

THE GLOBAL NEGLECTED TROPICAL DISEASES: THE CURRENT STATUS AND THE FUTURE PERSPECTIVE

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ABSTRACT

Objective: This review identifies the risk factors of the major neglected tropical diseases and describes the epidemiology, global burden of the diseases as well as highlights on the roadmap in tackling the diseases which focuses in eliminating, eradicating and controlling them by 2020. **Method:** An electronic search of titles related to tropical neglected diseases, global burden of diseases using PUBMED and other bibliographic databases was conducted. The abstracts of relevant articles and full articles available online were accessed and references were reviewed to extend the search. **Result:** The review reveals that the neglected tropical diseases are the most common conditions affecting the poorest globally in sub-Saharan Africa with billions of people infected with one or more of the neglected tropical diseases. The World Health Organization has identified 17 core neglected tropical diseases among the numerous ones which exist globally which have caused serious health implications like high morbidity and mortality globally which has prompted a lot of interventions from different international and national organizations aimed at fighting to eliminate, eradicate or control the diseases by 2020. **Conclusion:** Elimination, eradication and control of the diseases are achievable by 2020 with mass administration of preventive therapy; intensified control and enhanced surveillance, new tools for diagnosis; vector control and interruption of transmission; better case management and focused research on medicines and vaccines; and an integrated vector management approach.

Keywords: Neglected tropical diseases, global burden, epidemiology

INTRODUCTION

The neglected tropical diseases are a group of chronic parasitic diseases and related conditions that represent the most common illnesses of the world's poorest people [1]. They are said to be historically overlooked diseases that have been neglected at the community, national international levels and are endemic in many resource-poor populations and developing countries [2-4]. The neglected tropical diseases cause substantial health and economic burden on poor populations in Africa, Asia, and Latin America with about 534 000 deaths every year and have a similar disease burden to either malaria or tuberculosis [1].

According to the WHO [5], of the numerous neglected tropical diseases present in the world, there are 17 core neglected tropical diseases which include: human African trypanosomiasis, Chagas disease, leishmaniasis, taeniasis/cysticercosis, dracunculiasis, echinococcosis, food-borne trematodiasis, dengue, rabies, trachoma, buruli ulcer, endemic treponematoses, leprosy, lymphatic filariasis, onchocerciasis, schistosomiasis, and soil-transmitted helminthiasis. Among these neglected tropical diseases, Nigeria has the greatest number of people infected or at risk with schistosomiasis (29 million), lymphatic filariasis (80–121 million at risk), ascariasis (55 million), hookworm (38 million) and Trichuriasis (34 million) among all the African nations [6-8].

EPIDEMIOLOGY AND GLOBAL BURDEN OF THE NEGLECTED TROPICAL DISEASES

Human African Trypanosomiasis

This is a protozoan infection also called sleeping sickness, and Trypanosoma causes it *brucei gambiense* and *Trypanosoma brucei rhodesiense*. These parasites are transmitted by *Glossina* spp. Also called tse-tse fly [5, 9, 10]. This infection occurs only in sub-Saharan Africa where tse-tse flies are found in 36 countries [11].

Trypanosoma brucei gambiense is found in 24 countries in west and central Africa. This form currently accounts for 97% of reported cases of sleeping sickness and causes a chronic infection. The Democratic Republic of the Congo accounts for most reported cases of the disease [11]. A person can be infected for months or even years without major signs or symptoms of the disease. When more evident symptoms emerge, the patient is

often already in an advanced disease stage where the central nervous system is affected [11].

Trypanosoma brucei rhodesiense is found in 13 countries in eastern and southern Africa. Nowadays, this form represents fewer than 3% of reported cases and causes an acute infection. First signs and symptoms are observed a few months or weeks after infection. The disease develops rapidly and invades the central nervous system. Only Uganda presents both forms of the disease, but in separate zones [11].

Human African trypanosomiasis is a fatal disease which can degenerate without prompt diagnosis and treatment because the parasites multiply in the body, cross the blood-brain barrier and invade the central nervous system [5].

