

Diagnoses of Emerging but neglected diseases (END's) in Africa: challenges and prospects

Stephen T. Odonkor¹* ²Tahiru Mahami and ³Hubert Nyarko

¹Radiological and Medical Sciences Research Institute (RAMSRI) of the Ghana Atomic Energy Commission P. O. Box LG 80, Legon-Accra, Ghana

²Biotechnology and Nuclear Agriculture Research Institute (BNARI), of the Ghana Atomic Energy Commission P. O. Box LG 80, Legon-Accra, Ghana.

³Department of Laboratory Technology
University of Cape Coast
Cape coast

Correspondence: Stephen T. Odonkor, Radiological and Medical Sciences Research Institute (RAMSRI) of the Ghana Atomic Energy Commission P. O. Box LG 80, Legon-Accra, Ghana.

Tel. +(233) 20 986221, +(233) 23 4709702 Fax:(+233) 30 2400807

E-mail: stodonkor@yahoo.co.uk

ABSTRACT

Emerging but neglected diseases (ENDs) are a significant burden on global economies and public health. ENDs impact over 1 billion of the world's poorest populations and require special attention. However, within the ENDs recognized by the World Health Organization, some are also dually categorized as emerging and re-emerging infectious diseases. The diagnosis of the ENDs presents a great challenge to African economies. It has a potential impact on efforts and strategies aimed at attaining the health targets of the Millennium Development Goals.

This paper reviewed literature on ENDs, presenting a new angle on Emerging but neglected diseases (ENDs) with emphasis on diagnosis. Multi-sectorial efforts and targeted public- private partnerships is needed to develop capacity not only for effective and accessible ENDs treatments but also in the general health system strengthening efforts. This is essential for enhancing knowledge to address public health aspects of these ENDs, which are now spreading rapidly to non-endemic regions.

During diagnose of emerging and neglected diseases in Africa, certain challenges are confronted by laboratory technicians. These challenges arise due to inadequate resources, inadequacy of specialized medical practitioners, noncompliance of citizens due to superstitious beliefs, etc. thus making diagnosis procedures less accurate and the tendency of misdiagnosis. It is therefore expected that The WHO and allied health organizations should focus international funds into developing new technologically advanced diagnostic tools and make them broadly available for use in poor countries.

Keywords: *disease, diagnosis, Africa, emerging, neglected and, infection*

1.0 Introduction:

Phenomenon and definition

Emerging but Neglected Diseases (ENDs) are a significant burden on global economies and public health (1–3). Their emergence is thought to be driven largely by socio-economic, environmental and ecological factors (1–9), but no comparative study has explicitly analyzed these linkages to understand global temporal and spatial patterns of ENDs. END events have risen significantly over time after controlling for reporting bias, with their peak incidence (in the 1980s) concomitant with the HIV pandemic. END events are dominated by zoonoses (60.3% of EIDs): the majority of these (71.8%) originate in wildlife (for example, severe acute respiratory virus, Ebola virus), and are increasing significantly over time (10). Ebola Virus for example is has recently, gone out of control, killing thousands in west Africa prompting the World Health organization to declare a health emergence, warning the diseases could infect over 20,000 people and spread to more countries(11), thus almost half a billion dollars is needed to overcome the outbreak.(11)

Emerging but neglected diseases (ENDs) are in two major categories of emerging infections—newly emerging and reemerging infectious diseases. These can be defined, respectively, as diseases that are recognized in the human host for the first time; and diseases that historically have infected humans, but continue to appear in new locations or in drug-resistant forms, or that reappear after apparent control or elimination (12). Emerging/ reemerging infections may exhibit successive stages of emergence. These stages include adaptation to a new host(13) , an epidemic/ pathogenic stage, an endemic stage, and a fully adapted stage in which the organism may become nonpathogenic and potentially even beneficial to the new host (e.g., the human gut microbiome) or stably integrated into the host genome (e.g., as endogenous retroviruses). Although these successive stages characterize the evolution of certain microbial agents more than others, they nevertheless can provide a useful framework for understanding many of the dynamic relationships between microorganisms, human hosts, and the environment. Table 1. Shows some Emerging disease of public health importance.

Table 1. Newly discovered microbes of public health importance

Year	Microbes	Disease
1975	Parvovirus B-19	Fifth disease
1976	<i>Cryptosporidium parvum</i>	Cryptosporidiosis
1977	Ebola Virus	Ebola Hemorrhagic fever
1977	<i>Legionella pneumophila</i>	<i>Legionnaires disease</i>
1977	<i>Hantaan virus</i>	Korean hemorrhagic fever
1977	<i>Campylobacter jejuni</i>	Gastroenteritis (food poisoning)
1980	Human T- lymphotropic virus I (HTLV-I)	T-cell leukemia/lymphoma
1981	Toxin producing strains of <i>staphylococcus aureus</i> (<i>golden staph</i>)	Various infection
1982	<i>Escherichia coli</i> 015: H7	Food poisoning
1982	HTLV-II	Lymphoma
1982	<i>Borrelia burgdorferi</i>	Lyme disease
1983	Human immunodeficiency virus	AIDS
1983	<i>Helicobacter pylori</i>	Duodenal and gastric ulcer
1985	<i>Enterocytozoon bieneusi</i>	Microsporidiosis diarrhoea
1986	<i>Cyclopora cayatanensis</i>	Diarrhoea
1988	Hepatitis E virus	Hepatitis
1989	<i>Ehrlichia chaffeensis</i>	<i>Human monocytic Ehrlichiosis</i>
1989	Hepatitis C virus	Liver cancer (hepatocellular carcinoma)

