaboration in procurement and supply systems.

2.3 Public Health

There are several major factors that have an impact on public health, some of which are briefly described here.

Global warming has led to variability in climate. Heavy rainfall and floods, or severe drought, have led to emergencies linked to, for example, to landslides in Bududa, eastern Uganda, and food insecurity in other part of Africa. Landslides and floods result in the spread of infectious diseases such as typhoid, cholera and malaria. Emergency responses to such disasters need to be accompanied by adequate levels of research to inform planned interventions. Deforestation as a result of drought and climate change has a severe impact on rural people's livelihoods, in particular.

Water, sanitation and hygiene practices (WASH) are essential preventive measures against typhoid and water-borne diseases. Moreover, water, food, and access to health facilities are essential for life, and influence the health and well-being of people. They have central social functions in almost all cultures and traditions, and are thus major determinants of human behaviour.

Health and well-being in urban populations are affected by several factors, most markedly by rapid urbanisation, industrialisation, air pollution and the relationship with respiratory diseases, occupational safety and health linked to industries, overcrowding, and trauma, injuries and violence (ICSU, 2011). Further, higher levels



Source: <http://theconversation.com/african-leaders-step-up-to-the-plate-to-narrow-immunisation-gaps-58237>

of income and dietary changes have increased the risk of NCDs (obesity, anorexia nervosa, diabetes, hypertension).

Urbanisation

Many countries in Africa are experiencing rapid urbanisation which is often seen as a problem, especially where it overwhelms governments' capacity to manage it. Globally economic development underpins urbanisation and the growth of most large cities. In almost all nations, the increase in the level of urbanisation tracks the increase in the proportion of GDP generated by industry and services, and the increase in the proportion of the workforce in such industries and services (Satterthwaite *et al.*, 2010). Satterthwaite *et al.* raise three key environment and development issues related to an increasingly urbanised world:

- The first is the extent to which living and working in urban areas is associated with good health and the lack of deprivation and, beyond this, with health and well-being.
- The second is the extent to which urbanisation is associated with unsustainable levels of resource use or degradation (such as loss of soil, forests, biodiversity), and increased greenhouse gas (GHG) emissions.
- The third issue is the opportunities that urbanisation presents for reducing poverty, and why these so often have not been acted on.

Social protection and human well-being

Social protection strategies and thinking have become dominated by transfers of cash, food or assets that are targeted at individuals or households identified as poor and/or vulnerable. This is inadequate as an approach to reducing poverty sustainably. What is needed is to tackle the structural causes of poverty with coordinated social policies (*cf.* Devereux & McGregor, 2014). It is important that the focus remains on causes of poverty and vulnerability (e.g., discrimination against ethnic minorities) rather than merely be directed to the symptoms. Also, there is the need to re-orient social protection to include a focus on human rights, and to upgrade and upscale externally designed and financed sub-national projects to domestically owned national social protection systems.

Preventive healthcare

Africa's 800 million people face a huge burden of preventable and treatable health problems, which not only cause unnecessary death and suffering, but also undermine economic development and damage the continent's social fabric. The HIV/AIDS pandemic has taken a disproportionate toll on the continent, as over 25 million of the world's 40 million people with HIV/AIDS live in sub-Saharan Africa. Countries in North Africa and the Horn of Africa have significant lower prevalence rates, with Southern Africa the worst affected region on the continent.

More than 13 million cases of measles occur in Africa, and 450 000 children die from the disease every year. In addition, as noted earlier, malaria, acute respiratory infections, and diarrhoea are among the leading causes of death for African children under five years of age.

Immunisation

When the Expanded Programme on Immunisation (EPI) was launched in 1974, less than 5% of the world's children were immunised in their first year of life against six killer diseases – polio, diphtheria, TB, pertussis

(whooping cough), measles and tetanus. Nearly 75% of children worldwide now receive these life-saving vaccinations, and increasing numbers are also protected by new and underused vaccines, such as that against hepatitis B. However, immunisation against these killer diseases has not yet reached a quarter of the world's children (about 34 million infants), most of whom are in Africa. While global rates have risen, the levels of immunisation have in fact decreased in some African countries. Immunisation coverage in Africa had dropped to just above 50% in 2000, and, in 12 of the poorest countries, rates are below 35% (UNICEF, 2002; USAID, 2003). In Somalia, only 18% of children were fully immunised against diphtheria-pertussis-tetanus (DPT). In Nigeria, the most populous country in Africa, less than one in four children were vaccinated in 2002. Yet only a decade earlier, more than twice as many children had been immunised (WHO, 2002b).

In 1989, the WHO recommended that yellow fever vaccine be used in countries where the disease is endemic, and, in the 1990s, hepatitis B and Haemophilus influenzae type b (Hib) vaccines were recommended where the disease burden was known or suspected to be high, and where control of the diseases was a public health priority. By 2001, however, 72% of the countries in the world had still not included these vaccines in their routine immunisation campaigns (WHO, 2002b).

Completion of a full course of immunisations before a child's first birthday can prevent serious illness and death. In 1990, the EPI target for Africa was to make immunisation available to all infants and to achieve at least 75% coverage for all six EPI vaccines. As of August 1991, the immunisation coverage in Africa for children aged 12–23 months was estimated to have reached 79% for BCG (TB vaccine), 57% for the third dose of the DPT vaccine, 56% for the third dose of the oral poliomyelitis vaccine, and 54% for the measles vaccine.

Measles

The World Summit for Children in 1990 set a target of 90% coverage by 2000 for the measles vaccine, as well as for other vaccines used in the EPI. By 1999, however, 12 African countries (Burkina Faso, Burundi, Cameroon, Congo, the Democratic Republic of Congo [DRC], Gabon, Guinea-Bissau, Liberia, Niger, Madagascar, Senegal, and Togo) reported measles coverage below 50%, as compared with only three countries (Afghanistan, Djibouti and Somalia) in the Eastern Mediterranean Region (WHO and UNICEF, 2001).

The measles initiative is a long-term commitment to control the 450 000 annual measles deaths in Africa by supporting immunisation services, including the vaccination of 200 million children through both mass and follow-up campaigns in African countries. The target was to prevent 1.2 million deaths by 2005, thus bringing measles deaths in Africa to near zero.

Polio

The Global Polio Eradication Initiative, which is spearheaded by WHO, Rotary International, the Centres for Disease Control and Prevention (CDC), and UNICEF, was launched in 1988 and has been at the forefront of eradicating polio from all parts of the world. In many countries, vitamin A was administered with the vaccine to boost children's immunity. This initiative was implemented under the auspices of the African Union in response to the 2003–2004 polio epidemics. In 2004, Africa recorded 74% of all polio cases in the world (12631 cases). The new epidemic was caused by the suspension of immunisation campaigns in countries such as Nigeria. It re-infected 11 previously polio-free countries and re-established transmission in six African countries (Burkina Faso, Central African Republic, Chad, Côte d'Ivoire, Mali and Sudan). In total, 10 previously polio-free countries

(Angola, Cameroon, Chad, Eritrea, Ethiopia, Indonesia, Mali, Somalia, Sudan and Yemen) were re-infected in late 2004 and 2005 (WHO, 2005c).

Immunisation in Africa faces several challenges, the most important of which include the following:

Inequalities in immunisation coverage

The existing inequities in immunisation coverage rates between the poorest and wealthiest populations within African countries provide a major challenge to attaining immunisation targets. Studies by the World Bank reveal that, in many countries, immunisation rates are consistently higher within the wealthier groups of people (World Bank, 2006).

Conflict

Conflict in Africa continues to interrupt health service delivery, and immunisation service, in particular. The 2005 mass polio immunisation campaign during the 2004 polio epidemic was hampered by the war in Sudan, where those administering the vaccine found it difficult to reach children. In Côte d'Ivoire, immunisation campaigns were halted owing to civil unrest (WHO *et al.*, 2006). In some countries, wars and conflicts have destroyed infrastructure and fractured health service delivery systems. In 1999, only 18% of children were fully immunised with DPT in Somalia, while in Chad and Ethiopia only 21% were fully immunised.

Loss of medical personnel to HIV/AIDS

Public health systems in Africa are generally overwhelmed by the increasing burden of HIV/AIDS. This problem is further exacerbated by HIV-related illnesses, absenteeism, and deaths among health workers. In 2001, UNAIDS reported that some countries were losing one-quarter of their health workers to HIV/AIDS. In one hospital in Zambia, deaths among health workers increased thirteen-fold between 1980 and 1990, largely due to HIV/AIDS.

Inadequacy of disease surveillance and reporting systems

In developed countries, the widespread use of vaccines against Hib almost eliminated Hib-related diseases over the past decade. During the same period, however, many developing countries did not have the capacity to establish the extent of the burden of Hib disease, in addition to the fact that the vaccine was initially too expensive for most low-income countries to contemplate. As a result, an estimated 4.5 million unvaccinated children died from Hib-related diseases (mainly pneumonia) in developing countries during the same 10-year period. Hepatitis B vaccine, the first cancer-preventing vaccine, has shared a similar fate since it first came onto the market in 1981. Despite a massive reduction from the initial price of US\$150 for a 3-dose course to under US\$1.50 today, the vaccine still costs almost as much as all six original EPI vaccines combined. Over 520 000 people worldwide die from hepatitis B infection every year. In 1992, the WHO recommended that every national immunisation programme should introduce the vaccine by 1997, but this target is far from being met. By 2001, 72 countries were still not using the vaccine in their routine immunisation programmes (WHO, 2002b).

Occupational health

Workplace hazards are categorised into four broad types: chemical, biological, physical, and psycho-social. More than 80% of the world's workforce residing in the developing world shares disproportionately in the global burden of occupational disease and injury. Several classic occupational diseases, such as silicosis and mercury (Hg) and lead (Pb) poisoning, have been substantially eliminated in industrialised countries but are still prevalent in Africa. Compelling evidence indicates that adverse work-related health conditions could be substantially improved, often at modest cost (Rosenstock *et al.*, 2006).