According to WHO [5], at least 10,000 new cases have occurred for the first time in 50 years annually. This trend represents a decrease of 72% during the past 10 years. The number of cases reported annually is considered to be a fraction of the real number of infected individuals. According to Simaro *et al.* [12], the incidence could be around 20 000 cases a year. An estimated 60 million people are at risk of both forms of parasites in sub-Saharan Africa [9]. Malvy & Chappuis [13] in 2010 reported *Trypanosoma brucei gambiense* was focally endemic in 24 countries of Western and Central Africa, mainly Angola, the Democratic Republic of Congo, the Central African Republic, Chad, Ivory Coast, Guinea, southern Sudan, and northwest Uganda. In 2013, out of a total of 6228 reported new *gambiense* human African trypanosomiasis cases, 5647 (more than 90%) were clustered in the Democratic Republic of Congo [14].

Chagas Disease

Chagas disease is caused by infection with the protozoa, *Trypanosoma cruzi*, transmitted to humans through the primary vector, *Triatoma infestans* also called kissing bug; contact with faeces of vector insects (triatomine bugs) including ingestion of contaminated food; transfusion of infected blood; congenital transmission; organ transplantation; and laboratory accidents [15]. The disease is found in North America, Central America, and South America [5]. About 7 million to 8 million people worldwide are estimated to be infected with *Trypanosoma cruzi*, mostly in the endemic areas of 21 Latin American countries: Argentina,

Belize, the Bolivarian Republic of Venezuela, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, French Guyana, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, the Plurinational State of Bolivia, Suriname and Uruguay [5].

The vectors live in the cracks in mud walls and thatched roofs of rustic rural houses, causing repeated infections [15]. The estimated global prevalence of *Trypanosoma cruzi* infection declined from 18 million in 1991, when the first regional control initiative began to 5.7 million in 2010. Most cases in the United States are imported from Latin America, with an estimated 300,000 infected residents living in the U.S. Outbreaks of orally transmitted *Trypanosoma cruzi* infection through food or drink contaminated with vector feces appear to be associated with a higher incidence of myocarditis and a higher case-fatality rate than vector-borne infections [15].

Leishmaniasis

The Leishmaniasis are caused by protozoan parasites transmitted through the bite of female sandflies known as *Phlebotomus*, *Psychodopygus*, and *Lutzomyia*. Visceral Leishmaniasis, also known as kala-azar, is usually fatal within 2 years if left untreated. After treatment, visceral Leishmaniasis sometimes evolves into a cutaneous form known as postkala-azar dermal Leishmaniasis, cases of which may serve as sources and thus, maintain the transmission [16]. Cutaneous leishmaniasis is the mostly occurring form which causes ulcer that heals spontaneously while the mucocutaneous form enters the mucous membrane of the upper region of the respiratory tract destroying soft tissues in the nose, mouth, and throat [5].

More than 90% of the 200,000 to 400,000 new cases of visceral leishmaniasis globally occur in six countries: India, Bangladesh, Sudan, South Sudan, Ethiopia, and Brazil [17–19]. The risk of seroconversion and disease was significantly increased in individuals aged 14–24 years old [20]. The spread of the Leishmaniasis is mostly caused by migration of immunocompromised populations that are exposed to transmission [21].

Taeniasis/Cysticercosis

Taeniasis and cysticercosis are caused by infection with the tapeworm called *Taenia solium* and *Taenia saginata*. Taeniasis is a mild pathogenic disease which occurs when the adult tapeworm is present in the intestine causes while cysticercosis is a severe pathogenic disease which occurs when humans ingest the tapeworm's eggs after which larvae (cysticerci) develop in their tissues like muscles, skin, the eyes, and the central nervous system. Neurocysticercosis is the term used when the central nervous system is invaded [5,22]. *Taenia solium* and *Taenia asiatica* are transmitted in humans through ingestion of undercooked or raw beef (*Taenia saginata*) and pork for *Taenia solium* [22].

Endemic regions include Latin America, South Asia, South-East Asia, and sub-Saharan Africa. High prevalence of human cysticercosis occurs in various foci in Burkina Faso, the Democratic Republic of the Congo, Mozambique, Senegal, South Africa, the United Republic of Tanzania and Zambia. In Asia, new reports of cases of neurocysticercosis have been received from Bangladesh, Malaysia, and Singapore, mainly in migrant workers [5].