1991	Guanarito virus	Venezuelan haemorrhagic fever
1991	<i>Encephalitozoon hellem</i>
1991	New species of <i>Babesia</i>	Babesiosis haemolytic disease
1992	<i>Vibrio cholerae</i> 0139	Cholera
1992	<i>Bartonella henselae</i>	Bacteremia, endocarditis, bacillary angiomas and peliosis hepatis
1993	Sin nombre virus	Hantavirus cardiopulmonary syndrome (HCI) aka four corners virus or Navajo flu
1993	<i>Encephalitozoon cuniculi</i>
1994	Sabia virus
1995	Human herpes virus 8(HHV-8)	Kaposi sarcoma
1999	Nipah Virus*
2002	SARA coronavirus*	Severe acute respiratory syndrome
2003	Influenza A (H5N1)*	Avian influenza
2009	Influenza A(H1N1)	Swine flu
2012	Novel coronavirus	Severe respiratory infection

Adapted from WHO, 2005

* First identified in Asia

Within the Emerging but neglected diseases (ENDs), are also the Neglected Tropical Diseases (NTDs). The NTDs are a group of diseases, mostly of zoonotic origins and related conditions that plaques the world’s poorest people (14). These diseases are the most common diseases of the 2.7 billion people globally who live on less than US\$2 per day (15). Despite the substantial disease burden they impose, NTDs have largely been ignored in the global health architecture until recently. Social stigma, prejudice, marginalization and the extreme poverty of afflicted populations are among the factors contributing to the neglect of these diseases. Lack of funding for the prevention and treatment of these diseases is also a contributing factor (16). Out of more than seventeen

NTDs, seven attract most attention because of their high prevalence and amenability to control worldwide (17). These are the soil-transmitted helminth infections (hookworm, ascariasis, and trichuriasis); lymphatic filariasis; schistosomiasis; trachoma and onchocerciasis (17). Globally, 600–800 million people have soil-transmitted helminth infections(17) [5], 200 million people are infected with schistosomiasis, and 120 million with lymphatic filariasis in 83 countries(17,18). Onchocerciasis affects nearly 37 million people in 34 countries, and is most abundant in Africa, with small foci in southern and Central America (19), while trachoma affects 84 million people globally (16).. Roughly 534,000 are killed by an NTD annually (Table 2).

Table 2. Estimated Prevalence of and Deaths Caused by 12 Most Common NTD

Disease	Prevalence (millions)	Annual deaths	Most Afflicted Region
Soil- transmitted helminthes			
Ascariasis (roundworm)	807	3,000 60,000	South and East Asia/Pacific, Latin America, and sub Saharan Africa
Tricuriasiss	604	3,000 10,000	South and East Asia/Pacific, Latin America, and sub Saharan Africa
Hookworm	576	3,000 65,000	South and East Asia/Pacific, Latin America, and sub Saharan Africa
Schistosomiasis	207	150,000 200,000	Latin America and sub Saharan Africa
Lymphatic filariasis (elephantiasis)	120	<500	South and East Asia/Pacific ,and sub

Dengue fever	50	12500	Saharan Africa Tropical region
Trachoma	84	<500	East Asia/Pacific ,Latin America, Middle/ East North Africa and sub-Saharan Africa
Onchocerciasis(river blindness)	37	<500	Latin America and sub Saharan Africa
Lesmaniasis	12	51,000	South Asia Latin America and sub Saharan Africa
Chagas Disease	8.5	14000	Latin America
Laprosy	0.4	6,000	India, Latin America, and sub Saharan Africa
Human African Trypanosomiasis (Sleeping sickness)	0.3	48,000	Sub Saharan Africa
Buruli Ulcer	0.05	unknown	Sub Saharan Africa
Dracunculiasis (guinea worm)	0.01	unknown	Sub Saharan Africa

1.2 Impact of emerging but neglected tropical diseases

NTDs can have terrible social and economic consequences, as well as a major impact on the health and well-being of those infected. On the clinical side, trachoma, for example, can lead to redness and swelling of the eye, sensitivity to light, corneal scarring, and eventually permanent blindness. Schistosomiasis is associated with painful and/or bloody urination, bloody diarrhea, enlargement of the liver and/or spleen, and liver cancer; it is also the most deadly of the NTDs. Lymphatic filariasis is well known for the horrible swelling it can cause of the extremities. Onchocerciasis leads to skin problems and can also lead to blindness (20).