It is estimated that over 1.1 million people worldwide die yearly from occupational injuries and work-related diseases, a figure roughly equivalent to the global annual number of deaths from malaria. In developing countries, this risk reaches a proportion that is estimated to be 10–20 times higher than in established market economies. While it is difficult to obtain data on Africa, the International Labour Organisation (ILO) estimates the fatality rate from occupational accidents in Africa to be 21 per 10 000 employees per year (Takala, 1998).

Despite country-to-country differences, some commonalities exist within the workforce in Africa and other developing countries. Workforce distribution by economic sector is different from that in the industrialised world. Compared with developed countries, where single-digit percentages prevail (about 2% in the UK, for instance), developing countries employ about 70% of their economically active population in the agricultural sector (World Bank, 2003). For many of these workers, the distinction between health at work and health at home is blurred, because health in the workplace is integrated into aspects of daily life for example, pesticide poisoning is a hazard faced by workers, their families and their communities.

In recent decades, the mining fatality rates both in South Africa and in other mining nations have been declining. In 1984, there were 1.12 fatal mining injuries per 1 000 workers, but this had decreased to 0.71 by the year 2000. The gold and platinum mines, with 71% of the workforce, account for 77% of deaths and 88% of injuries (Moorman *et al.*, 2002). This suggests that new intervention strategies should be designed to address the hazards associated with gold and platinum mining populations in South Africa and elsewhere on the continent. Another primary factor contributing to mining fatalities in South Africa and elsewhere in Africa is the remote location of many of the mines. Also, the confined working space in mines is not designed to be occupied for lengthy periods, and work underground is made more hazardous by poor ventilation, poor visibility, and high concentrations of combustible or toxic dust, gases and vapours (Rickey *et al.*, 2005).

Addressing the problem

The integration of safety considerations in work places in national, regional and international development strategies implies the need for social behavioural changes. For stakeholder participation to be effective and efficient, the social partners require training and awareness of the problems, and opportunities for practical action.

In the health sector, various actors conduct activities in Africa, but there is no coordination among these actors at national and international levels. This results in the risk of overlap and wasteful duplication. The WHO and ILO developed the concept of an African Initiative on Occupational Safety and Health to address this situation (WHO/ILO, 2001) and four areas for collaboration were identified:

- Human resource development focused on capacity building
- National policies, programmes and legislation
- Information, research and raising awareness
- Promotion of occupational health and safety in particularly hazardous occupations, in vulnerable groups (including informal sector workers and children), and in newly transferred technologies.

While there are several challenges, there is an urgent need to strengthen occupational hazard prevention and control in Africa. Safer and healthier working conditions can make an important contribution to poverty alleviation and sustainable development. Strategies for controlling injury and occupational disease developed over many decades in industrialised countries are also applicable in developing countries. Such strategies include:

- Substituting major hazardous materials or processes with less hazardous ones
- Applying engineering controls to separate workers from residual hazards

- Using administrative controls to minimise contact that is not controlled by engineering
- Using personal protective equipment, such as respirators and protective garments.

2.4 Emerging and Re-emerging Diseases

The burden of disease in Africa is discussed in some detail under Section 2.1 above. Here emerging and re-emerging diseases are briefly described:

Epidemic malaria

Epidemic malaria occurs in the highlands of eastern and southern Africa and in some semi-arid regions of the continent. The outbreaks are associated with climatic hazards, such as the El Niño phenomenon. Since 1988, epidemics have become frequent on the eastern African highlands, with up to 300% increase in the number of cases reported in hospitals. There is a need to study the situation and identify the barriers holding back the attainment of the effective control of malaria.

Tuberculosis

With an estimated 33% of TB patients being HIV-positive, sub-Saharan Africa endures most of the HIV-driven TB epidemic. The incidence of all TB cases in Africa in 2004 was estimated at 2.57 million. The World Health Assembly set targets to detect 70% of TB cases and treat 85% of them successfully by the end of 2005 (WHO-RCA, 2005). No African country has met this target. The high prevalence of HIV/ AIDS on the continent is a major constraint to the control of TB, the effective treatment of which will require the concurrent control of HIV/AIDS and the monitoring, prevention and management of multidrug-resistant TB strains. Additional strategies include advocacy, communication and social mobilisation, and community participation in TB care and the Patients' Charter for Tuberculosis Care.

Microbial resistance

The resistance of parasites, bacteria, and viruses to drugs is perhaps one of the greatest threats to healthcare. In Africa, microbial resistance has particular and spectacular significance to malaria, TB, HIV/AIDS, and many other less frequent infections. The malaria parasite, *Plasmodium falciparum*, has developed resistance to many drugs such as pyrimethamine, chloroquine and the combination drug sulfadoxine/pyrimethamine (SP). In East Africa there are signs of significant resistance to amodiaquine. The rate of drug resistance is expected to increase because changing anti-malaria drug policy takes a long time in many African countries to affect. The high cost of new drugs and the fear of developing resistance are key factors in delaying policy change. The TB bacilli have developed resistance to the commonly used drugs for its treatment, and multiple-drug-resistant TB (MDR-TB) is a major health scare, as it needs long-term aggressive treatment, which is costly.

Currently, the level of drug resistance in viruses appears to be low in Africa and it is predicted to remain low (<10%). However, as more people start using anti-retroviral drugs to treat HIV/AIDS, resistance could accelerate. The current strategy is to use combination drugs to prevent the emergence of resistance. The potential for parallel occurrence of drug resistance to malaria, TB and HIV is real and poses a great challenge to healthcare providers.

Chikungunya

Chikungunya is a re-emerging arboviral disease spread by multiple *Aedes* mosquito vectors. Its first strains were isolated in Tanzania in 1952. The disease itself is characterised by fever, severe myalgias and arthralgias,

dermatologic manifestations, and frequently chronic arthritis, and is at times clinically difficult to distinguish from dengue fever. Chikungunya is rarely fatal, and complete recovery can be expected, although some people did experience chronic arthritis following acute infection. Documented outbreaks of Chikungunya occurred in 1996–1997 in Senegal, in 1999–2000 in the Central African Republic and the Democratic Republic of the Congo. The most recent epidemic began in Kenya in 2004, quickly spreading to the islands of the Indian Ocean, and by 2005 had caused disease in at least one million people in the region (Thiberville *et al.*, 2013). African countries where Chikungunya cases have been reported include Benin, Burundi, Cameroon, Central African Republic, Comoros, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Guinea, Kenya, Madagascar, Malawi, Mauritius, Mayotte, Nigeria, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Tanzania, Uganda, and Zimbabwe. Currently, there is no antiviral treatment for the Chikungunya virus and therapy is therefore purely based on the patient's symptoms.

Africa is in a unique position for potential collaborative research opportunities, promoting cross-cutting capacities to address the prevention, diagnosis, treatment and control of Chikungunya disease. Other points of importance are drug development programmes to identify new antiviral compounds derived from African biodiversity to treat Chikungunya (Leyssen *et al.*, 2014).

Viral haemorrhagic fevers

There are six viral haemorrhagic fevers (VHFs), of which three (yellow fever, Rift Valley fever and Congo-Crimean fever) are transmitted mainly by mosquitoes or ticks, and the other three (Lassa, Marburg, and Ebola fevers) by direct contact with infected people, rodents, or contaminated materials. Yellow fever and Rift Valley fever can be considered endemic, but non-ARBO groups tend to be episodic and epidemic. The WHO estimates that approximately 200 000 cases of yellow fever occur in Africa per year (Onyango *et al.*, 2004). Lassa fever is most prevalent in West Africa where the most common sources of infections are rodents and, in particular, fruit bats. It is responsible for an estimated 100 000–300 000 infections per year and 5 000 deaths (www.biology.uni.edu/cei/lassa.html). In 2004–2005, an outbreak of Marburg haemorrhagic fever occurred in Angola that affected 374 people, of whom 80% died (Smetana *et al.*, 2006). This is the largest outbreak ever reported in Africa.

Ebola virus disease

In May 2004, an outbreak of Ebola fever in southern Sudan killed 41% of the people infected (WHO, 2004b). A decade later, between 2014–2016, West Africa experienced the largest outbreak of Ebola in history, with multiple countries affected.

Ebola disease is caused by a virus belonging to the Filoviridae family. The Ebola virus disease (EVD) has been reported in the Democratic Republic of Congo, Gabon, Sudan, the Ivory Coast, and Uganda (Muyembe-Tamfum *et al.*, 2012). Overall, there were 2390 cases and 1585 deaths for the period 1976–2012 (WHO-AFRO, 2012). But in terms of reported morbidity and mortality, the current epidemic of Ebola appearing in six countries in West Africa—Guinea, Liberia, Mali, Nigeria, Senegal and Sierra Leone—is far larger in history than all previous epidemics (WHO Ebola Response Team, 2014).

Figure 3 gives the geographical distribution of Ebola virus disease cases in West Africa (WHO-AFRO, 2015). Signs and symptoms include fever, chills, myalgias, malaise, anorexia in the initial stages, followed five days later by nausea, vomiting, watery diarrhea, abdominal pain. Other complications include headache, conjunctivitis, hiccups, rash, chest pain, shortness of breath, confusion, seizures, and hemorrhagic symptoms.

