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Drinking Water in Nigeria: A Public Health Threat and Burden

by

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**The problems with drinking water encountered in underdeveloped countries are not new or unique. Governments that are unable to provide safe drinking water and other basic, fundamental public services are likely to experience outbreaks of infectious disease. Poverty is also a contributing factor to increased incidence of infectious disease among the population. All of these conditions can be mitigated with the efforts from the United States and the international community. Nigeria is a country suffering from the crippling burden of disease resulting from unsafe drinking water. The prevalent diseases of unsafe drinking water in Nigeria include cholera, guinea worm, hepatitis, and shigellosis. Additionally, the country is dealing with security issues and instability from religious squabbles between Muslims in the northern region of Nigeria and Christians in the southern region. The economic, political, social, and health-related problems faced by the population of Nigeria require intervention from the government of Nigeria as well as foreign stakeholders. United States Africa Command (AFRICOM) has the capability to influence and shape the continent of Africa, and Nigeria should be near top of the list of countries demanding priority. The US has vital national security interests in Nigeria that include petroleum products, counterterrorism, and ensure governmental stability that sets the example for other African nations. The mission of AFRICOM provides the mechanism and funding for appropriate action to mitigate the disease burden from unsafe drinking water in Nigeria. Based on the problems plaguing Nigeria, it is recommended that AFRICOM take the following intervention steps: develop educational training programs addressing waterborne diseases, work closely with the U.S. Embassy in Nigeria to provide direct support to the Nigerian government and military, and Mitigate unsafe drinking water and waterborne disease in Nigeria by working closely with inter-agencies, international organizations, and non-governmental organizations (NGO). viii**

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## **Preface**

The topic of “Drinking Water in Nigeria: A Public Health Threat and Burden” was selected based on my educational background and professional expertise. In addition to my background and expertise, I also have deployment experience dealing with unsafe drinking water in foreign countries, implementing mitigation strategies, and investigating disease outbreaks.

I would like to take this opportunity to thank the U.S. Navy and the medical leadership for providing me the chance to further my professional education and attain an advance degree. Additionally, I would like to thank my wife and children for supporting me during my time at Air Command and Staff College (ACSC), as well as supporting my career around the globe. The staff and instructors at ACSC have been outstanding and are building the foundations for superb future air-minded and joint leaders.



## **Abstract**

The problems with drinking water encountered in underdeveloped countries are not new or unique. Governments that are unable to provide safe drinking water and other basic, fundamental public services are likely to experience outbreaks of infectious disease. Poverty is also a contributing factor to increased incidence of infectious disease among the population. All of these conditions can be mitigated with the efforts from the United States and the international community.

Nigeria is a country suffering from the crippling burden of disease resulting from unsafe drinking water. The prevalent diseases of unsafe drinking water in Nigeria include cholera, guinea worm, hepatitis, and shigellosis. Additionally, the country is dealing with security issues and instability from religious squabbles between Muslims in the northern region of Nigeria and Christians in the southern region. The economic, political, social, and health-related problems faced by the population of Nigeria require intervention from the government of Nigeria as well as foreign stakeholders.

United States Africa Command (AFRICOM) has the capability to influence and shape the continent of Africa, and Nigeria should be near top of the list of countries demanding priority. The US has vital national security interests in Nigeria that include petroleum products, counter-terrorism, and ensure governmental stability that sets the example for other African nations. The mission of AFRICOM provides the mechanism and funding for appropriate action to mitigate the disease burden from unsafe drinking water in Nigeria.

Based on the problems plaguing Nigeria, it is recommended that AFRICOM take the following intervention steps: develop educational training programs addressing waterborne diseases, work closely with the U.S. Embassy in Nigeria to provide direct support to the Nigerian

government and military, and Mitigate unsafe drinking water and waterborne disease in Nigeria by working closely with inter-agencies, international organizations, and non-governmental organizations (NGO).

## **Introduction**

### **Research Question/Thesis Statement**

This research paper focuses on two questions. First, what are the major waterborne disease threats in Nigeria resulting from poor access to safe drinking water? Second, what steps can U.S. Africa Command (AFRICOM) take to mitigate these threats?