The helminthic infections are generally associated with abdominal pain, loss of appetite, malnutrition, diarrhea, and anemia. In addition, chronic helminthic infection in children can limit the physical and mental development of the child. Pregnant women with hookworm are at high risk of giving birth to low birth-weight babies, of poor milk production, and of birthing babies who fail to thrive. In addition, pregnant women with anemia, commonly caused in low-income countries by hookworm, are three and a half times more likely to die during childbirth than women who are not anemic. This risk is especially significant for pregnant women in sub-Saharan Africa—a quarter to a third of them are infected with hookworm (21). Whipworm can also lead to severe growth retardation in children.

NTDs by themselves not only have enormous effects on individuals but also worsen the effects of other major infectious diseases or make individuals more susceptible to them. Recent studies have shown that people infected with genital schistosomiasis has an increase susceptibility to becoming infected with HIV(22). Neglected tropical diseases are also associated with the onset of some chronic noncommunicable diseases, such as the bladder cancer associated with urinary schistosomiasis(23).

Social stigma is a major consequence of the NTDs. Many of the NTDs cause disability and disfigurement, resulting in individuals being shunned by their families and their communities. When not treated, for example, leprosy can cause terrible skin lesions that have been stigmatized since biblical times. Few health conditions are as stigmatizing as the swelling of limbs and genitalia that can result from lymphatic filariasis. Individuals who are stigmatized are less likely to leave their homes to seek diagnosis and treatment. Social stigma is particularly demoralizing for young women because they are often left unmarried and unable to work, in settings where the social “value” of a woman has much to do with her marital status.

NTDs also have a major impact on the productivity of individuals and the economic prospects of communities and nations. Children are disproportionately affected by NTDs and often suffer long-term consequences from them. Hookworm

infection in school-age children contributes in some areas to drops in school attendance by greater than 20 percent and poor school attendance and poor school performance reduce future earnings. In fact, hookworm has been shown to reduce future wage earning capacity in some affected areas by up to 43 percent (24)

NTDs adversely affect economic productivity at the individual, family, community, and national levels. NTDs lead to important losses in income that cause some families to sell assets to try to stay financially solvent. In addition, regions severely affected by onchocerciasis often cannot be used effectively for economic activities such as farming, since families that try to live in these areas are at risk of being blinded by the disease. Trachoma alone has been shown to contribute annually to an estimated \$2.9 billion loss in productivity worldwide (25)

2.0 Factors in Africa leading to diseases localization

Several factors result in disease localization in Africa. Factors that would be addressed include political instabilities, economic conditions, social conditions, technological factors, climate conditions and finally the education factor. For instance, in Africa, where there is a close and unmonitored proximity relation of humans and animal species, endemic zoonoses prevail to a great extent hence most occurring emerging diseases in Africa are zoonoses. e.g. Hantavirus and Ebola. Reasons are that, inter human-animal species relations are less monitored, there is rare implementation of sustainable control measures for zoonoses, lack of diagnostic techniques and surveillance institutions to curb zoonoses and those available are less supported by government. Apart from a remnant of newly emerging zoonoses like Ebola that has drawn the attention of the World Health Organization (WHO), most endemic zoonoses are neglected. Zoonoses not only affect the health of the poor population but also the economy of livestock farmers. It generally has a negative global impact and should however not be underestimated through under-

reporting, leading to the neglect of their global burden hence fewer funding agencies attracted (26). Other factors aside unrestricted relation with animals –leading to zoonotic infections- are addressed below.

2.1 Economic conditions

Approximately one and half of the 800 million people living in Africa fall below the World Bank poverty level. This high poverty rate of Africans is reflected in their standard of living. Developing children in poor countries are susceptible to malnutrition, anemia and diseases related to food contamination. They are normally stunted in growth and are of low intelligence. Other common such as helminthes like guinea worm, hookworm, schistosomiasis, ochocerciasis, are prone to poor populations. Also amongst pregnant and adolescent women, anemia is a common disease due to lack of balanced diet intake to make up for blood loss through menstruations. Increased maternal morbidity is therefore at a higher occurrence primarily due to anemia. Other emerging diseases on the rise due to the poor economy of African countries are HIV/AIDS which is spread at a quicker pace in Africa mostly due to economic influences like prostitution, the need to share sharp equipments in a family, etc. another emerging and neglected disease is Cholera, which is a disease caused by the intake of contaminated food or water. People found in rich countries barely drink contaminated river waters. However, the poor economic status of some African populations leaves them with little option when it comes to drinking contaminated river water. Moreover, the hot adverse condition also decreases the available water and concentrates the parasites in the rivers. Managing of these diseases is therefore a difficult challenge due to poor economic status hence most emerging and infectious diseases are localized in Africa (27).

2.2. Technological factors

Most of these emerging and neglected infectious diseases were previously associated with rich countries as well. However

due to advancement in technology, effective implementation of prophylaxis measures, improved sanitation and more innovative ways of confining and treating infectious diseases that could pose future problems, advanced continents have successfully eradicated these diseases. Through technological application of improved and more specific laboratory machines, improved communication systems and hence effective public education, etc. most of the diseases were curtailed. Africa however hasn't seen much of these developments and therefore efforts to eradicate diseases are if not impossible, highly unlikely (28).