Dracunculiasis

Dracunculiasis is commonly known as guinea worm disease, and it is caused by the worm, *Dracunculus medinensis* through the drinking of contaminated water from open sources such as stagnant ponds that contain immature parasites in tiny copepods (water fleas) [23].

During the 1980s, dracunculiasis was endemic in 21 countries in African, Eastern Mediterranean, and South-East Asia regions [24]. Through the Global Guinea Worm Eradication (Dracunculiasis) Program, enormous progress has been made since it began in the 1980s. From an estimated 3.5 million cases in 1986, it

dropped to only 25 cases in 2016 [25,26]. As at 2013, 197 countries were certified dracunculiasis free [27]. At the end of 2016, 17 of the 21 previously endemic countries had stopped transmission of the disease, while WHO have certified 15 free of transmission [26]. Currently, the disease is endemic in four countries which are South Sudan, Chad, Ethiopia, and Mali [5].

Echinococcosis

These are infections called hydatidosis caused by ingestion of the larvae of *Echinococcus granulosus* and alveolar echinococcosis caused by infection with *Echinococcus multilocularis* [5]. Dogs are the definitive hosts while sheep, cattle, goats, and pigs are intermediate hosts. Most of the infections are asymptomatic. However, hydatid cyst can cause destruction due to gradual growth of cysts in liver, lungs, and other organs that may not be noticed for years [28].

Highly endemic areas are mostly found in the eastern part of the Mediterranean region, Northern Africa, Southern, and Eastern Europe, at the Southern tip of South America, Central Asia, Siberia and Western China. Alveolar echinococcosis is limited to the northern hemisphere particularly regions of China, the Russian Federation and countries in continental Europe and North America. Available data indicate that echinococcosis is reemerging as an important public health problem. There are more than 1 million people worldwide affected with these diseases at a time [29,30].

Food-borne Trematodiasis

Infections with food-borne trematodes are acquired when food contaminated with larval stages of metacercariae is ingested. The diseases of most public-health importance are clonorchiasis caused by infection with *Clonorchis sinensis*; opisthorchiasis, caused by *Opisthorchis viverrini* or *Opisthorchis felineus*; fascioliasis, caused by *Fasciola hepatica* or *Fasciola gigantica*; and paragonimiasis, caused by *Paragonimus* spp [5].

Although food-borne trematodiasis have been reported in over 70 countries of the world, countries in Asia and Latin America are the worst affected [31]. There is a paucity of information on the epidemiological status of food-borne trematodes in Africa; however, paragonimiasis is known to be transmitted in the central and western parts of the continent [32].

Morbidity due to infection with food-borne trematodes is both systemic and organ specific and becomes more severe as the number of worms increases through subsequent rounds of infection. Chronic infections with *Clonorchis sinensis* and *Opisthorchis viverrini* are strongly associated with cholangiocarcinoma and both parasites are grouped by the International Agency for Research on Cancer as carcinogenic to humans [32].

The economic burden of food-borne trematodes is mainly linked to the expanding livestock and aquaculture industries. Losses in animal production and trade are likely to indirectly affect human welfare [5].

Dengue

Dengue fever is caused by four serotypes of a virus, DENV transmitted by mosquitoes, primarily *Aedes aegypti* and *Aedes albopictus* [33].

According to WHO [5], 22 countries in African Region reported sporadic cases or outbreaks of dengue between 1960–2010; 12 additional countries reported that dengue was restricted to travelers. The presence of disease and the high prevalence of antibodies to dengue virus in serological surveys suggest that endemic dengue virus infection exists in all or many parts of Africa. Dengue may be underreported in Africa owing to a lack of awareness among health-care providers, the presence of other febrile illnesses especially malaria and insufficient testing that hinders systematic surveillance [5].

Generally, cases of dengue have been detected along the coasts of countries bordering the Red Sea and the Arabian Sea, and in

Pakistan. The current situation of dengue in countries of the region can be stratified as follows:

Group A (Pakistan, Saudi Arabia and Yemen): Dengue is emerging as a major public-health problem in this group. There have been outbreaks of dengue in urban centres within two decades between 1999-2000 and the disease has spread to rural areas in Pakistan and Yemen. An outbreak in Lahore in 2011 caused more than 300 deaths [5].