To mitigate the public threat and burden caused by waterborne diseases and unsafe drinking water in Nigeria, AFRICOM should develop waterborne disease awareness training programs for Nigerian public health and military organizations. Military assessment teams within Nigeria should provide technical expertise on water sanitation and disease surveillance and directly liaison with the U.S. Embassy staff. Coordination with inter-agencies, international organizations, and non-governmental organizations are necessary to develop solutions and provide financial assistance for poor water quality within Nigerian borders.

### **Background/Significance of Waterborne Disease and Unsafe Drinking Water**

Drinking water and access to safe drinking water sources eludes millions of people each and every day.<sup>1</sup> As a result, waterborne diseases have become a serious threat throughout the world, especially in underdeveloped nations with poor public health, sanitation, and water treatment infrastructures. The former Director-General of the World Health Organization (WHO), Dr. Lee Wong-jook, stated, "Water and sanitation is one of the primary drivers of public health. I often refer to it as 'Health 101', which means that once we can secure access to clean water and to adequate sanitation facilities for all people, irrespective of the difference in their living conditions, a huge battle against all kinds of diseases will be won."<sup>2</sup>

The Federal Republic of Nigeria (Nigeria, the short form, will be utilized in the context of the research paper) is the most populated nation in Africa with a population estimated near

140 million from the 2006 provisional census results.<sup>3</sup> After gaining its independence from Great Britain on October 1, 1960, Nigeria struggles to support its populace due to civil war, military coups and instability of the government infrastructure resulting in disease outbreaks, starvation, and hostilities. As a result of this instability and poor government infrastructure, Nigeria has an estimated 54% of its population without access to safe drinking water, which means more than 70 million people are exposed to non-potable water daily, which includes swimming, bathing, and laundry water sources.<sup>4</sup> Additionally, it is estimated that this exposure to non-potable water sources are as high as 69% of the population in rural areas of Nigeria.<sup>5</sup> Per United Nation's Children Fund (UNICEF)/WHO Joint Monitoring Program for Water Supply and Sanitation analysis on Nigeria, "The inadequacy of safe water to the entire population is manifested in the prevalence of water related diseases such as guinea worm, cholera, diarrhea, dysentery, etc."<sup>6</sup> These diseases have resulted in a public health threats and burdens on the Nigerian population that will be examined to determine mitigation strategies to prevent/eradicate the threats.

On October 1, 2008, AFRICOM became the newest geographic combatant command. The mission of AFRICOM is, "in concert with other U.S. government agencies and international partners, conducts sustained security engagement through military-to-military programs, military-sponsored activities, and other military operations as directed to promote a stable and secure African environment in support of U.S. foreign policy."<sup>7</sup> In addition to the mission of AFRICOM, the staff incorporates many inter-agencies, such as the State Department and U.S. Agency for International Development (USAID), that are involved in support throughout Africa, including Nigeria. The command also works with host nations and humanitarian organizations to provide solutions for foreign policy issues, which include public health threats.<sup>8</sup>

In lieu of interventions or mitigation strategies, the burden of waterborne diseases will continue to plague the Nigerian government and population. To promote health, the Nigerian government must follow WHO guidance, which states: “a clear understanding of the burden of disease and the effectiveness of alternative approaches to reduce this burden provides the basis for the development of effective intervention strategies.”<sup>9</sup> U.S. AFRICOM will be instrumental in providing assistance to the Nigerian government and military through interactions with the U.S. State Department and other inter-agencies/non-governmental organizations conducting operations in Nigeria. An example of this assistance is stated by AFRICOM in their partnership for counter-terrorism: “The overall goals are to enhance the indigenous capacities of governments in the Pan-Sahel (Mauritania, Mali, Chad, and Niger, as well as Nigeria and Senegal) to confront the challenge posed by terrorist organizations in the region.”<sup>10</sup>

### **Research Methodology**

This research utilizes the problem/solution methodology. By instituting this methodology, the research systematically defines the problem and explores proposed solutions. Statistical data is incorporated to substantiate the significance of the disease burden and display the access to safe drinking water throughout Nigeria. The problem is the public health threat stemming from the lack of access to safe drinking water, poor public health infrastructure, and the socio-economic problems plaguing Nigeria and sub-Saharan Africa. The solutions examined include mitigation strategies that the newly established AFRICOM should incorporate. This research paper provides background information on Nigeria, the impact of public health threats, and solutions that should be incorporated to prevent or eliminate the burden of disease. Solutions include awareness training, liaison teams to work with health officials and the Nigerian

military and international coordination to provide necessary funding. Although these solutions are specific, the context of this research will generalize recommended strategies for AFRICOM.