Typical of diseases prevailing due to poor technology is brucellosis. It records the highest incidence in livestock productions and rampant among populations whose major occupation is pastoral farming. In 2002, high incidence was observed in Kampala, Uganda, where it was contracted through consumptions of improperly pasteurized raw milk due to lack of technological mechanisms. Successful eradication programs like the use of effective vaccines for livestock control of infection in animals and efficient pasteurization procedures were implemented in developed countries over a prolonged period and with an established monitoring system to study progress. Consequently, brucellosis was eradicated in rich countries due to technological advancements. However in Africa due to inadequate technologically advanced infrastructures and lack of funds, eradication processes has failed for brucellosis and has led to its negligence (29).

2.3. Educational factors

Notion of Africans consequently resulting in their actions is probably the most important factor to be addressed when it comes to localized diseases. A proportion of Africans lack education in health related issues especially those that involve either replacing the advice of native practitioners or going contrary to perceptions created by the many African customs. Certain customary activities undertaken due to native beliefs of Africans could be at the expense of their health. Hence, the

most challenging problem to address by health institution services does not reside in engineering anti-epidemic measures, rather in convincing most uneducated Africans into adopting the practices of personal hygiene in their everyday social lives. For instance in performance of female genital mutilations, certain sharp tools utilized can transmit HIV and certain spiritual directions involve the intake of contaminated river waters, etc. diseases like typhoid and cholera for instance can be contracted. Over a 3 month period in 1997 outbreaks of Cholera was observed in Kenya & Tanzania with over 400 killed, similar cases were reported in 2000 in the Federated States of Micronesia with 954 cases and 9 deaths, Somalia recorded 2,232 cases with 230 deaths and Madagascar recorded 15,173 cases with 860 deaths. The bacterium *Vibrio cholera* is found in the feces of houseflies which when released on food leads to food contamination and subsequently the acute infection cholera when consumed. Transmission is therefore a result of unsanitary conditions, sometimes influenced by some African customs, which can be addressed through personal hygiene (30).

Therefore to eliminate emerging and neglected African diseases, sanitary and health institutions should implement strategies to educate the public of the health hazards associated with certain domestic practices. This education procedures should be standardized and yet outline clearly, basic personal hygiene practices, prophylaxis practices, relevance of vaccinations, and also create a general awareness of available diseases especially emerging and neglected ones.

2.4. Political factors

Primarily, political instabilities caused by Coup d'états, tribal wars, civil wars etc. and others that has taken place in Africa for a long time has retarded development. Instabilities in governments and damages incurred during wars have led to the loss of resources during these situations and channeling of resources to curb them –which could be used to improve upon standard of living of people, embark upon scientific projects, health researches etc. Moreover, unfavorable conditions created for citizens during wars like drinking of impure water

to survive, striving for shelter and hence congestion in small rooms, injuries incurred which can lead to bacterial infections (tetanus, *Clostridium perfringes*, etc.), highly polluted environment, uncleanliness of individuals, rapes, etc. resulting from political disorderliness, leads to the spread of several diseases. Political instabilities not only slow down nation building but also cause several infections(31)

Another political aspect leading to long term disease localization in Africa is due to political prioritization. It is realized that the financial status of the population suffering the diseases could either prompt international interest or not. Diseases believed to threaten countries or populations of rich caliber are more likely to prompt health organizations or international health bodies' interests, to aid in their immediate eradication. Moreover, pharmaceutical companies are likely to view these diseases as a vantage point for sales and therefore make efforts to engineer drugs to eradicate it. Africa, which has been marked as economically poor worldwide, therefore gains little attention to its emerging diseases which are of 'low priority', hence most disease localized within the continent. Lack of international support due to political prioritization is responsible for most emerging diseases. For instance, due to immigrations and international travelling purposes, the WHO aided Africa by delivering technologically advanced vaccines of poliomyelitis which subsequently decreased its prevalence. Likewise Ebola was given attention because, there was the likelihood of the virus crossing continental borders to rich countries and quick measures had to be implemented.

Finally, politically, tropical Africa diseases are neglected because these diseases are not found to pose threats to developed countries hence less interest mobilized to eradicate them. An example of emerging and neglected disease is African trypanosomiasis which is spread by the bite of a tsetse fly. This vector inhabits mostly in tropical countries in Africa. Every year, the World Health Organization (WHO) estimates that almost 450,000 cases occur. If left untreated after its acute stage, it results in irreversible neurological destruction, and then death. This is a very fatal disease and its eradication

should of concern to the world. However since sandfly is mostly localized in Africa, its effect is less felt on rich countries and hence African trypanosomiasis is neglected (32).

Leishmaniasis is another disease of such caliber. Its vector is the sandfly located in tropical countries in Africa. Several strains have been isolated with their different effects yet since it's of little concern to rich people; it has also been neglected internationally to an extent. Approximately 12 million cases of leishmaniasis are recorded to exist today (33).