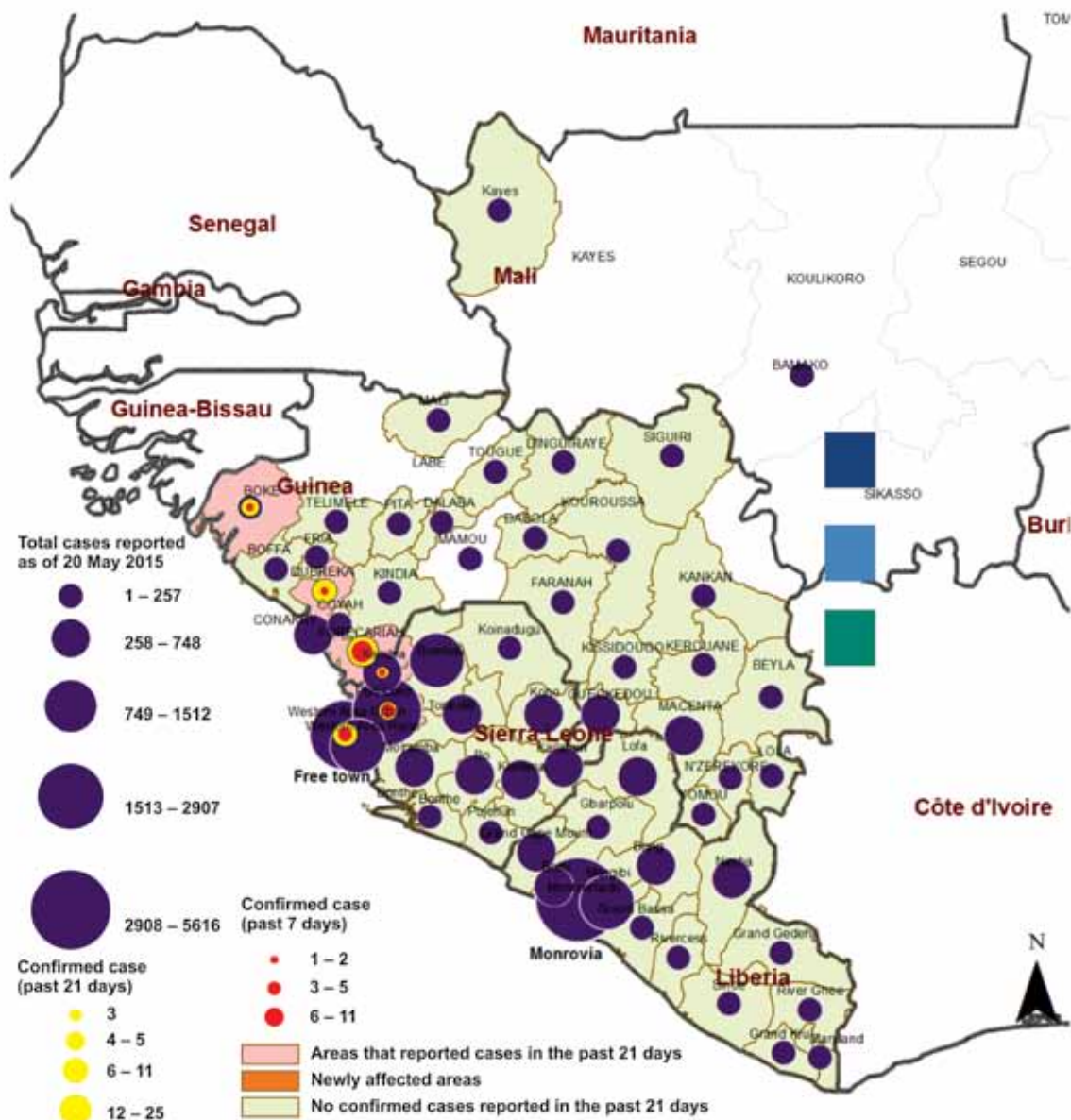


Figure 3. Geographical distribution of Ebola virus disease cases in West Africa

Source: WHO-AFRO, 2015

Two in five people who got Ebola in the 2015–2016 outbreak died: by April 2016, a total of 28,616 cases (suspected, probable and confirmed) were reported, and 11,310 died (CDC, 2016). On 29 March 2016, the WHO terminated the Public Health Emergency of International Concern (PHEIC) for the Ebola outbreak in West Africa. As a result of ongoing surveillance and strengthened response capacities, the affected countries now have the experience and tools rapidly to identify any additional cases and to limit transmission (WHO, 2016).

GAPS AND CHALLENGES

In summary, the following are key challenges:

- It seems clear that countries in Africa are not sufficiently prepared to cope with severe public health emergencies; there is insufficient capacity at all levels, and inadequate infectious disease surveillance capacity.
- Changes in local environmental factors (climate change, global warming, and anomalous rainfall) allow for increases and changes in mosquito vectors, resulting in widespread disease.
- There is also insufficient implementation of infection control guidelines, and in some cases a misuse of resources.

2.5 Food and Nutrition

Food and nutrition security

Food and nutrition security exists when all people at all times have physical, social and economic access to food, which is consumed in sufficient quantity and quality to meet their dietary needs and food preferences, and is supported by an environment of adequate sanitation, health services and care, allowing for a healthy and active life.

Figure 4 illustrates the dimensions to food security, and Table 6 the linkages between nutrition and the four dimensions of food security.

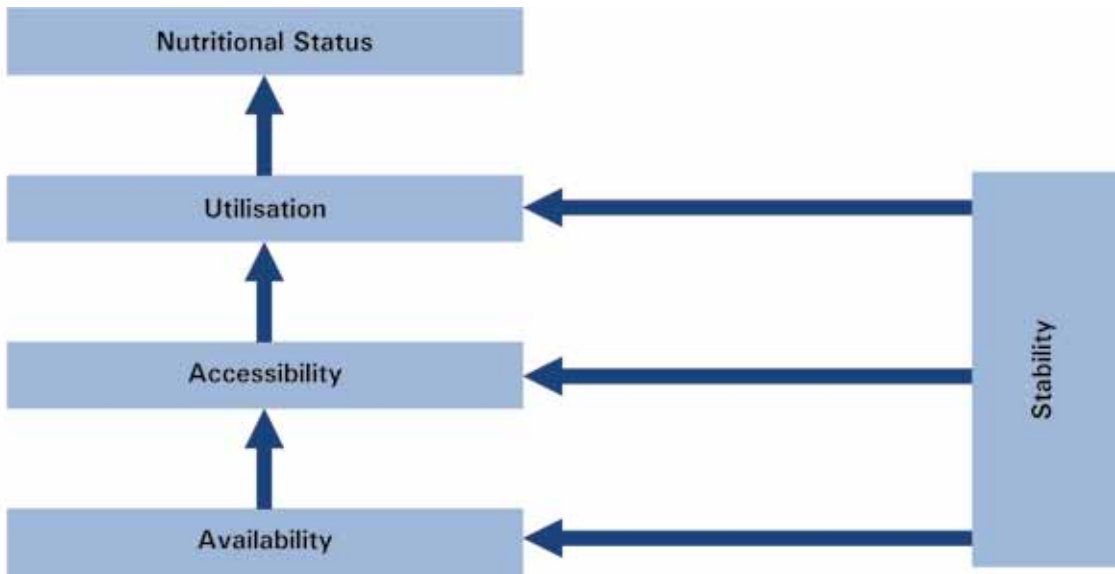


Figure 4. Dimensions to food security

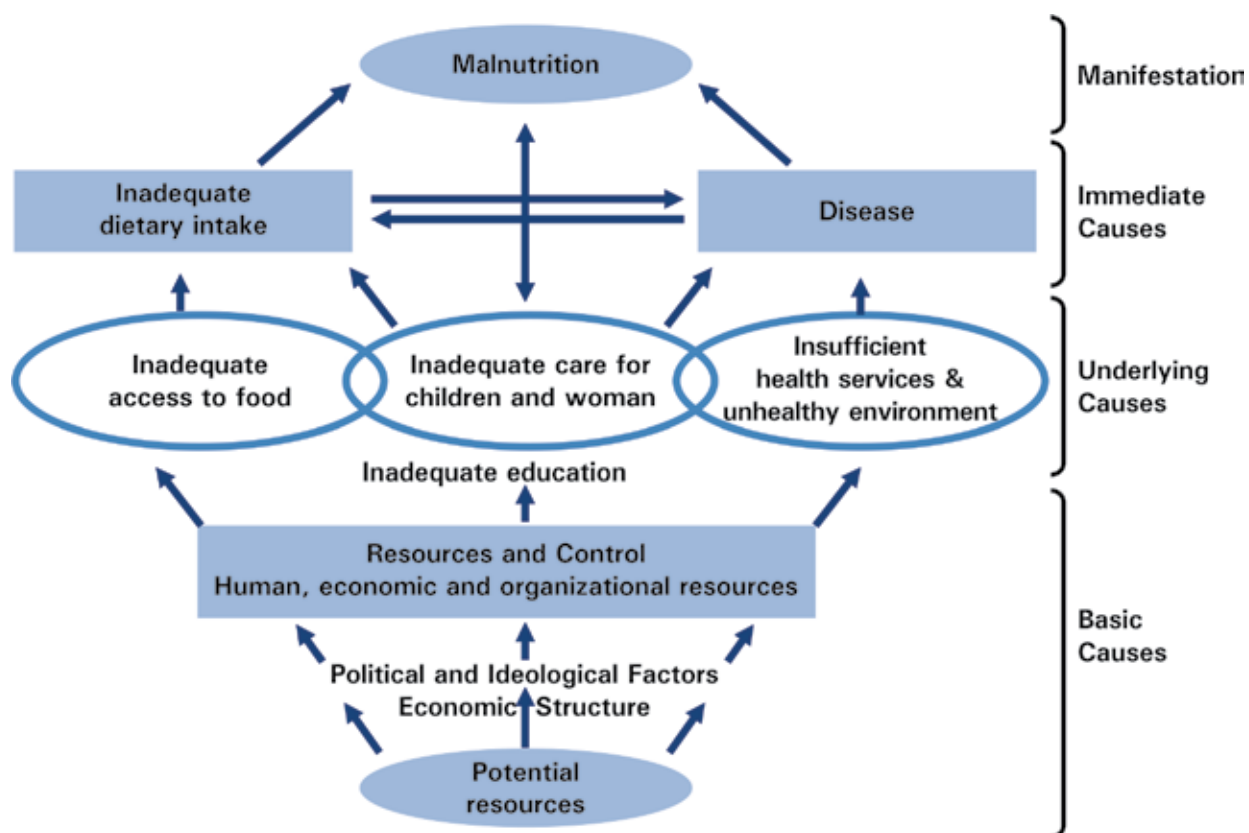
Source: FAO, 2013



Table 6. Linkages between nutrition and the four dimensions of food security

| Availability | Access | Stability | Utilisation |
|---|---|--|---|
| <ul style="list-style-type: none"> - domestic production - import capacity - food stocks - food aid | <ul style="list-style-type: none"> - Poverty/ purchasing power - Transport and market infrastructure - Food distribution | <ul style="list-style-type: none"> - Weather variability - Price fluctuations - Political factors - Economic factors | <ul style="list-style-type: none"> - Food safety and quality - Clean water - Health and sanitation - Care and feeding |