### **Study Limitations**

Resources and information utilized to answer the research questions and support the thesis are mainly attained from the World Health Organization (WHO), Centers for Disease Control (CDC), and USAID. These sources will provide the background information on status of drinking water and waterborne diseases prevalence in Nigeria, and mitigation strategies for preventing or eliminating the disease burden on the Nigerian population. Secondary sources will be employed to provide background information on Nigerian demographics, socio-economic status, public health infrastructure, and military background. The secondary sources will include the U.S. State Department, Central Intelligence Agency, and literary sources from Muir S. Fairchild Research Information Center (MSFRIC). Military doctrine and websites will provide information on the newly formed AFRICOM (pending new Unified Command Plan that incorporates newest geographic combatant command). The limitations to this research paper are the time constraints which prevent a more detailed study, the direct access to the Nigerian government ministry information and updated health statistics, and the lack of public health related resources at the Muir S. Fairchild Research Information Center (MSFRIC).

### **Nigeria**

“The U.N. Human Development Index ranks Nigeria as having one of the worst standards of living, below both Haiti and Bangladesh. For all its oil wealth, and after seven years of governance by one of Africa’s most highly touted democrats, Nigeria has become the largest failed state on earth.”<sup>11</sup>

## **Country Overview/Profile**

The Republic of Nigeria is a democratic nation located in sub-Saharan Africa with an Atlantic Ocean border. Compared with other African nations, Nigeria is relatively wealthy and ranked 2<sup>nd</sup> for economy on the continent.<sup>12</sup> This wealth is mainly due to its oil industry, which was first discovered in the country during the 1950's. Nigeria has a long and tumultuous history as detailed in the following paragraph.

The history of Nigeria dates back more than 11,000 years, when the first evidence of human civilization in the country was discovered. Highlights of its history include:

- The arrival of traders from Portugal (late 15<sup>th</sup> century)
- Slave trade outlawed by Great Britain (1807)
- Capital city of Lagos annexed by the British (1861)
- Nigeria unified into one state (1914)
- Nigeria becomes independent and a federal republic (1960-1963)
- Nigeria officially joins the Organization of the Petroleum Exporting Countries (OPEC) in 1971
- First official census conducted in the country (1991)
- Nigeria has its first satellite launched into orbit with the assistance of the Russian space program (2003).<sup>13</sup>

This history of Nigeria has impacted its current democracy and the violence, poverty, and corruption that plaques this failing state.

The landscape of Nigeria is quite diverse with low-lying coastal regions, swamps, rainforests, plateaus, rocky cliffs, grasslands, and desert sands in the northern region of the country.<sup>14</sup> The climate in Nigeria is not quite as diverse; the country typically experiences very

high temperatures year-round. There are three distinctly different climatic regions in the country, which are equatorial, semiarid, and tropical. The significance of the different climatic regions is evident in the population distribution in Figure 1. Majority of the Nigerian population is concentrated in the tropical and semiarid regions, which results in competition for potable water. Another important factor is the religious difference between the two regions: Muslim in the north (semiarid) and Christian in the south (tropical).