2.5. Climate conditions

Hot climate conditions and low rainfall patterns as realized in Africa due to geographic location, decrease the water availability and thereby increase the concentration of parasites present in water bodies since the lower the volume, the higher the concentration. Moreover, in these poor countries, water sanitation especially is less ensured due to less improved water treatment facilities, poor sewage treatment, improper sewage waste disposal mechanisms, poor drainage systems, etc. decreased water available promotes harmful processes like the use of waste contaminated waters for irrigation purposes on farms (especially vegetable farms), contaminated water available to domestic animals which can lead to zoonotic diseases, bathing and drinking of contaminated waters by individuals, generally low personal hygiene , etc. These processes amongst others consequently initiates seasonal outbreak of water borne diseases which form a significant proportion of emerging and neglected diseases in these poor African regions. The WHO has estimated that environmental factors contribute approximately 94 percent of the 4 billion cases of diarrhea associated diseases that occur yearly in the global world. An approximate value of 31, 000 children in low-income nations die from diarrhea diseases making a relative value of 4,500 mortalities per day. It is therefore recognized as a major global burden. Current studies have shown that extreme weather conditions substantially influences the incidence of diarrheal diseases in Sub Saharan Africa where cholera is predominantly the cause of childhood hospitalization.

Secondly, the warm Climate condition in Africa favors the growth and development of most vectors, reservoirs or carriers of various diseases making them increase in population hence difficult to be completely eradicated out of the system. Most of these emerging and neglected diseases are localized because their vectors, reservoirs or carriers are found mostly in Africa due to the favorable climate conditions they require for existence. An emerging and neglected disease like Onchocerciasis is caused by *onchocerca volvulus* which is a nematode found in the simulium black fly. Due to climate conditions, this fly is localized mostly in Africa where it can survive. Another example is in the tsetse fly responsible for African trypanosomiasis (34).

3.0 Some diagnostic mechanisms of ENDs

Currently, there has been a substantial upgrade in diagnostic procedures employed worldwide in disease identification like the introduction of new technologies by advanced countries such as thermocyclers, PCR, NMR, electron microscopes, spectrophotometers, MRI devices etc., intense pathological study of diseases even at the molecular level, wider knowledge obtained about the anatomy and physiology of humans etc. Laboratories in advanced nation's therefore diagnose diseases with more specific and sensitive approaches including proteomics, enzyme immunoassay, advanced serology based assays, etc. in addition to the usual clinical symptoms, geographic location of patient, clinical history, and travel history they require. Modernized diagnostic techniques enable technicians identify the distinct stages of infection- acute, latent, past and reactivated infections- and are effective for prognosis where therapy response by patient is to be monitored (35)

However these researches undertaken and technological devices are not widely employed in health facilities resident in Africa. This is primarily due to poor financial status of their economies and lack of expertise by trained medical practitioners who mostly utilizes ancient, time consuming, labor intensive and less accurate diagnostic procedures.

Disease diagnosis and consequent drug engineering to localize and cure disease infections are however less credible. Moreover, effective prophylaxis cannot be ensured in Africa due to high incomppliance of patients (36).

3.1. Microscopy

Diagnosis by microscopy requires the direct observation of blood smears, feces, bone marrow, cerebrospinal fluid, urine, biopsy tissue specimens and lymph node aspirates of patients under the microscope primarily to visualize the presence of causative agents like parasites or abnormal cells and if possible count them. Here, light is passed through the prepared sample and focused on the objective lens which magnifies it onto the ocular lens for images to be perceived. Resolving and magnifying powers of different microscopes differ. Its usage however requires expertise and training. Most laboratory technicians currently employ a variety of light microscopes in their work; bright-field, dark-field, phase-contrast, and fluorescence microscopes are most commonly used. However, modern microscopes are all compound microscopes where the magnified image formed by the objective lens is further enlarged by one or more additional lenses providing better resolution and magnification. Microscopy requires sample preparation which can be labor intensive, time consuming and increase the occurrence of erroneous readings. Accurate diagnosis through observation requires the expertise of qualified lab technicians and sometimes proofreading by second and third observers since misdiagnosis is frequent, which will negatively affect the patient during drug administration. Emerging diseases like intestinal helminth infections are diagnosed solely by microscopy and it's used in confirmation of other parasitic diseases after positive preliminary readings are recorded in serology based assay (35)

3.2. Serology Based Diagnosis

Where tissues or biological specimens from the patient are not available, this method of diagnosis proves to be the standard. This form of diagnosis is based on specificities of antigen-antibody affinities and employs its procedure. It is mostly

referred to as Enzyme linked Immunosorbent Assay test (ELISA) and can be spilt in dot-ELISA and Falcon assay screening test (FAST-ELISA). Serology based assays are more specific and sensitive due to the specificities of enzymes for their substrates and are better options especially in tests where there is difficulty in distinguishing between parasites as observed with Plasmodium and Babesia, tests where patients show low-parasitemia and in asymptomatic conditions such as Chagasic patients, Fasciola infections like chronic fascioliasis when there is less spore formations. Serology based assays is therefore another means of disease diagnosis

3.2.1. Falcon Assay Screening Test ELISA (FAST-ELISA)

Unlike the dot-ELISA procedures, it makes use of synthetic and recombinant peptides in determining the presence of antigens. This assay technique has been utilized to study malaria, schistosomiasis, fascioliasis and taeniasis in the past but due to some probable drawbacks, its use has been limited. A major drawback is that an antibody synthesized purposely for a specific antigen might provide positive reading due to cross reactions with proteins from other present species. Hence lack of specificity(35)

3.2.2. Dot-ELISA

Here, nitrocellulose paper forms the matrix onto which the target antigen would be trapped for interactions if any. After passing of the analyte through the paper, an enzyme-conjugated protein (chromogen) would also be passed through just as in immunoblot. This would be observed for the formation of a chromophore if there is binding of the antibody to an antigen and would be shown as a visual color on the nitrocellulose paper which indicates a positive reading. The use of nitrocellulose paper as the matrix support appears to be a more specific and sensitive approach since it traps firmly antigens present in analyte if any. It is therefore still extensively used in diagnosis of various diseases like

leishmaniasis, echinococcosis, toxocariasis, trichinosis, etc (37).