Source: FAO, 2012

*Figure 5. Conceptual Framework of Malnutrition*

Source: UNICEF, 2012

Role of agriculture in food security and human health

It is projected that by 2050 the world's population will grow by one-third, reaching between 9 and 10 billion. With globalisation and expected growth in global affluence, a substantial increase in per capita meat, dairy and fish consumption is also anticipated. The demand for calories from animal products will nearly double, highlighting the critical importance of the world's animal agriculture system. Meeting the nutritional needs of this population and its demand for animal products will require a significant investment of resources as well as policy changes that are supportive of agricultural production. Ensuring sustainable agricultural growth will be essential to addressing this global challenge to food security (NAP, 2015). Advances in science and policy during the past 50 years have prevented the predicted widespread food shortages as the world's population soared. Malnutrition, however, remains prevalent (Sahn, 2015).

The critical role of animal science research in food security and sustainability must not be underestimated and researchers need to be encouraged to identify areas of research and development, technology, and resource needs for research in the field of animal agriculture, both nationally and internationally.

Micronutrient and Bio fortification

The density of minerals and vitamins (micronutrients) in food staples eaten widely by the poor may be increased either through conventional plant breeding, or through the use of transgenic techniques, a process known as bio-fortification. The objective is to develop and distribute varieties of food staples (rice, wheat, maize, cassava, pearl millet, beans and sweet potato) that are high in iron, zinc, and provitamin A, through an interdisciplinary, global alliance of scientific institutions and implementing agencies in developing and developed countries. The results would be that bio-fortified crops offer a rural-based intervention that, by design, initially reaches more remote populations, which comprise a majority of the undernourished in many countries, and then penetrates to urban populations as production surpluses are marketed. In this way, bio-fortification complements fortification and supplementation programmes, which work best in centralised urban areas, and then reach into rural areas with good infrastructure.

In broad terms, three conditions must be met for bio-fortification to be successful:

- The breeding must be successful high nutrient density must be combined with high yields and high profitability.
- Efficacy must be demonstrated the micronutrient status of human subjects must be shown to improve when they are consuming the bio-fortified varieties as normally eaten. Thus, sufficient nutrients must be retained in processing and cooking and these nutrients must be sufficiently bioavailable.
- The bio-fortified crops must be adopted by farmers and consumed by those suffering from micronutrient malnutrition in significant numbers.

The impact of climate change and globalisation

Globalisation can be defined as the increased integration of economies, societies and cultural systems across national boundaries, and reflects the economic face of global change. It will accelerate significantly in the coming years because of the expanding international market economy, the increase in foreign direct investments, the growth of multinational co-operations from both the developed and developing world, the continued information and communication revolution, as well as legal and illegal migration.

Recent signs of a much more globalised, integrated world are the energy crisis of 2005–2007, the food price crisis of 2005–2008, and the financial crisis of 2005–2009. These crises have affected all countries in different ways, but generally poor and vulnerable producers and consumers have been affected most (Ringler *et al*, 2013). While these crises may slow the global integration process in the short term and favour enhanced regional integration, it is unlikely that they will cause a significant shift in the direction of the process.

Meat demand is projected to increase rapidly by 2025 with an increase of 138 million metric tonnes globally, 86% of which is accounted for by the group of developing countries where meat demand more than doubles. China alone accounts for 39% of total meat demand growth. The increase in meat demand also helps to fuel the increase in cereal demand as more animal feed is required for the increase in livestock production.

Climate change already has a negative impact on Africa through extremely high temperatures (IPCC, 2007), which are not favourable to animal growth and development. Domestication and intensive management of some wild species like the edible land snail is inevitable. Research on climate change in the tropics has focused more on crops, with less work on livestock and little on biodiversity conservation. Change in species abundance can provide useful insights into climate change and drivers of this change. However, there is a dearth of information on this in most parts of the tropics, especially in Africa.

In the face of the worldwide environmental damage, the effects of climate change and habitat change (natural or anthropogenic) on organisms need to be determined, to better estimate the ecological and evolutionary response of the organisms to ongoing climatic or environmental change or threats. This is so because any acceptable risk assessment of large-scale climate change or manipulation or perturbation, however, will require a certain appreciation of how organisms may respond or adapt to any change brought about by drastic environmental change.

Food security is concerned with easy and affordable access to adequate quantities of food. On the other hand, nutrition security means access to food with the essential vitamins and minerals needed for good health. More than 820 million people in the world are chronically undernourished because they are unable to obtain sufficient food by any means. Ironically, global food supplies are sufficient to meet the calorie requirements of all people if food were distributed according to need. Per capita food supplies are projected to increase further over the next 20 years. Thus, the world food problem now and in the near future is not one of global shortage. Instead, the world faces three main food-related challenges: widespread hunger and malnutrition, mismanagement of natural resources in food production, and obesity.

The current global population of about seven billion people has 15% more food available per capita than the world's three billion people had four decades ago. However, after 50 years of substantial economic growth, steady progress in agricultural productivity, remarkable increases in per capita food availability, and numerous international and national efforts to address hunger, food security remains a formidable global problem.

Definitions of food security used in African policy debates revolve around that of the World Bank (1986): access by all people at all times to sufficient food for an active healthy life. Other definitions of food security include different elements but emphasise overall food availability, food access, and food use. Recent research on food security also emphasises the risks to food access and people's ability to cope with such risks (Davies, 1996). Availability of and access to food are affected by population growth, demographic trends, economic development, government policies, income levels, health, nutrition, gender, environmental degradation, natural disasters, refugees, migration, disease, and concentrated resource ownership. Nations increasingly understand that a single country or group cannot resolve many of these problems, as they transcend national borders, spreading starvation, instability and environmental degradation throughout the region and around the world.



Source: <https://www.globalgiving.org/projects/emerg-nutrition-and-health-care-e-africa-crisis/updates/>

There are close links between hunger and food security, on the one hand, and numerous issues of global relevance, on the other. The adverse impact of structural adjustment and liberalisation policies on food security and agriculture, coupled with persistent trade barriers, the overall downward trend of official development assistance (ODA), agricultural subsidies, and debt burdens in Africa, highlight the need for international cooperation as an instrument for addressing food insecurity on the continent.

Attaining nutrition security goes beyond having enough food to eat at all times. Having food available does not always guarantee good nutritional status. Nutrition security encompasses all the components of food security but also includes aspects of environmental health, such as fundamental hygiene practices, water sanitation, and access to basic healthcare services with palpable levels of care. It is pertinent to mention that the problems of under-nutrition will continue to soar in most countries in Africa because stakeholders have failed to distinguish between food security and nutrition security.

Food and nutrition security remain Africa's most fundamental challenges for human well-being, including economic growth. In one-third of African countries, the mean daily calorie availability per capita is below the recommended intake level of 2 100 calories, while in Burundi, the DRC, Eritrea, and Somalia, calorie availability is below the minimum intake level of 1 800 calories. As a result of low food availability and profound poverty, an estimated 200 million people on the continent are undernourished or unable to meet their dietary energy requirements.

The global prevalence of child malnutrition has declined significantly over the past 25 years. Rates of stunting (low height for age) among children aged six months to five years in all developing countries dropped from 49% to 30% between 1980 and 2000, while underweight (low weight for age) rates dropped from 38% to 25% (de Onis *et al.*, 2004a). Africa, however, is an unfortunate exception to these trends. The estimates of reduction in malnutrition are much lower on this continent than elsewhere. Over the period 1980–2000, stunting rates declined by less than 4 percentage points, implying that, with increased population growth, the absolute



Source: <https://crisisboom.files.wordpress.com/2011/06/africa-water-crisis.jpg>

number of stunted children effectively increased by more than 12 million. Both relative and absolute numbers of underweight children in Africa increased over the same period.

Malnutrition and under-nutrition

In general terms, malnutrition is considered from the perspective of under-nutrition alone and, as a result, interventions have often not covered the holistic picture, which includes the problems of both under-nutrition and overweight. The immediate cause of malnutrition could be inadequate or inappropriate dietary intake, ill-health, or both.

Ironically, under-nutrition is often assumed to result primarily from food insecurity, but available data from many countries suggest that food is not the only factor, and often not even the main cause of under-nutrition, except under famine conditions. The data in Table 7 show that, at any given level of food availability, underweight rates can change from as low as 2–10% to as high as 40–70%. The conclusion, confirmed by many studies, is that adequate nutrition requires sufficient food supplies but also depends on factors such as maternal knowledge, caring practices for young children, and access to health services, potable water and sanitation. Data from many countries show high under-nutrition rates in regions and households where food is plentiful. Examples are the Arsi region in Ethiopia and the Iringa region in Tanzania, both of which have high food production rates, but also very high stunting rates of 62% and 66% in Arsi and Iringa, respectively (World Bank, 2006b).