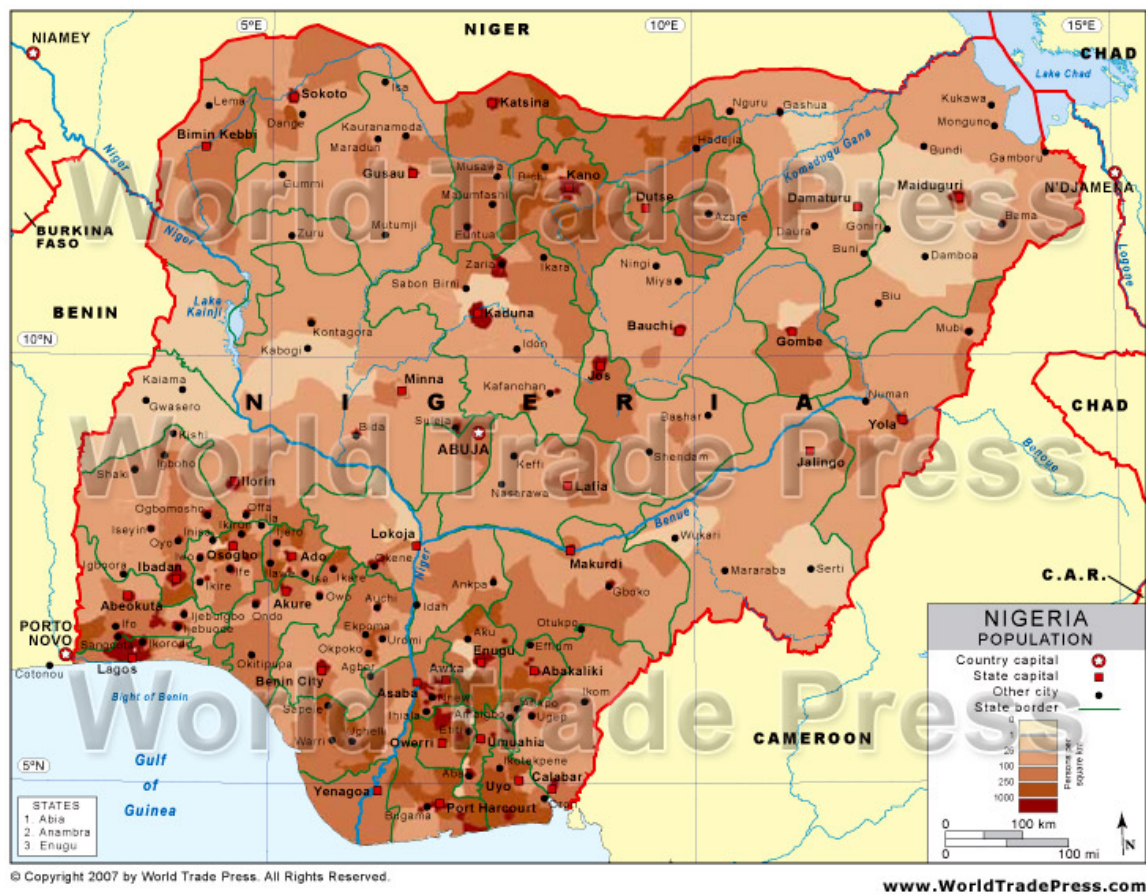


Figure 1 – Population Distribution Map of Nigeria<sup>15</sup>

Nigeria has the largest population in Africa and its distribution is displayed in Table 1. The total population fluctuates based on the statistical source, but the largest figure is estimated at 140 million according to that latest census conducted in 2006. The population distribution is



intended to demonstrate the breakdown by age. Age can potentially play a key role in disease prevalence. In addition to a large population, the country also has over 250 different ethnic groups.<sup>16</sup> The importance of the different ethnic groups is the unrest and violence between different groups; this places additional burdens on the government to maintain security and stability. A disease burden on any sort will only compound the strife within the country.

The country of Nigeria is considered a federation with the three basic tiers of government, which includes the state, local, and federal branches.<sup>17</sup> Since its independence in 1960 from Great Britain, the government of Nigeria has been ruled by the military with a few occasions of civilian rule during that period. In 1999, civilian rule gave the Nigerians a new opportunity to strengthen the infrastructure of its government and battle the owners' and local leaders' corruption from the oil revenues.<sup>18</sup>

The socioeconomic condition of Nigeria is the foundation of the public health and disease burden plaguing the population. Nigeria is a country rich in resources and export items, especially oil. The United States has a vital interest in the African nation for several reasons. The main reasons are Nigeria's oil production that yields 1.1 million barrels daily for the US, and the global war on terrorism. Because of Nigeria's large Muslim population, the US fears that it is a potential sanctuary and training ground for Islamic extremists.<sup>19</sup> This is a direct result of poverty, the same poverty which contributes to the public health and disease burden.