3.3. Rapid Antigen Detection System (RDTS)

In most laboratories, RDTS serves as an additional test to microscopy in the diagnosis of malaria. Its technique is based on immunochromatography. In RDTS, a nitrocellulose strip is adhered to specific antibodies which will be embedded in the nitrocellulose matrix. A drop of patient's blood sample is then applied and using a buffer solution, it is eluted from the strip. If antigens are present in the blood sample, they will complex with the antibodies embedded on the strip and be visualized either by spraying with a chromophore or by the use of other techniques. This diagnostic procedure is very useful in differentiating the different plasmodium strains of malaria available. It identifies *P. falciparum* and *P. vivax* strains but cannot identify *P. ovale* and *P. malariae*. Malaria RDT's are however provided by World Health Organization (WHO) to African countries to reduce misdiagnosis of the malaria disease (35).

3.4. Molecular-Based Diagnostic Approaches

This is currently the most accurate means of disease diagnosis. It overcomes all odds in microscopy and serology based approaches. With molecular based approaches, blood samples with least spores can be diagnosed and those with asymptomatic strains can be identified as well as specific parasitic infection of interest can be specifically identified without the interference of other parasites which might be present during the test. This technique makes use of gene amplification with the help of the polymerase chain reaction (PCR). Detection of sequence of genes of parasite DNA has made their artificial synthesis in molecular laboratories possible as well as their intense manipulation to know drastic measures to destroy their pathogenic nature. Modernized PCR techniques like Real time PCR, inverse PCR, etc. have made parasitic disease diagnosis even more accurate (38).

4.0. Challenges confronted in diagnosis in Africa

In eradicating neglected and infectious diseases, it is an important priority to address challenges in diagnostic techniques or processes to subsequently identify and eliminate these infections since a problem addressed is half redressed. In Africa where health resources are limited, educational level of citizens is relatively low, investment funds are scarce and poverty rate is high, numerous challenges and risks confront health organizations in diagnosing disease strains. Efforts of WHO and global health organizations to eradicate emerging diseases are also undermined to a large extent by several factors, some of which are addressed below.

4.1. Inadequate resources

In order to assume fewer risks, most global health firms including multinational pharmaceutical companies, assign investments to rich countries where they upgrade and improve upon disease diagnostic techniques. However, since these diseases occur among individuals falling within the poverty zone as defined by the WHO, resources available for use pose a great challenge in diagnostic testing since they are less modernized and inadequate. Facilities for diagnosis in medicine are however better in advanced countries than in the poor African countries. Due to the rich economy of these countries, they are able to mass better diagnostic mechanisms and easily study the pathology of these infections in order to affect diagnosis and further eradication of emerging diseases. Moreover, their better diagnostic mechanisms make the process faster especially for tests that require fast immediate assays. This not only makes efficient the process but the process is more accurate due to less room created to introduce errors (26).

Most importantly, to diagnose certain diseases like Malaria: where different species of the parasite exists, the particular strain of parasite should be identified before effective diagnosis and cure can be ensured. There are four different species of the genus *Plasmodium* that causes malaria in humans. They include *P. falciparum*, *P. vivax*, *P. malariae* and *P. ovale*. Antigens therefore produced by these parasites also differ not only amongst them but from region to region.

Rapid Diagnostic Test (RDT) which has been recommended by WHO for prompt diagnosis of malaria has different specificities for the different parasites. Medical diagnostic opinion of specialist can easily be misled leading to misdiagnosis since a negative indication by an RDT cassette could not actually mean an absence of plasmodium species in the blood sample. The designed malaria RDTs detect the antigens based on the measure of various metabolites. Most of which are produced during the parasitic life cycle of the parasite in the individual. Some include:

- The histidine-rich protein 2 (HRP2) content in blood
- Various subtypes of Plasmodium Lactate Dehydrogenase (pLDH) in blood
- Presence of Aldolase

For instance, a specific test for *P. falciparum* which is the most virulent amongst the species requires an RDT that measures the HRP2 content of blood since it is produced by only this parasite. RDT's that targets Aldolase as analyte can be used as a general test for human plasmodium parasites since this metabolite is produced by all plasmodium species. Knowing the plasmodium specie of interest therefore enable medical practitioners identify the RDT cassette to use. Normally the most prevalent and virulent plasmodium specie *P. falciparum* is of interest to specialists. However, to avoid misdiagnosis in RDT use, this specie should primarily be identified as the prevalent specie within the locality through advanced diagnostic procedures like molecular assays.