Infant and young child feeding

Pregnancy and lactation substantially increase the nutritional needs of women to support adequate growth of the foetus, and subsequently, the baby. These additional energy and nutrient demands easily place pregnant and lactating women at great nutritional risk. Teenage pregnancies carry even greater risk, due to competition for nutritional requirements between the mother and the baby. Children of adolescent mothers are also often at high risk of poor nutritional care and feeding practices. Very young babies need the dietary inputs (through exclusive breastfeeding and timely complementary feeding) to support the fast rate of growth that typically occurs in the first two years of life. They are the least able to make their needs known and the most vulnerable to the effects of improper care. The main cause of the often precipitous decline in nutritional status immediately after birth are often inadequate feeding and caring practices, rather than a lack of food in the household. The damage done to physical growth and brain development through under-nutrition during the very early stage in life is largely irreversible.

Constraints to exclusive breastfeeding

Breast milk provides infants with the first feed in life and it is scientifically proven to be the best for them. There are challenges, however, that may threaten the continuing use of breast milk to feed babies. The concern for HIV- positive mothers' breastfeeding practices needs more investigation. The use of pre-lacteal feed is becoming more pronounced, and some mothers still believe that babies should be given water to prevent dehydration. The use of native concoctions in addition to mother's breast milk should be investigated. The problems associated with the suggestions that HIV-positive nursing mothers should introduce infant formula are causing a stir and confusion among mothers who had earlier been discouraged from using infant formula. More research is also needed in the area of compliance with the international code of conduct on the use of breast milk substitutes.

Table 7. Estimated percentage prevalence of malnutrition among children aged 0–5 years, by region (1980–2005)

| Stunting | 1980 | 1985 | 1990 | 1995 | 2000 | 2005 |
|--------------------------------|------|------|------|------|------|------|
| Africa | 39.0 | 37.8 | 36.9 | 36.1 | 35.2 | 34.5 |
| Asia | 55.1 | 48.2 | 41.1 | 35.4 | 30.1 | 25.7 |
| Latin American Countries (LAC) | 24.3 | 21.1 | 18.3 | 15.9 | 13.7 | 11.8 |
| Developing countries | 48.6 | 43.2 | 37.9 | 33.5 | 29.6 | 26.5 |
| Developed countries | | | 2.8 | 2.8 | 2.7 | 2.6 |
| Global | | | 33.5 | 29.9 | 26.7 | 24.1 |
| Underweight | | | | | | |
| Africa | 23.5 | 23.5 | 23.6 | 23.9 | 24.2 | 24.5 |
| Asia | 45.5 | 40.5 | 35.1 | 31.5 | 27.9 | 24.8 |
| LAC | 12.5 | 10.5 | 8.7 | 7.3 | 6.1 | 5.0 |
| Developing countries | 37.6 | 33.9 | 30.1 | 27.3 | 24.8 | 22.7 |
| Developed countries | | | 1.6 | 1.4 | 1.3 | 1.1 |
| Global | | | 26.5 | 24.3 | 22.2 | 20.6 |
| Overweight | | | | | | |
| Africa | | | | 3.3 | 4.2 | 5.2 |
| Asia | | | | 2.6 | 2.5 | 2.5 |
| LAC | | | | 4.4 | 4.3 | 4.3 |
| Developing countries | | | | 2.9 | 3.0 | 3.4 |

Sources: SCN, 2004; de Onis et al., 2004b

Evaluation of nutrient content of local staples used as complementary food

The use of local staples has been encouraged, to make the introduction of complementary diets more practicable and economically sustainable. Research is needed, however, to determine the nutritional content and adequacy of these local complementary diets. In addition, the anti-nutritional factors in some of the locally available complementary diets need research to inform decisions on appropriate methods that can help to reduce these factors. The development of country-specific educational materials on different complementary formulas is long overdue in most African countries.

Micronutrient fortification of local complementary food

The local assessment of complementary food is necessary, to determine the appropriate methods for improving their micronutrient content. More information is needed on possible fortifiers that can be used locally to improve the micronutrient complement to infant feeding.

Micronutrients, food supplementation and genetic modification

For several decades, it has been known that micronutrient deficiency (that is, the lack of key vitamins and minerals) can lead to anaemia, cretinism and blindness. Information from the 1990s is that these manifestations are just the tip of a large iceberg. Mineral and vitamin deficiencies have no clinical symptoms and, although they

were previously thought to have relatively little importance, it is now known that they can impair intellectual development, cause ill-health and early death, and condemn about a third of the world to live below their physical and mental potentials. Four principal micronutrient deficiencies are of public health concern in Africa – vitamin A, iron (Fe), zinc (Zn), and iodine (I).

Considerable progress has been made since the early 1990s, both globally and in Africa, in addressing micronutrient deficiency conditions. This progress has come about partly because the solutions to these problems are relatively inexpensive to implement – they include salt iodization, fortification of commonly consumed commercial foods, and supplemental doses of vitamin A and iron for women and children. Because of such efforts, the global prevalence of iodine deficiency has been reduced by half since 1990.

Vitamin A deficiencies are common in children across the continent, reducing their ability to resist infection and contributing to the death of more than half a million African children annually. Many countries are now providing more than 70% of their children with at least one vitamin A capsule a year (UNICEF/MI, 2004). Policy-makers need to be as concerned with micronutrient deficiencies and the quality of food consumed as they are with broad hunger and the quantity of food consumed.

2.6 Water and Sanitation

Water is an essential commodity around which life revolves. Besides its crucial use for direct drinking and for other immediate household needs, water is also important for agriculture, electricity, transport, construction, and in various domestic and industrial activities.

Fresh water is a finite and vulnerable resource essential to sustain life, development and the environment. Although the resource is increasingly under strain, effective water management is becoming critical, especially in many African cities. Water remains inaccessible to many households, however, and many people, usually women or young girls, must join long queues or walk long distances to reach a water source. The human rights to water and sanitation are inextricably linked, in functional and normative terms. These rights are fundamental to human dignity and essential for the realisation of many other internationally recognised human rights. They are also the foundations for public health and human development. For example, an estimated 1.6 million people, mostly children under the age of five, die each year from water and sanitation-related diseases. Poor sanitation may be linked to as much as a quarter of all under-five deaths, with diarrhoea among the leading causes (WHO and UNICEF, 2010).

In many parts of Africa drinking and irrigation waters are sourced mainly from surface waters, including lakes, dams, rivers and streams that are vulnerable to faecal contamination, thus contributing to high morbidity and mortality rates from waterborne and food-borne diseases, such as typhoid fever, cholera and diarrhoea (Prüss-Ustün *et al.*, 2008; WHO 2009). Worldwide, 37% of people who do not use improved source of drinking water live in Africa (WHO/UNICEF 2010).

Water safety in a community depends on a range of factors, from the quality of source water to storage and handling in the domestic setting (Banda *et al.*, 2007). In Africa, the burden of unsafe potable water tends to be compounded by the challenge of household storage of water due to the infrequent availability (Brick *et al.*, 2004). Household storage of water may lead to contamination arising from the site of storage, type of container and handling practices. Within countries, the practices used for collection, household storage and dispensing of water differ with geographic area and culture.



Source: <https://connexions.wordpress.com/tag/poverty/>

Emerging organic contaminants in groundwater sources

Most water quality studies in Africa have focused on a narrow range of pollution indicators such as nitrate, sulphate, chloride, ammonium and faecal coliforms. The emerging organic contaminants (EOCs) include a range of industrial compounds, including pharmaceuticals, water treatment by-products, personal care products, and biocides. Although the pharmaceuticals generally detected in natural water are at the nanogram levels, the continual releasing into aqueous environment leads to the chronic exposure of non-target organisms in the water with largely unknown consequences (Bound and Voulvoulis, 2006).

The problem of sanitation

Adequate sanitation, together with good hygiene and safe water, are fundamental to good health and to social and economic development. Despite efforts and approaches to extend and sustain water, sanitation and hygiene (WASH) systems and services, the lack of safe water and adequate sanitation has led to several health complications leading to death within the region. The water and sanitation position in West and Central Africa is particularly urgent, as the region has the highest under-five mortality rate of all developing regions (191 child deaths per 1,000 live births). Recurrent outbreaks of cholera in both urban and rural areas underline the poor state of this region's basic living conditions (UNW-DPC, 2015). Among developing regions, Africa is estimated to have the highest prevalence of urban slums and it is expected to double to around 400 million people living in slums by 2020. Rapid, unplanned urban growth has increased the number of settlements on unstable, flood-prone and high-risk land where phenomena such as landslides, rains and earthquakes have devastating consequences.

In 2011, almost two thirds (64%) of the world had improved sanitation facilities. However, current trends show Africa still struggle with low sanitation coverage. Indeed, 44% of the population uses either shared or unimproved facilities, and an estimated 26% practices open defecation. In fact, only in Africa is the number of people defecating in the open still increasing (UNW-DPC, 2015).

New and more appropriate approaches need to be promoted in order to achieve a significant change in sanitation provision. Good sanitation needs to consider affordability, cost and benefits and find a consensus between health improvement and minimal environment impact. In addition, creating value from the resources in sanitation can offer significant business opportunities and enhance livelihood assets as well as food products, thus also supporting the poor and vulnerable (Strande *et al.*, 2014).

Over the past 15 years, the thinking of engineers worldwide has started to shift, and people are starting to consider onsite or decentralised technologies as not only long-term viable options, but possibly the more sustainable alternative in many ways, compared to sewer-based systems which are prohibitively expensive and resource intensive. The key to resolving the problem of sanitation lies in the ability to prevent water and environmental pollution by faecal matter. Hence the need to treat faecal sludge cannot be over emphasised (Kengne *et al.*, 2008).