Group B (Djibouti, Somalia and Sudan): Outbreaks are becoming more frequent with multiple virus serotypes cocirculation; and the disease is probably expanding its geographical reach in these countries [5].

Group C (Oman): Imported cases of dengue have been reported but there is no evidence of endemicity or local transmission [5].

Group D: This includes countries where dengue has not yet been reported, although the inability of a surveillance system to detect the disease cannot be ruled out [5].

During the 1960s and early 1970s, campaign to eradicate *Aedes aegypti* was carried out in much of the Region of the Americas to interrupt the transmission resulted from the virus. But due to failure to sustain the vector surveillance, mosquitoes thrived and dengue outbreaks recurred in the Caribbean and Central America and South America. The region is now in a hyperendemic state with indigenous transmission occurring in almost all countries [34].

Dengue is endemic in South-East Asia with variation in incidence among countries and within each country. The seasonal pattern of dengue differs among countries: in India, the number of cases peaks between August and November; Myanmar and Sri Lanka, the peak occurs between May and August. Severe dengue is endemic in most of the countries in the South-East Asia Region [35].

Aede salbopictus rapidly became established mainly through the global trade in used tyres in the European Region in the 1990s. The threat of dengue outbreaks exists in Europe. Local transmission of the virus was reported in France and Croatia in 2010; reported cases were reported in various other European countries; and an outbreak of dengue was also reported from Madeira island of Portugal in 2012 [5].

Despite the fact the number of reported cases of dengue around 50,000 annually in 1999 and 2000 after an epidemic in 1998, the incidence of dengue has increased during the past decade. In 2010, the region reported 353,907 cases, including 1073 deaths (case-fatality rate, 0.30%). The incidence of dengue was highest in the Lao People's Democratic Republic but most cases and deaths were reported from the Philippines. Island nations have been susceptible to epidemics with both Micronesia and the Marshall Islands having epidemics in 2011. Increases in the number of cases reported from Malaysia and Singapore indicate sustained epidemic activity [5].

Approximately 390 million people are exposed to Dengue Virus each year, resulting in 96 million annual cases of viral-associated disease globally while approximately 3.6 billion people living in the tropical and sub-tropical regions are at risk of infection [36,37]. According to the WHO, approximately 500,000 people develop severe disease each year, and among them, about 1250 (2.5%) die [37].

Rabies

Rabies is a vaccine-preventable viral disease which is very fatal once the symptoms have developed. It is said to be one of the most important reemerging zoonotic diseases throughout the world. Transmission of the virus usually occurs by the bite of rabid animals. South Asian countries contribute to more than half of the global burden of rabies. India is a major contributor to the global rabies burden, being responsible for 17,000–20,000 of the 55,000–70,000 deaths that occur globally each year [38,39]. In Nepal, reported human deaths due to rabies are about 10–100 per year [40]. Death also occurs in Africa and West Pacific regions [5].

Trachoma

Trachoma is a bacterial eye infection caused by the bacterium *Chlamydia trachomatis* which accounts for 3% of global blindness burden [5,41]. It is transmitted via contact with infected eye and nose secretions. Reinfection can develop into a condition known as trichiasis in which scarring and inward turning of the eyelid causes the eyelashes to scrape against the cornea of the eye [41]. In endemic areas, reinfection of the conjunctiva starts early in life and can initiate recurrent episodes of chronic conjunctival inflammation, characterized by the formation of lymphoid follicles. These are most easily seen in the upper tarsal conjunctival surface known as pannus formation [41]. This can result in permanent blindness if left untreated [42].

Estimate of 1.2 billion people live in endemic areas worldwide with 40.6 million people suffering from active trachoma. Ethiopia, India, Nigeria, Sudan and Guinea record 48.5% of the global burden of active trachoma. Africa is the most affected continent with 27.8 million which is about 68.5% of the 40.6 million cases of active trachoma [43].