All of these aforementioned categories are contributing factors in the current drinking water problems in Nigeria. The Nigerian government has not demonstrated the ability to handle security and stability in the country; evidence is their current status as a near failed state.<sup>20</sup> There is a necessity for the United States to intervene with all of the instruments of power, and AFRICOM should be the vehicle for intervention on behalf of the administration.

Age Group	Males	%	Females	%	Both Sexes	%
0-4	10,981,454	16.5	10,465,581	15.7	21,447,035	16.1
5-9	11,026,101	16.6	10,655,036	16.0	21,681,137	16.3
10-14	8,690,928	13.1	7,978,620	12.0	16,669,548	12.5
15-19	6,771,495	10.2	7,187,409	10.8	13,958,904	10.5
20-24	4,955,558	7.4	6,515,001	9.8	11,470,559	8.6
25-29	4,941,258	7.4	5,991,179	9.0	10,932,437	8.2
30-34	4,199,472	6.3	4,643,053	7.0	8,842,525	6.6
35-39	3,299,721	5.0	3,002,462	4.5	6,302,183	4.7
40-44	2,947,341	4.4	2,803,090	4.2	5,750,430	4.3
45-49	2,026,152	3.0	1,587,311	2.4	3,613,463	2.7
50-54	2,076,314	3.1	1,767,553	2.7	3,843,868	2.9
55-59	954,501	1.4	719,782	1.1	1,674,283	1.3
60-64	1,343,891	2.0	1,183,563	1.8	2,527,453	1.9
65-69	610,850	0.9	579,242	0.9	1,190,092	0.8
70-74	735,918	1.1	589,284	0.9	1,325,202	1.0
75-79	292,245	0.4	233,802	0.4	526,047	0.4
80-84	385,851	0.6	332,873	0.5	718,723	0.5
85+	344,772	0.5	290,674	0.4	635,445	0.5
Total	66,583,821	100	66,525,514	100	133,109,335	100

Table 1 – 2005 Population Distribution by Age & Sex<sup>21</sup>

Poverty, weak government infrastructure, corruption, and the inability to provide the basic public services for the population contribute to the public health burden within the country. Author, Lisa Margonelli, makes the following recommendations regarding Nigeria and the need for intervention:

Before it was unidimensional – instability requires intervention. Now we need to look at more than one instrument of U.S. national power. We cannot address security without addressing development. We need a broader definition of security – welfare of the individual, physical security, and environmental protection. We need to coordinate peacekeeping, development, and capacity building. That hasn't happened in the past.<sup>22</sup>

AFRICOM will play a significant role in the stability and development of Nigeria, and ultimately the mitigation of unsafe drinking water. As stated by the Bush Administration, “In Africa, promise and opportunity sit side by side with disease, war, and desperate poverty.”<sup>23</sup>

### **Military Background**

The Nigerian military consists of three branches of service, which are the army, navy, and the air force. The total force of the Nigerian military is 80,000 on the active force, and 82,000 on the paramilitary force.<sup>24</sup> The government spends approximately 1% of its gross domestic product on the military forces and services.<sup>25</sup> This is substantial because it limits the amount of support and services provided to the general population. Nigeria spends a large portion of its GDP on its enormous debt accrued from decades of governmental economic mismanagement.<sup>26</sup>

The Nigerian army is the largest of the three main services comprising nearly 62,000 soldiers. The main roles of the Nigerian army are the armored divisions, mechanized divisions, the presidential guard, and air defense regiment.<sup>27</sup> Most of their equipment is modern, but limited due to the amount of funding available for sufficient supplies and replacement parts. Development of the army in stability and security operations is critical for the mitigation of the huge disease burden on the general population.