Although sanitation has received less attention than water in the international human rights discourse to date, human rights obligations related to access to sanitation are now internationally recognised and accepted. States must ensure in a non-discriminatory manner that everyone has access to sanitation in all spheres of life that is safe, hygienic, secure, socially and culturally acceptable, provides privacy and ensures dignity (UN, 2009). Doing nothing is costly. A study of the economic returns on investments in water supply and sanitation indicated that every US\$1 spent on water supply and sanitation services could lead to an economic return of between \$5 and \$46, with the highest returns in the least-developed areas (Haller *et al.*, 2007).

The General Assembly of the African Ministers' Council on Water (AMCOW), meeting on the back of the 5th African Water Week held in Dakar, Senegal, declared prioritising water and sanitation in the post-2015 development agenda, and committed to elevate water security and sanitation for growth in Africa as AMCOW's strategic focus up to 2025.

2.7 Contextual Factors

Environmental context

Climate-sensitive diseases. The environment is undergoing rapid changes, many of which are the result of anthropogenic impact on the environment. Warm climates tend to increase the rate of pathogen and vector reproduction and thus the intensity of transmission of these diseases. Historical records for Africa show warming of approximately 0.7 C over most of the continent during the 20th century (UNEP, 2006). In addition, there has been an increased frequency of episodic departure from normal climate, as seen during the El Niño events. Associated with these events are epidemics of malaria, Rift Valley fever, and cholera.

The main driver of these epidemics is anomalous rainfall and temperature. There are reports of malaria outbreaks in the last decade, in areas where the disease was previously non-existent, such as in the highlands around Mount Kenya (Boko *et al.*, 2007). This is attributed to the fact that these areas have warmed up sufficiently to support the breeding of the malaria vector. The trend is a cause for concern because human populations in these newly threatened areas are not immune to the disease and are therefore most vulnerable.

Land use change and diseases. Changes in land use and land cover can modify the local climate and its patterns. Furthermore, land cover change affects diversity of species including disease vectors. Extensive reclamation of natural swamps in the highlands of eastern Africa has led to local warming in the swamp microhabitat and the proliferation of *Anopheles gambiae*, the world's most efficient malaria-transmitting mosquito. The phenomenon may have led to an increase in malaria in the highlands. Deforestation causes local temperature to rise by about 0.5–2 C, and this has increased the rate of malaria transmission in the highlands of western Kenya. Re-forestation and restoration of natural swamps can reverse these adverse climate changes and, thereby, reduce malaria transmission in the highlands.

Social determinants of health

Both the incidence and outcome of illness are shaped significantly by the income and assets available to the people at risk, and the resources they require to live a healthy life (Ecob and Davey Smith, 1999; Marmot and Wilkinson, 1999). Malnourishment, poor sanitation, poor-quality water and crowding are examples of conditions leading to illness.

Illness results partly from the inability to meet the costs of accessing adequate preventive and curative healthcare. A significant component is also due to the high risk work that poorly resourced people frequently undertake. This can be at the workplace, which is often in the home, as well as in inadequately protected factories and farms, for example. In addition, some of the activities undertaken by poorly resourced people are risky by their very nature, for example sex-work, garbage picking, and other forms of survivalist activity. As a result, those engaged in these activities are vulnerable to both disease and injury. Attitudes towards illness can also be an issue, inhibiting care-seeking behaviour, or causing those who are ill to seek inappropriate or costly treatment.

The ability of many people at risk of illness to make decisions about their own health can also be an issue. In particular, women, the elderly, and children might not have control over household resources and therefore be unable to incur the costs (including transportation) associated with seeking healthcare.

3. Major Challenges

For Africa to emerge from the current challenges with respect to the health and well-being of its people, it is necessary to revitalise research so as to inform policy- and decision-making. The main research gaps include the following:

- Inadequate basic research to understand the molecular mechanisms underlying the prominent diseases affecting Africa.
- A general neglect or complete absence of research on chronic diseases in developing countries, especially in Africa.
- The absence of scientific validation of the therapeutic claims made by TM practitioners. This has, most often, resulted in their being looked upon with scepticism by AM practitioners. Generally, traditional herbal concoctions are not subjected to toxicological testing, so data on acute, sub-acute, and chronic toxicities are not available. Unhygienic preparations abound and may be harmful. Furthermore, the preparations are often suitable only for extemporaneous consumption with little or no packaging for long-term storage. Effective remedies may therefore not be available beyond the limited confines of the TM practitioner's immediate community. Research is therefore needed to adapt the preparation of traditional medicines to scientific drug manufacturing principles. In addition, the seasonality and rarity of some of the valuable medicinal plant species calls for research into their domestication for agricultural-scale production, to ensure their availability whilst also preventing their extinction.
- The lack of comprehensive investigations on the level of toxins present in local staples. Some of the local foods may predispose the population to NCDs, especially cancers, because of the presence of certain natural toxins in them.
- Insufficient research on the use of micronutrients as food additives for infants. In addition, the stability of micronutrients in fortified foods deserves proper investigation. It is also important to study the cost-effectiveness of fortified foods (especially infant formulations), compared to promoting the consumption of local foods. Such a study is essential, as cost may be a major factor determining the acceptability of fortified foods.
- A general neglect of the psycho-social aspects of NCDs. Research is needed to determine how people perceive these diseases in their communities. For example, obesity is not normally regarded as a health problem in some African countries.
- There is an inadequate or complete lack of research on maternal and child health-related issues. Improving the situation in Africa will require intensifying research in this area.
- The need to study both short- and long-term effects of government policies on the nutritional status of the people. Monitoring strategies are required to determine the effect of government policies on nutrition.
- The neglect of country-specific research, targeted at local conditions and institutions. Such research is necessary for evaluating policy development and implementation in occupational health.

In the water and sanitation sector, the research gaps and challenges include:

- Equity considerations in access to water supplies and sanitation between rural and urban settings.
- The lack of innovative sanitation technologies and solutions towards providing more appropriate

solutions to Africa. Sanitation innovations are regarded as those systems or solutions which are alternative to conventional waterborne sewerage and onsite ventilated improved pit latrines.

- Reduction of water pollution to minimise health hazards and protect ecosystems.
- The lack of monitoring and evaluation components, from inception through to implementation and in the follow-up of water and sanitation projects.

3.1 Capacity Enhancement and Retention

The WHO estimates a shortage of more than 4 million health workers worldwide. This shortage includes 2.4 million doctors, nurses and midwives. Of the 57 countries world-wide where there is a critical shortage of health workers, 36 are in Africa. For example, sub-Saharan Africa has a mere 4% of the world's health workers, who have to deal with 25% of the global burden of disease (GBD), whereas the Americas have 37% of the world's health workers but only 10% of GBD (WHO, 2006).

African countries need to increase their current numbers of health workers by a factor of three at the current levels of population growth. African governments also need to strengthen institutions through direct funding for research, development, innovation, and the manufacture of healthcare materials, including medicines.

The water and sanitation sector is currently experiencing a severe shortage of critical skills qualified engineers, water scientists, technicians and artisans. This poses a risk to the sector's continued capacity to provide water services effectively. Despite strong political support for universal access to water and sanitation, few countries have national WASH plans that are being fully implemented, funded and regularly reviewed (Joint WHO UN-Water news release, 2014). There is a need to invest in building human capacity in-country in order to be able to construct, operate, manage, and maintain water and sanitation services.

Training and public awareness

One of the major challenges facing the strengthening of human capacity to provide healthcare services is the general neglect of formal training for TM practitioners, despite the fact that more than 80% of the population in Africa depends on TM. So far, the registration of TM practitioners is practised only in few countries such as Mali, Mauritius and South Africa (WHO, 2002a).

The number and capacity of health professionals need to be increased significantly. An efficient way of doing this would be by sharing resources, for example through exchange programmes and research scholarships for training young scientists. There should be role modelling and mentorship at all levels through national, regional and international programmes. Knowledge transfer and succession have to be well-planned to ensure continuity, so that gaps are not created when prominent researchers retire.

In most African countries, rural communities live mainly on what they can produce locally. Agricultural extension officers need to provide relevant information on what the farmers should produce or procure to supplement the traditional staples that are often deficient in some essential nutrients. Consumers also need to be kept appropriately informed about fortified and genetically modified foods.

Further, agricultural extension and community development workers need to know enough about HIV/AIDS so as to be able to educate rural populations about the problem and its implications for their health and productivity.

Healthcare providers need training to be able to deliver quality information on nutrition with regard to breastfeeding and complementary feeding practices, and to be able to help prevent under-nutrition. Proper

breastfeeding practices and adequate feeding in HIV/AIDS infected mothers are essential for coping with the infection. Access to basic quality education and skill acquisition would enable economic empowerment, which is an essential tool for ensuring adequate nutrition.

Institutional strengthening and networking

The present conditions in many African universities and other higher education and research institutions are often not sufficiently motivating to pursue and sustain research practices. African governments have to increase their commitment to strengthen the capacity of these institutions for research and training. Actions that need to be taken would include: sustainable funding for research equipment and consumables, fully functional laboratories, grants for maintaining equipment and infrastructure, access to information technology, competitive staff remuneration commensurate with productivity, demarcated funding for young scientists, and performance incentives, such as rewards, for service or research outputs. Tax incentives may also be required to motivate the private sector to provide institutions with equipment, scholarships for students, and funding for research.

Formal agreements (MoUs) between strong and weak institutions, and the promotion of visiting scientists/ professor exchange programmes, would improve networking and strengthen research and training in institutions. Better networking among top-level scientists within Africa, as well as with those in other continents, would facilitate brain gain and brain circulation and improve the performance of local institutions and researchers. The design of international collaboration and partnership programmes ought to be mutually beneficial and enable the driving of an African agenda. Such programmes should also have a focus on inter- and intra-disciplinary research projects.