Trachoma is commonly found in areas with limited access to adequate water, sanitation and basic hygiene (WASH). According to Ngondi *et al.* [44], risk factors such as an unclean face, less frequent face washing, cattle ownership, and increasing fly density are independently associated with severity of active trachoma after adjusting based on age and gender.

Buruli Ulcer

Buruli ulcer is a necrotizing skin disease caused by *Mycobacterium ulcerans* with slow generation time that infects the skin and subcutaneous tissues to give rise to indolent ulcers. The disease has been reported from more than 33 countries especially in West Africa with Ivory Coast, Ghana, Benin and Cameroon having 80% of the cases [45,46]. Approximately 48,373 cases were reported from 20 countries mostly in West and Central Africa. The risk is highest in children aged 4–14 years, and in people aged over 50 years [46]. Transmission of the disease has been linked with contaminated water with aquatic insects, adult mosquitoes and biting arthropods have been considered possible reservoir species and/or vectors [46,47].

Endemic Treponematoses

The human treponematoses comprise venereal syphilis and the endemic treponematoses called yaws, bejel and pinta. The etiological agents of these diseases are Gram-negative bacteria of the genus, *Treponema*[48]. Syphilis is caused by *Treponema pallidum pallidum*; yaws is caused by *Treponema pallidum pertenue*; bejel is caused by *Treponema pallidum endemicum*; and pinta is caused by *Treponema carateum*.

Traditional laboratory tests cannot distinguish the treponematoses [49]. However, molecular approaches involving PCR to identify these sequences have been developed to differentiate among the *Treponema pallidum* subspecies [50,51].

Of all the treponematoses, yaws is the commonest [52]. The global extent of endemic treponematoses is not accurately determined with the most recent data based on routine surveillance from some countries [53].

Leprosy

Leprosy is a disease caused by *Mycobacterium leprae*. The course and pathology of the disease depend on the response of the person's immune system to the infection [5]. Brazil, India, Nepal, Myanmar, Madagascar, and Mozambique are responsible for almost 90% of the leprosy cases registered worldwide [54]. In America, 8% of leprosy occurs in Brazil. A study in northeast Brazil has associated a low education level, having ever experienced food shortages, bathing weekly in open bodies of water (creeks, rivers and/or lakes), and a low frequency of changing bed linen or hammock with leprosy. Having a BCG vaccination scar was found to be a highly significant protective factor [54]. According to WHO [58], there were 211 009 new leprosy cases registered globally in 2017 according to official figures from 159 countries from the 6

WHO Regions. Based on 193 118 cases at the end of 2017, prevalence rate corresponds to 0.3/10000 [55].

Lymphatic filariasis

Lymphatic filariasis is a chronic condition caused by filarial nematode of the species *Wuchereriabancrofti*, *Brugia malayi* and *Brugia timori* transmitted by mosquitoes. *Anopheles* mosquito transmits the infection in Africa and *Culex quinquefasciatus* transmits in America. In the Pacific and in Asia, *Aedes* and *Mansonia* transmit the infection [56]. Adult worms live almost exclusively in humans and lodge in the lymphatic system. The infection is commonly acquired during childhood but usually manifests during adulthood [5].

Global estimates of 120 million people are affected in 80 countries throughout the tropics and sub-tropics, with 1.3 billion people at risk [57]. In sub-Saharan countries alone, 46–51 million people suffer from lymphatic filariasis [6].

Onchocerciasis

Onchocerciasis (river blindness) is a parasitic disease caused by the nematode *Onchocerca volvulus*, transmitted by *Simulium* spp is popularly known as blackflies which are bred in free-flowing streams and rivers [58]. The adult worm produces microfilaria larvae which migrate to the skin, eyes, and other organs. The disease causes severe itching, skin lesions, and vision impairment, including blindness [58–60].

Onchocerciasis is endemic in over 99% of all current cases are found in 30 sub-Saharan Africa namely Angola, Benin, Burkina Faso, Burundi, Cameroon, the Central African Republic, Chad, Côte d'Ivoire, the Democratic Republic of the Congo, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Malawi, Mali, Mozambique, Niger, Nigeria, Rwanda, Sierra Leone, Senegal, Sudan, South Sudan, Togo, Uganda and the United Republic of Tanzania; Yemen and 6 countries in Latin America namely the Bolivarian Republic of Venezuela, Brazil, Colombia, Ecuador, Guatemala and Mexico [58–60].