The Nigerian navy consists of approximately 8,000 sailors, which also includes their coast guard personnel. The main role of the Nigerian navy is to provide patrol and coastal combat and reconnaissance, mine warfare and countermeasures, amphibious operations, and

logistical support.<sup>28</sup> Their commands are strategically located along the coastline with two naval headquarters, two naval bases and a naval training school. Nigerian navy ships include frigates, patrol boats, and mine sweepers. In addition to the complement of ships, the navy also boasts a fleet of four helicopters. The Nigerian navy has the potential to play an important role in the mitigation strategies with AFRICOM, but the other services should lead based on available resources to provide support.

The Nigerian air force is the most operationally limited of the three branches of services. The air force consists of approximately 10,000 airmen and has the role of providing transport, training, and helicopter operations.<sup>29</sup> The fixed-wing assets of the air force have 75 combat capable fighter jets and transport planes.<sup>30</sup> Like the Nigerian navy, the air force will likely play an inferior role in intervention strategies with AFRICOM, but the air assets can be utilized for any support required. The main purpose of the air force is to provide air defense and presidential support, but these assets can be delegated by the government as required.<sup>31</sup>

The last source of military assets for Nigeria includes the approximately 82,000 paramilitary personnel. These personnel make up the coast guard (part of the navy as discussed earlier), the port security police consisting of 2,000 personnel, and 80,000 security and civil defense corps.<sup>32</sup> These paramilitary forces utilize armored personnel carriers, helicopters, aircraft, and boats to complete their mission. The paramilitary may be instrumental in implementing intervention strategies, and AFRICOM may be able to utilize their resources to meet the public service needs of the population, if available.

## **Purpose**

The main purpose of this paper is to identify the infectious disease threats caused by unsafe drinking water and the impact this may play on the population at risk. Nigeria is an

African country that is categorized as a near failing state that is unable to provide safe drinking water for its population.<sup>33</sup> With the newly formed AFRICOM, it is imperative that the United States uses all of its instruments of power to provide solutions for this lingering problem.

Nigeria is important to AFRICOM because of the following pillars of foreign policy:

- Support the spread of political freedom & strengthen democracies
- Reinforce African initiatives to end conflict and violent extremism
- Address the challenge of HIV/AIDS, TB, malaria and other diseases
- Expand economic opportunity and growth<sup>34</sup>

The first step that AFRICOM should take is the development of educational training programs addressing waterborne diseases. These training programs should be designed for Nigerian public health organizations and military. The importance of this training is that it can provide the general population with information for avoiding unsafe drinking water and the consequences of consuming unsafe water. Steps should be included on methods to produce potable water; funding is necessary to provide safe drinking water.

The second step for AFRICOM is to work closely with the U.S. Embassy in Nigeria to provide direct support to the Nigerian government. This support is in the form of liaison teams that working directly with public health organizations and the military to provide technical assistance on water sanitation and disease surveillance techniques. Although resources are limited and may not be readily available by the Nigerian government, the US State Department and AFRICOM should support the government in areas deemed necessary for maintaining the pillars mentioned above. The importance of supporting Nigeria is substantiated by Theresa Whalen's (Deputy Assistant Secretary of Defense for African Affairs) statement:

Well, I think in one sense the new command is going to be just sort of picking up, at the present time, what we're currently doing on the continent. And we are

currently focused in working with countries like Nigeria, like Senegal, like Ghana, Botswana, et cetera, to help them build their capacity to participate in peacekeeping missions so that they can contribute to the A.U. mission in Darfur or elsewhere -- wherever the A.U. has peacekeeping missions -- and/or the U.N. mission.<sup>35</sup>

The last step necessary for AFRICOM to help mitigate unsafe drinking water and waterborne disease in Nigeria is to work with interagencies, international organizations, and non-governmental organizations. Coordinating with these organizations is necessary to solicit necessary funding for education, training, and intervention strategies and programs. These organizations can provide long-term assistance until the Nigerian infrastructure is stable enough to mitigate all threats without external support.