Protection of intellectual property

African indigenous knowledge systems are rich, especially in the domain of traditional medicine. Most of this knowledge, however, remains inaccessible to the public, as it is often considered a secret on which family livelihoods depend. There is also a tendency for research scientists and engineers to work in isolation, for fear of being robbed of their discoveries and innovations. Knowledge sharing would be beneficial to society and to the international scientific community as a whole. To encourage such sharing, some critical issues regarding intellectual property rights (IPR) have to be addressed through actions such as:

- Appropriately enforcing IPR legislation
- Raising awareness among African scientists, engineers, technologists, and policy- and decision-makers on IPR issues
- Dedicating funding to service intellectual property fees
- Protecting the indigenous knowledge systems of Africa, especially with regard to its biodiversity, which is often violated during bio-prospecting.

3.2 Funding

The challenges highlighted in this Science Plan cannot be resolved unless governments allocate adequate funding for research. Most African countries spend less than 1% of their GDP on research, compared to 3–5% spent in developed countries. It is suggested that African nations need to commit at least 1% of their GDP to research funding and to provide equipment for scientists to carry out essential analyses to identify active ingredients in African medicinal plants, and to determine nutrient content and deficiencies (especially, of micronutrients) in local food staples, including fruits and vegetables.



Source: https://commons.wikimedia.org/wiki/File:Caf_babies.jpg

At this point, there is inadequate funding for healthcare delivery. Investment in primarily healthcare to address the problem of high maternal and child mortality is generally inadequate. The per capita expenditure on health and the proportion of the national budget allocated to health are below recommended levels. Poor African countries cannot afford vaccines and, in many of the poorest countries, immunisation programmes lack the capacity to deliver existing vaccines.

African governments depend greatly on foreign donor funding for healthcare. Most programmes on essential medicines are too dependent on donor support, and this is partly because government-operated procurement and supply systems for drugs and vaccines are unreliable.

Whilst it is necessary for African governments to take the first initiatives in this sector, it is clear that most of them cannot do much without foreign assistance. Therefore, international donors need to be approached for specific funding programmes, for example, the Wellcome Trust, WHO, EU Marie Curie Programme, UNESCO. There also need to be re-entry grants for returning PhD graduates in order to reduce the current rate of brain drain. Governments can source donor funding in the form of grants to young researchers to help improve their capacity. Prominent public figures could also be approached by governments to champion specific targeted activities.

Funding of basic research for water and sanitation infrastructure, as well as investment in the maintenance and renewal of assets in water, are key challenges. The sustainability of existing infrastructure cannot be neglected and is requiring funding as infrastructure ages. The cost of extending the network infrastructure to outlying communities is not cost-effective or sustainable, which points to the need to explore alternative service delivery options. Furthermore, the bulk of financing continues to benefit urban residents. To illustrate, expenditures for rural sanitation comprise less than 10% of total WASH financing (Institute for Medicine, 2009).

3.3 Policy

Most African countries do not have appropriate policies on the health and well-being of their people. For example, there is often no comprehensive national strategy on occupational health. This sector of healthcare is characterised by the inadequacy of human resources, weak policies, lack of healthcare services, and insufficient budget allocations. Although most workers in Africa are in the informal sector, health and safety policies have neglected this group and focused mainly on the formal sector.

Poor access to physical healthcare facilities in many African countries is a major problem. Worse still, within countries, there are urban–rural and regional disparities in income and in access to health facilities, a constraint that is further compounded by socio-cultural factors. Even where available, the state of the physical facilities, as well as the quality of the care provided, leave much to be desired. Health facilities in Africa are poorly maintained and often operate in a state of disrepair. In addition, most African countries lack clear policies, plans, or guidelines for equipment management.

Public health and hygiene remain a great challenge for African governments. Many households do not have access to piped water, and adequate sanitation facilities are often non-existent. Protected wells, springs, boreholes, and valley dams are not explored as potential sources of clean water for people. The following gaps in sanitation policy have been identified:

- The lack of sanitation policy guidelines for basic sanitation service delivery to dense urban informal settlements, and to severely marginalised groups (i.e. people with physical disabilities, elderly, women, children, HIV/AIDS infected individuals and child-headed households).

- The lack of policy for operation and maintenance of VIP toilets and other on-site sanitation technologies, especially the emptying of full pits and safe disposal of pit sludge.
- Sanitation policy guidelines for the integration of water conservation and water demand management strategies into the delivery of basic sanitation infrastructure and development of economic and legal instruments for enforcing compliance.

3.4 Documentation

Most African institutions do not have efficient systems for information gathering and storage. Accurate statistics on diseases, proper records of traditional medicine, and population registers of traditional healers are incomplete or lacking. Although it is widely claimed that TM predominates in Africa, for example, accurate statistics on its use and practitioners are scarce. In many cases, it is difficult to assess the true extent of the use of TM because of the lack of proper documentation and meaningful statistics. The inadequacy of disease surveillance and reporting systems in some countries makes it difficult to establish the burden of disease and the potential cost-effectiveness of any of the new vaccines. Traditional methods of diagnosis and treatment are generally passed down orally from generation to generation, and very little documentation exists on the plant- and animal-based remedies used.

Reports reveals critical gaps in monitoring. Indeed, reliable data is vital to identify gaps in access to WASH services and inform policy decisions. Though many countries have monitoring frameworks in place, there is inconsistent or fragmented gathering of data and weak capacity for analysis.

4. Proposed Research Themes

Based on the status of, and the key challenges to, health and human well-being on the continent, five broad research themes are proposed. Specific multidisciplinary regional projects will subsequently be developed on each of these themes.

Theme 1: Understanding the scientific basis of diseases in Africa

Diseases such as malaria, TB, cholera, measles, and other infectious diseases have persisted in Africa, and they keep re-emerging despite numerous programmes and efforts to combat them. Development of sustained control strategies for these diseases will require a good understanding of the factors that favour their persistence and/or frequent re-emergence. Research projects aimed at understanding some of these factors will focus on the following themes:

Epidemiology of emerging and re-emerging diseases. In order to understand the epidemiology of emerging and re-emerging diseases, research activities will target the following objectives:

- To identify the factors influencing emerging and re-emerging diseases
- To identify the spatial and temporal trends in emerging and re-emerging diseases
- To model and predict the emergence of diseases with changing environmental conditions.

Pathogenesis of common diseases. Research in this area will investigate the molecular basis of disease development in infected individuals, including studies on molecular interactions between the pathogens and their intermediate hosts (disease vectors).

Resistance to drugs and pesticides. Research on this topic will aim at:

- Strengthening surveillance of drug resistance in key diseases
- Understanding the molecular and biochemical bases for disease resistance to drugs
- Understanding the molecular and biochemical bases for resistance of disease vectors to pesticides
- Monitoring and cataloguing the frequency of drug resistance in key diseases and of pesticide resistance in disease vectors
- Developing the capacity for a rational synthesis of new drugs and pesticide formulations, so as to circumvent the development of resistance.

Capacity building and networking in the molecular biosciences. The objectives of this cross-cutting theme are:

- To build capacity for medical biotechnology including diagnostics, molecular entomology, and parasitology
- To establish and/or support regional centres of excellence for training in the molecular biosciences.

Theme 2: Health Promotion and Disease Prevention

Most of the NCDs, such as CVDs, diabetes and obesity, are associated with lifestyle, particularly relating to eating habits. These diseases can be prevented by adopting quality nutrition and health-seeking behaviours.

Quality nutrition. Research on quality nutrition will target the following objectives:

- To investigate and propose healthy balanced diets based on locally available and accessible foods
- To investigate the nutrient deficiencies of locally available foods and methods for their fortification.

Food safety (food pathogens, toxins). Research on food safety will be intended:

- To develop cost-effective methods for improved food safety (that is, food free of pathogens and toxins), especially during processing, transportation, and storage
- To address issues of pathogen transmission from food to humans
- To develop cost-effective and user-friendly food and quality procedures.

Health-seeking behaviour. Research on this topic will aim at investigating the determinants of health-seeking behaviour in different cultural contexts and will propose strategies such as policy interventions.

Education and awareness. Activities in this area will target the following objectives:

- To develop, contextualise, and test strategies for improved health education and communication to minimise health hazards
- To investigate the possibility of integrating current knowledge to eradicate diseases, for example, those diseases that can be prevented with known vaccines.

Appropriate indicators and methodologies. The purpose of this study is to develop tools for epidemic forecasting (e.g., the prediction of epidemic outbreaks due to climate change and variability).

Theme 3: Health Systems Analysis and Development

The systems approach to health integrates environmental, cultural and socio-economic factors with the classically recognised health systems that include health personnel and health infrastructure (hospitals, health centres, pharmacies, dispensaries, and health training institutions). This approach seeks to analyse health issues from a broader perspective that considers not only the effects of physical factors such as global climate change, but also socio-cultural variables associated with factors such as urbanisation and globalisation. Mathematical models will be used to describe the interactions between these variables and the ways in which they influence various pathologies.

Cost-effective analysis and optimisation of health services. The objectives of this study will be:

- To conduct a detailed analysis of available interventions in order to determine their cost-effectiveness
- To advocate for sharing and the scale-up of proven interventions.

Models of health delivery systems in Africa (performance improvement, ecosystem approach to health) The objectives of this study are:

- To develop home-grown, locally relevant models for effective health service delivery
- To identify models for improving performance of health systems
- To investigate modalities of financing healthcare.

Human and other resources for health. Activities to improve the state of resources for health and human well-being will focus on:

- Investigating the means for capacity building and retention
- Advocacy for the reduction of the push and pull factors in the brain drain of health professionals and researchers
- Advocacy for adequate investment in health infrastructure by African governments
- Exploring modalities for engagement of the African Diaspora in capacity building, material investment, and application of science, technology, and innovation to improve the well-being of African populations.