Aside less appropriate diagnostic tools which lead to misdiagnosis, other resources like clinical infrastructures (clinics, research pharmacies, certified clinical laboratories, etc.) required for research in emerging neglected diseases as well as trained research personnels are few. During the early stages of disease emergence, these are very critical assets needed for diagnosis, accurate chemistry evaluations and early eradication of disease before endemic results. However, in most cases this is not so until an endemic results and WHO sets in. Amongst other factors, a great challenge posed by medical practitioners in an attempt to eradicate the Ebola virus

was the limited well advanced research organizations and clinical laboratories available in Sudan. In African countries therefore, it is very difficult to diagnose emerging diseases and easy to neglect them due to lack of adequate infrastructures.

4.2. Inadequacy of specialized medical practitioners

Specialists available in African countries to partake in most critical disease diagnosis are very few. This decreases the ratio of health technician to patients. The lower the ratio, the less effective the procedures since most of the processes are rushed and instances where positive are to be recorded is recorded negative. Moreover most of the locally trained technicians available have little understanding of the physiology of pathogens since little research study has been undertaken on these parasites by the technicians. Evolution and adaptation of parasite strains with time has made ancient means of diagnosing and combating them less effective. Locally trained practitioners with little knowledge of modern diagnostic innovations, therefore make wrong diagnosis which makes eradication of the diseases very difficult. An emerging disease like Malaria evolved in most continents as an epidemic disease during the early 1940's but with time, it was successfully eradicated by all but Africa. A contributing factor was as a result of available specialists who handled the diagnosis of the emerging infectious diseases and therefore effectively eradicated the available strains (29).

4.3. Incompliance of citizens

Incompliance of patients during diagnosis makes it difficult to acquire information and make correct inferences. Moreover most diseases to be reported to health institutions for early diagnosis at their acute or febrile stages (as in Malaria) are not reported. Inevitably, diseases reach their infectious stages and spread throughout the population before there is the notification of health personnels. It is very difficult in African countries to hospitalize all sick patients of a particular endemic and treat them since some of them hold on to contrary custom beliefs and barely cooperate with these health

personnels to make more effective the diagnosis process. Some citizens refuse to take instructions from these health personnels especially those that require them to go against their norms, making it difficult to confirm with certainty the diseases present. Emerging diseases are therefore difficult to be eradicated in Africa due to incompliance of patients and their cultural beliefs (34).

4.4. Lack of motivation of health personnel's by government

In attempt to ensure sustainable access to efficient disease diagnosis for its people, health personnels in Africa faces diverse challenges which could arise due to inadequate resources, inadequacy of specialized medical practitioners and incompliance of African citizens but with motivation, these personnels could go beyond all odds and ensure efficient diagnosis and disease treatment. Unfortunately, this is not the case. Health personnels available are less motivated by government. Most developed nation governments donate incentives and other motivational rewards to researches and projects undertaken to eradicate diseases. Medical personnels responsible for submerging diseases that emerged were rewarded and appreciated. In Africa however, this is not so. Politically, the nation's finances are used in campaigning and other businesses to maintain the ruling government in power. Relatively fewer projects in the health sectors are therefore being undertaken by in African countries due to less motivation from local governments (39).

4.4. Economic status of Africans

The poverty aspect of Africans is a great impediment when it comes to disease diagnosis. Financial status of Africans not only does not serve as a motivation to health personnels to know more about the disease, but also it limits the patients to the tests and hospitalization if required due to cost. Moreover, due to this economic status, they find it difficult to adhere to certain ultimatums given them by health personnels in order to affect efficient diagnosis since some diagnostic procedures

require monitored observation of patients under given conditions with time in order to conclude confidently on the disease at hand. Managing of the disease is therefore highly impossible in Africa due to the financial requirements of the people and more importantly, disease diagnosis is limited with poor economic status of Africans (34).

5.0. Prospects

Interestingly, effective treatment and control mechanisms are available to eradicate these neglected infectious diseases. However, the issue lies in adopting or channeling these interventional methods to where they are most required: primarily poor and developing regions of Sub Saharan Africa where the health implications of these diseases are massive and little attention is offered by healthcare organizations. In spite of logistical challenges, most emerging and neglected diseases have been successfully combated in recent years, hence the optimistic urge of the possibility to control, eradicate and eliminate most of them. The WHO together with other global health bodies is helping make these available opportunities accessible to most poor countries. In 2000 for instance, due to the approximate figure of 120 million people who were reported to have been infected with lymphatic filariasis (elephantiasis), a parasitic disease spread by the culex mosquitoes, 2.7 billion treatments were issued out to effect eradication by the WHO. In the case of dracunculiasis (guinea worm disease), another reported neglected and emerging disease caused by drinking water contaminated with the water flea, effective diagnostic procedures and control measures were implemented in four countries which caused a sharp fall to just 541 patients in 2012 unlike records of high historic occurrences.