Schistosomiasis

Schistosomiasis also called bilharzia is a parasitic infection caused by flukes of the genus, *Schistosoma* and five species are

known to infect humans with snails as the intermediate hosts. These are *Schistosoma mansoni*, *Schistosoma intercalatum*, *Schistosoma haematobium*, *Schistosoma japonicum*, and *Schistosomamekongi*. In Africa, *Schistosoma mansoni* and *Schistosoma haematobium* are predominant throughout the continent while *Schistosoma intercalatum* is found in certain areas of central and western Africa. *Schistosoma mansoni* is also found in Latin America and the Caribbean. *Schistosoma japonicum* and *Schistosoma mekongi* are mostly confined to Asia and the Pacific [61]. Infected snails release larval stages of the organism (cercariae) into water. Human contact with water where the snails live is the source of the persistence of schistosomiasis [5].

The sub-Saharan Africa is the region mostly affected by this infection. Factors responsible for persistent transmission of the disease in sub-Saharan countries include climate changes and global warming, proximity to water bodies, irrigation and dam construction, occupational activities such as fishing and farming and poverty [62–64].

Soil-Transmitted Helminthiasis

Soil-transmitted helminth infection is caused by intestinal nematodes, of which the three major parasite types are *Ascaris lumbricoides* (roundworm), *Trichuris trichiura* (whipworm), and two species of hookworm (*Necator americanus* and *Ancylostoma duodenale*). Soil-transmitted helminth is transmitted to humans through faecally-contaminated soil [65–67].

According to WHO [68], more than 1.5 billion people representing 24% of the world's population, are infected with soil-transmitted helminth infections worldwide. Infections are widely distributed in tropical and subtropical areas, with the greatest numbers occurring in sub-Saharan Africa, the Americas, China and East Asia. Over 267 million preschool-age children and over 568 million school-age children live in areas where these parasites are intensively transmitted and are in need of treatment and preventive interventions [68]. WHO estimates that about 890 million children require annual treatment with preventive chemotherapy [5]. Table 1 presents the regions of the major neglected tropical diseases ranked by prevalence

Table 1: The regions of the major neglected tropical diseases ranked by prevalence

Disease	Global Prevalence (Million)	Population at Risk (Million)	Regions with Highest Prevalence	Source
Human African trypanosomiasis	0.3	60	Sub-Saharan	[69]
Chagas' disease	8–9	25	Latin America and Caribbean	[70]
Leishmaniasis	12	350	India, South Asia, sub-Saharan Africa, Latin America and Caribbean	[71]
Taeniasis/Cysticercosis	ND	ND	Latin America, South Asia, South-East Asia and Sub-Saharan Africa	[4]
Dracunculiasis	ND	ND	Sub-Saharan Africa	[4]
Echinococcosis	ND	ND	Eastern part of the Mediterranean region, Northern Africa, Southern and Eastern Europe, at the Southern tip of South America, in Central Asia, Siberia and western China	[29] [30]
Food-borne trematodiasis	ND	ND	Asia, Latin America and Sub-Saharan Africa	[32]
Dengue	ND	ND	Americas, South-East Asia and Western Pacific	[72]
Rabies	ND	ND	Africa, Asia, Caribbean	[73]
Trachoma	1.9	158	Africa, Central and South America, Asia, Australia and the Middle East	[74]
Buruli ulcer	ND	ND	Sub-Saharan Africa, the Americas, Asia and the Western Pacific	[75]
Endemic treponematoses	ND	ND	West and Sahel region of Africa, South East Asia, the Pacific, Latin America and the Arabian peninsula	[76,77,78,79]
Leprosy	0.3	ND	India, sub-Saharan Africa, Latin America and Caribbean	[5,55]
Lymphatic filariasis	120	1300	India, South Asia, East Asia and Pacific Islands, Sub-	[57]