Theme 4: Traditional/Complementary and Alternative Medicine

While TM holds great potential for the continent and has stood the test of time against several diseases, it still faces major challenges that need to be addressed by applying contemporary science and technologies. Key issues of concern include the following:

Scientific validation and safety. Research will aim at the pharmacological characterisation of indigenous remedies and studies on their efficacy and toxicology.

Drug discovery, development and IPR issues. Targeted research objectives are to:

- Identify pharmacologically active natural compounds and formulate them into prescription drugs
- Standardise the formulation, dosage, stability and storage of indigenous remedies
- Protect indigenous knowledge so as to encourage trust and information sharing
- Establish partnerships between traditional practitioners, scientists, medical practitioners, and manufacturers for drug development and commercialisation.

Sustainable use of biodiversity. Research in this area will seek to develop practices that sustain ecosystems for providing goods and services for human well-being. Such practices will include domestication of medicinal species and application of appropriate agricultural techniques for the sound and sustainable use of African biodiversity.

Documentation of indigenous knowledge. The objectives of this study will include:

- Gathering and cataloguing information from traditional healers
- Collating, classifying, and cataloguing the uses of medicinal plants.

Theme 5: Promotion of Human Well-being

Although human well-being is a broad concept and cuts across all other aspects of good quality life, this thematic area does not intend to address all such issues. The ICSU ROA research activities on human well-being will be limited to the following areas:

Agricultural research (food security). Food security in Africa can be improved by re-orientating agricultural research to address issues such as the following:

- Developing pest- and drought-resistant crops, high-yield varieties, and reduced biological cycles
- Food processing in order to improve food quality and availability, income generation, and well-being
- Sustainable livestock production (tolerance to disease, drought, high yielding, zero grazing)
- Mechanisms for guaranteed food security (availability and access).

Water and sanitation. Water is at the epicentre of human well-being, and problems of water and sanitation cut across all the four priority areas of ICSU ROA. Projects on this subject will be developed within the framework of all of these priority areas. Issues of concern include:

- Supply of clean and safe drinking water
- Treatment and recycling of domestic and industrial wastewater
- Proper water management in agriculture and other production sectors
- Control of surface and ground water pollution from agricultural chemicals (wash-off and leaching of fertilizers and pesticides)
- Treatment and recycling of municipal solid wastes (kitchen and garden wastes)
- Development of innovative solutions for excreta disposal, collection, transport and treatment
- Valorisation of by-products of wastewater and faecal sludge treatment
- Removal of pollutant organic persistent (POP) in water and wastewater.
- Education and advocacy for proper sewage disposal
- Water governance and trans-border aquifers.

Mental health. Studies on mental health will aim at:

- Assessing the impact of changing economic, socio-political, and cultural environments on the evolution of mental well-being in Africa
- Investigating mental health in relation to trauma resulting from civil unrest, violence and disasters.

Injuries, violence and trauma. Studies in this area will aim at generating viable statistics on trauma, household violence and injury prevention (e.g., in the area of transport, the use of seat belts, speed control and overloading). Such data will be of great importance in policy- and decision-making processes.

Gender issues. The key questions concerning gender issues will be to:

- Evaluate the impact of gender bias on the health and well-being of African woman
- Investigate ways and means of empowering woman in different socio-economic contexts for better health and well-being.

Cultural issues. The objectives of studies on cultural issues are:

- To investigate the impact of cultural beliefs and practices on health-seeking behaviours of different African communities
- To develop mechanisms for influencing such practices for improved health and well-being.

5. Cross-Cutting Issues

Human well-being encompasses much more than just the problems of health and nutrition discussed in this Science Plan. Well-being also implies having access to such essentials as water, electricity, a clean environment, transport, communication, sources of livelihood, financial resources, education, clothing, good shelter and security.

These components of well-being are inter-related in a complex manner and cut across all four priority areas of ICSU ROA. Improving human well-being in Africa will require addressing the following cross-cutting issues: poverty alleviation; community education and awareness; youth empowerment; human and institutional capacity building; networking and centres of excellence; water management, sanitation and governance; environmental degradation; data collection and documentation; gender equity; and good governance.

6. Deliverables

This Science Plan has stimulated awareness of the current status and gaps in Health and Human Well-being in Africa. It is anticipated that its successful implementation will contribute to:

- Improved networking at the regional and sub-regional levels
- Increased awareness among African governments, the private sector, funding agencies, and donors with regard to funding in healthcare endeavours
- Fully functional institutions
- Change in trends of lifestyle and related disorders
- Improved hygiene, sanitation and supply of potable water
- Evidence-based policy- and decision-making with respect to health and human well-being
- Increased policy-relevant research
- Better healthcare personnel in terms of quantity, quality and motivation
- Improved socio-economic environment for human well-being
- Improved psychological well-being
- Improved access to healthcare facilities
- Affordable healthcare services in Africa.

7. Financing Mechanisms

Fundraising strategies

Funding of research projects on health and human well-being in Africa can potentially be generated through the following actions:

- A concerted drive to raise international funding in the interest of global health concerns that are not necessarily restricted to Africa (e.g., Ebola, Avian flu, HIV, TB)
- Advocacy for internal funding by African governments, through the AU, NEPAD, and the African Development Bank, as well as regional economic commissions (CEMAC, EAC, ECOWAS, SADC)
- Encouragement of synergies among WHO and other UN agencies, the World Bank, the Bill and Melinda Gates Foundation, and others.

Guidelines on budgets

The budget for implementing this Science Plan will be driven by long-term, large-scale and high-quality fundable research projects that will be developed from the generic research themes described in Section 4. Each project proposal will include a realistic budget, based on proper costing. Such budgets will also need to make provision for the purchase and maintenance of research equipment, and for administrative overheads.

8. Conclusion

This Africa Science Plan summarises the current status of health and human well-being in Africa and describes the major challenges faced by the continent. The plan also proposes key research themes to address the challenges. If successfully implemented, the proposed research will provide valuable scientific evidence and skills that would be useful in informing policy- and decision-making for the well-being of African people. Effective implementation will require substantial mobilisation of human and financial resources, and research facilities for training, research and community education (outreach), as well as extensive regional and international collaboration, partnerships, and networking.

ICSU ROA will promote, facilitate and coordinate the implementation of this plan and its concomitant projects dealing with health and human well-being in Africa.



Source: <http://wunderpix.com/strangest-fruits-in-the-world/>

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Acronyms and Abbreviations

| | |
|----------|--|
| ACT | Artemisinin-based combination therapy |
| AIDS | Acquired Immune Deficiency Syndrome |
| AM | Allopathic medicine |
| AMCOW | African Ministerial Conference on Water |
| APOC | African Programme for Onchocerciasis Control |
| ARBO | Arthropod-borne |
| ASPSC | African Science Plans Steering Committee |
| ASR | Age Standardized Rate |
| ACEMACU | African Union |
| BCG | Bacillus Calmette-Guérin |
| BMI | Body Mass Index |
| CAM | Complementary and Alternative Medicine |
| CDC | Centres for Disease Control and Prevention |
| CDTI | Community-directed treatment |
| CEMAC | Economic and Monetary Community of Central Africa [Communauté Economique et Monétaire de l'Afrique Centrale] |
| CHD | Coronary heart disease |
| CVD | Cardiovascular disease |
| DALYs | Disability Adjusted Life Years |
| DM | Diabetes mellitus |
| DOT | Directly observed treatment |
| DPT | Diphtheria-pertussis-tetanus |
| DRC | Democratic Republic of Congo |
| EAC | East African Community |
| ECOWAS | Economic Community of West African States |
| EOCs | Emerging organic contaminants |
| EPI | Expanded Programme on Immunization |
| EPR | Epidemic and pandemic alert and response |
| EU | European Union |
| EVD | Ebola virus disease |
| FDA | (USA) Food and Drug Administration |
| GBD | Global burden of disease |
| GDP | Gross domestic product |
| GHG | Greenhouse gas |
| Hib | Haemophilus influenzae type b |
| HIV | Human immunodeficiency virus |
| ICSU | International Council for Science |
| ICSU RCA | International Council for Science Regional Committee for Africa |



Source: <http://www.amrefcanada.org/>

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| ICSU ROA | International Council for Science, Regional Office for Africa |
| ILO | International Labour Organization |
| IPCC | Intergovernmental Panel on Climate Change |
| IPR | Intellectual property rights |
| LAC | Latin American Countries |
| MDGs | Millennium Development Goals |
| MDR-TB | Multiple-drug-resistant TB |
| MI | Micronutrient Initiative |
| MoU | Memorandum of Understanding |
| NCD | Non-communicable diseases |
| NEPAD | New Partnership for Africa's Development |
| NTD | Neglected tropical diseases |
| ODA | Official development assistance |
| PC-NTD | Preventative Chemotherapy for Neglected Tropical Diseases |
| PHEIC | The Public Health Emergency of International Concern |
| PHC | Primary health care |
| POP | Pollutant organic persistent |
| SADC | Southern African Development Community |
| SCD | Sickle cell disease |
| SDGs | Sustainable Development Goals |
| SETI | Science, engineering, technology and innovation |
| SP | sulfadoxine/pyrithiamine |
| STH | Soil-Transmitted Helminthiasis |
| STISA | Science, Technology and Innovation Strategy for Africa |
| TB | Tuberculosis |
| TM | Traditional medicine |
| ToR | Terms of Reference |
| UN | United Nations |
| UNAIDS | United Nations Programme on HIV/AIDS |
| UNDP | United Nations Development Programme |
| UNEP | United Nations Environmental Programme |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| UNICEF | United Nations International Children's Emergency Fund |
| USA | United States of America |
| USAID | United States Agency for International Development |
| VHF | Viral haemorrhagic fever |
| WASH | Water, sanitation and hygiene practices |
| WHO | World Health Organization |
| WHO-RCA | World Health Organization, Regional Committee for Africa |



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