Progress observed in lymphatic filariasis, dracunculiasis and other emerging diseases is mainly attributed to global alliances who distribute drugs donated by GlaxoSmithKline, Merck and Eisai pharmaceutical companies. In spite of the economic incentives involved, these pharmaceutical companies have

philanthropically increased their donations within the past years, to support research and develop new technologically advanced tools to diagnose and fight against neglected and emerging diseases. Studying the trend of disease occurrences in the past years showed that, if these diseases are prioritized, and with collaborative, innovative and sustained mechanisms by global organizations and the WHO, they can be eradicated.

The larger the scale of efforts from health bodies, the more effective the process. Hence in January 2012, global health institutions coalesced with 13 pharmaceutical companies, the governments of the United States, United Arab Emirates, United Kingdom, and the World Bank to eliminate 10 emerging and neglected diseases occurring in tropical countries within the next decade.

Diagnosis and subsequent eradication of emerging and neglected diseases in African countries should be of prime concern to WHO and African health organizations because, not only is it a burden on the continent but it keeps the majority of its citizens below the WHO poverty line. This is because, emerging and neglected diseases increase the sick population hence decreases the agricultural labor force, causes economic loss, lowers productivity of a nation, and consequently leads to poverty (40). In curbing challenges confronted during diagnosis of these diseases, future prospects to be undertaken are outlined below.

5.1. Developmental progress in the health sector

The health sectors of African countries need to be boosted with more clinics and scientific research infrastructures. Equipments and machines required for effective diagnosis of different parasitic strains of emerging and neglected diseases should be installed. This is possible because innovative methods of disease diagnosis are currently running in developed countries to meet up with the rapid mutating nature of disease strains. The health sector of the nation particularly government institutions should be equipped with these

updated machines and devices to enable efficiency and accuracy in disease diagnosis (41)

5.2. Improved and modernized diagnostic approaches

Instead of the ancient time consuming methods of diagnosing diseases like light microscopy, advanced proteomics and molecular based assays can be introduced into the health system to improve upon the sensitivity in the identification of diseases. Modern day technical and scientific methods can be employed to diagnose emerging and neglected tropical diseases to improve upon the accuracy of diagnosis.

Most misdiagnosis result from mechanical errors of devices used as well as manual mistakes of human activities which have been eliminated with the introduction of modern techniques. Also where prognosis is to be observed regularly, improved machineries are required. Emerging and neglected disease can also be curbed if the detection of these diseases in their acute stages is possible with the advanced technologies to prevent further damages from occurring and hence decreasing the mortality rate (41).

5.3. Government support

Government can greatly influence the degree at which these emerging diseases can be curbed by channeling resources and efforts into the eradication of these emanating diseases. Scholarships to train medical practitioners or specialists within and outside the country can be sponsored by government. Students trained outside are brought within the country to undertake effective projects and processes geared towards eradicating of these diseases. Also most importantly, majority of annual income and resources of the economy can be channeled into scientific projects to eradicate these diseases.

As part of the prospects to improve upon diagnostic techniques, there should be new approaches towards the elimination or control of emerging and neglected diseases, pharmaceutical companies should be more committed in drug provision, government should be more committed and prioritize these diseases and possibly include them in the

Millennium Development Goal (MDG) to be considered with maximum efforts. By this, diseases emerged and neglected in poor African countries should be addressed with high concern by the WHO. These diseases are great impediments to nation development as a result of their general socio economic, educational and health impacts. Their control and elimination should therefore be a mandate on member states of the WHO and regular reports should be addressed to the World Health Assembly concerning any progress observed (36).

5.4. Improved Education of Africans

Observations and analysis has realized that development of cheap and effective vaccines alone is no guarantee that total elimination of a disease will occur. However, proper disease diagnosis, and simple creating awareness through education about a diseases causes, preventive measures, diagnostic procedures could decrease endemic zoonoses occurrences. Governments of most African countries are expected to enact effective communication means like the media, general public lectures and basic classroom studies, where knowledge about emerging diseases can be relayed to the public. This can effectively help in eradication of emerging and neglected diseases (35).

6.0 Conclusion and recommendation

Emerging and neglected diseases represent a wide group of infectious parasitic diseases that tend to pose endemic threats in the present or near future and are normally common among people of low income countries. In Africa they are mostly zoonoses, helminth infections, water and food borne diseases. These diseases are emerging and neglected not only due to lack of resources to undertake projects and measures to eradicate them but primarily because, they occur within poor Africa populations where multinational pharmaceutical and health companies due to financial constrain barely undertake developmental projects and substantial scientific researches concerning diseases. Diagnostic techniques employed worldwide in identification of these diseases include, microscopy, serology based assays, RDTs and molecular

based assays amongst others. During diagnose of emerging and neglected diseases in Africa, certain challenges are confronted by laboratory technicians. These challenges arise due to inadequate resources, inadequacy of specialized medical practitioners, in compliance of citizens due to superstitious beliefs, etc. lack of motivation of health personnel's by government and poor economic status of Africans making diagnosis procedures less accurate and the tendency of misdiagnosis to set in. To eradicate these localized diseases, it is therefore expected that The WHO and allied health organizations should focus international funds into developing new technologically advanced diagnostic tools and make them broadly available for use in poor countries, there should be development in the health sectors of Africa nations, improved diagnostic techniques, government support and education of the public should be effectively carried out.

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