			Saharan Africa	
Onchocerciasis	37	90	Sub-Saharan Africa, Latin America and Caribbean	[80]
Schistosomiasis	207	779	Sub-Saharan Africa, Latin America and Caribbean	[81,82]

ND–Not determine

ROAPMAP IN TACKLING NEGLATED TROPICAL DISEASES

The fight against the neglected tropical diseases is achievable with the current campaigns of the WHO and her member countries towards the implantation of the five strategies for the prevention, control, elimination and eradication of the neglected tropical diseases recommended by the WHO. According to the WHO [83], the vision of controlling, eliminating and eradicating the neglected tropical diseases has gathered significant momentum over recent years. There are several reports by the WHO on the successes on the burden caused by many of the 17 diseases that affect more than 1 billion people worldwide.

According to WHO [83], the five strategic plans prevention, control, elimination and eradication of the neglected tropical diseases include preventive chemotherapy, intensified disease management, vector and intermediate host control, veterinary public health at the human–animal interface and provision of safe water, sanitation and hygiene.

Through the expanded use of mass drug administration as well as targeted treatments, there is now an opportunity to control, eliminate or eradicate some of the most important neglected tropical diseases in terms of prevalence and disease burden. Implementation of preventive chemotherapy interventions with high coverage will ensure that by 2020 the WHO goals for the targeted the neglected tropical diseases can be reached [83,84]. Preventive chemotherapy is a component of the established SAFE strategy for trachoma (Surgery, Antibiotics, Facial cleanliness and Environmental improvements) and helpful in controlling morbidity from some food-borne trematodiasis [5,83].

In cases of diagnosis and treatments of difficult the neglected tropical diseases which can trigger severe medical manifestations and complications, innovative and intensive disease-management is recommended by the WHO. Treatment for diseases like Buruli ulcer, Chagas disease, both forms of human African trypanosomiasis, leishmaniasis (cutaneous, mucocutaneous and visceral forms), leprosy and yaws requires individual case-management which allows patients to be seen at well equipped hospitals and by well trained, specialized technicians [84]. The focus of this management is on better access to specialized care through improved case-detection and decentralized clinical management aims to prevent mortality, reduce morbidity and interrupt transmission [84].

There are a number of zoonotic neglected tropical diseases which have been internationally accepted as neglected zoonotic diseases because they have not been sufficiently addressed by government and international community due to shift of interest to newly emerging zoonoses, particularly those tending to be pandemic [85]. They pose burden on health of both humans and animals especially in immunosuppressed population. They negatively affect the health and productivity of livestock, causing infertility, death, low yields of milk and as well rendering meat inedible [86]. These zoonoses include cysticercosis and taeniasis caused by infection with *Taenia solium*, cystic echinococcosis, human rabies transmitted by dogs, zoonotic trypanosomiasis, the leishmaniasis, zoonotic human African trypanosomiasis,

fascioliasis and food-borne trematodiasis [85]. An integrated human and animal health approach will improve the prevention and control of neglected zoonotic diseases [81].

However, there is a risk that access to only sufficient drugs and intensified case-management will not achieve the specific target in the absence of measures to controlling the immediate hosts or vectors. Many of the diseases like human African trypanosomiasis, leishmaniasis, dengue, Chagas disease, dracunculiasis, lymphatic filariasis, onchocerciasis and schistosomiasis are all transmitted through vectors and intermediate hosts. Therefore, efforts should be made to ensuring that the vectors are effectively controlled. According to WHO [5], vector control relies mainly on the use of pesticides and sound management of pesticides which requires collaboration among sectors for agriculture, health and the environment. Vector control serves as an important cross-cutting activity aimed at enhancing the impact of preventive chemotherapy and intensified disease management. Integrated vector management is a combination of different sectorial-linked interventions aimed at improving the efficiency, ecological soundness and sustainability of disease control measures against vector-borne the neglected tropical diseases, including the sound management of public-health pesticides. [81].

Majority of the neglected tropical diseases occur due to absence of potable and good hygiene. According to WHO [82], United Nations have reported despite the availability of improved water to over 2 billion people between 1990 and 2000, 900 million people lack access to potable water by and 2500 million people live without good hygiene conditions. This according to WHO [82] is a determinant in the burden of most neglected tropical diseases in areas where they occur particularly in sub-Saharan Africa where WHO [5] has reported as the most prevalent region with neglected tropical diseases and estimated 40% of those living without potable live

With the global campaign against open defecation which has culminated in the decrease of open defecation by 271 million since 1990, it is still practiced by most of rural communities in 19 countries which accounts for about 1.1 billion people worldwide [5].

Also, though 1.8 billion people have gained access to improved sanitation facilities between 1990 and 2010, an estimated 2.5 billion people still live without any improvements to sanitation services, and almost three quarters of them live in rural areas [5].

These environmental challenges have been an impediment to the obvious health benefits which accrue from improved sanitation and have as well hindered the achievement of the targets of Millennium Development Goal 7 especially in African and South-East Asia regions. Many of the neglected tropical diseases and other communicable diseases will not be eliminated and as well as not eradicated if the situations are on the status quo [82].

Two tables present the targets and milestones for eradication and elimination (Table 2a) and for control (Table 2b) of the neglected tropical diseases by 2015 and 2020.

Table 2a: Targets and Milestones for Elimination and Eradication of the Neglected Tropical Diseases, 2015–2020

Disease	2015			2020				
	Eradication	Global elimination	Regional elimination	Country elimination	Eradication	Global elimination	Regional elimination	Country elimination
Rabies ^a			Latin America				South-East Asia and Western Pacific regions	
Blinding trachoma						✓		
Endemic treponematoses (yaws)						✓		
Leprosy						✓		
Chagas disease			Transmission transfusion through blood transmission				Intra-domiciliary interrupted in the Region interrupted	
Human African trypanosomiasis				In 80% of foci		✓		
Visceral leishmaniasis							Indian subcontinent	
Dracunculiasis	✓							
Lymphatic filariasis						✓		
Onchocerciasis			Latin America	Yemen				Selected countries in Africa
Schistosomiasis	Eastern Mediterranean Region, Caribbean, Indonesia and the Mekong River basin						Region of the Americas and Western Pacific Region	Selected countries in Africa

^a Refers to human dog-mediated rabies
Source: WHO [83]

Table 2b: Targets and milestones for control of the Neglected Tropical Diseases, 2015–2020

Disease	2015	2020
Dengue	Sustainable dengue vector control interventions established in 10 endemic priority countries	Establishment of dengue control and surveillance systems in all regions Reduction in number of cases by more than 25% (2009–2010 as base line) and deaths by 50%
Buruli ulcer	Study completed and oral antibiotic therapy incorporated into control and treatment	70% of all cases detected early and cured with antibiotics in all endemic countries
Cutaneous leishmaniasis	70% of all cases detected and at least 90% of all detected cases treated in the Eastern Mediterranean Region	
Taeniasis/cysticercosis and echinococcosis/hydatidosis	Validated strategy for control and elimination of <i>T. solium</i> taeniasis/cysticercosis available Pilot projects to validate effective echinococcosis/hydatidosis control strategies implemented in selected countries as a public-health problem	Interventions scaled up in selected countries for <i>T. solium</i> taeniasis/cysticercosis control and elimination Validated strategy available for echinococcosis/hydatidosis and interventions scaled up in selected countries for their control and elimination
Food-borne trematode	Food-borne trematode infections included in mainstream preventive chemotherapy strategy Morbidity due to food-borne trematode infections controlled where feasible	75% of population at risk reached by preventive chemotherapy Morbidity due to food-borne trematode infections controlled in all endemic countries
Soil-transmitted helminthiasis (intestinal worms)	Regular treatment for 50% of preschool and school-aged children in need of treatment. Plan action for 100% of countries.	Regular treatment for 75% of preschool and school-aged children in need of treatment. Achievement of 75% coverage in preschool and school-aged children in 100% of countries

CONCLUSION

With large-scale administration of preventive therapy; intensified control and enhanced surveillance, new tools for diagnosis; vector control and interruption of transmission; better case management and focused research on medicines and vaccines; and an integrated vector management approach, the rates of morbidity and mortality by the neglected tropical diseases as well as eradication, elimination and control of those diseases are achievable by 2020.

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