The World Health Organization (WHO) and United States Agency for International Development (USAID) are to continue joint collaborative support to the Government of Nigeria in the health sector, to enable it achieve its set priorities and the health Millennium Development Goals (MDGs). This was arrived at, at a meeting between both Organizations, held in Abuja. The meeting agreed that while collaboration would continue in these traditional areas, new potential areas such as malaria control, “neglected” diseases (including guinea worm and buruli ulcer), public-private partnership, essential drugs and medicines and blood safety could be explored for joint activities.<sup>36</sup>

### **Waterborne Disease Threat**

Globally, improving water, sanitation and hygiene has the potential to prevent at least 9.1% of the disease burden (in disability-adjusted life years or DALYs, a weighted measure of deaths and disability), or 6.3% of all deaths. Children, particularly those in developing countries, suffer a disproportionate share of this burden, as the fraction of total deaths or DALYs attributable to unsafe water, inadequate sanitation or insufficient hygiene is more than 20% in children up to 14 years of age.<sup>37</sup>

The impact of unsafe drinking water is significant within Nigeria. Table 2 displays evidence of the extreme burden of waterborne disease within Nigeria, and the preceding sections discusses these major disease threats in detail. Table 3 is utilized to compare the data from the

same diseases and the same time period. The disease burden of Nigeria is amplified based on double the population of the US and a relatively low prevalence of waterborne diseases.

Type of Disease	Period			
	2001	2002	2003	2004
Cholera	10,294	23,441	2,599	1,386
Dracunculiasis	2,201	2,588	1,225	2,191
Hepatitis	8,599	9,451	8,472	3,236
Dysentery	381,476	424,021	214,185	123,240

Table 2 – Waterborne Diseases in Nigeria (2001-2004)<sup>38</sup>

Type of Disease	Period			
	2001	2002	2003	2004
Cholera	39	77	60	48
Dracunculiasis	NRC*	NRC*	NRC*	NRC*
Hepatitis	10,615	8,795	7,653	6,847
Dysentery	48	43	41	37

Table 3 – Waterborne Diseases in the United States (2001-2004)<sup>39</sup>

\*NRC – no reported cases

### Cholera

Cholera is a bacterial disease with symptoms of nausea, vomiting, watery stool, circulatory failure, hypoglycemia, dehydration, and renal failure. These symptoms are manifested in early stages of the disease and rapidly get worse, if untreated. The actual disease is caused by the infectious agent, *Vibrio cholerae*, and includes two biotypes, which are classical and El Tor.<sup>40</sup>

The reservoir for cholera outbreaks and transmissions is humans, and the mode of transmission for the disease is the ingestion of food or water contaminated by human feces.<sup>41</sup> Other sources claim that environmental reservoirs such as brackish and marine waters exist, but a valid definition of reservoir defines it as the ability to allow the organism to multiply.<sup>42</sup> Human feces carry multiple diseases, but the cholera bacteria persist longer in excreted feces, especially in water sources.<sup>43</sup> Water sources have been implicated in most endemics, epidemics, and pandemics of cholera around the world. These contaminated water sources result from poor sanitation habits, improper sewage disposal, inadequate sanitary water storage, and lack of education. In addition, economic status impacts the disease burden on the population. As Dr Chin states, “Clinical cholera in endemic areas is usually confined to the lowest socioeconomic groups.”<sup>44</sup>

The incubation period for cholera is generally a two to three days, but can be as short as a few hours and as long as five days.<sup>45</sup> The typical treatment for cholera varies depending on the severity of the symptoms and the progression of the disease, but there are three main treatments followed by most medical practitioners. The protocol is an aggressive rehydration therapy, an effective antibiotic medication, and the treatment of secondary symptoms or complications.<sup>46</sup> An oral cholera vaccine has been developed by some countries, but the CDC does not recommend the use of the vaccine and it is not approved or available in the United States.<sup>47</sup> The most effective strategy for preventing an epidemic of cholera and treatment of the disease is the education of the general public on proper water sanitation and treatment protocols if symptoms of cholera manifest.

Cholera has been an extreme burden on Nigeria, and it is detailed later in this research paper in the case study of the 2002 outbreak. The importance of safe drinking and public



education are paramount for the Nigerian government and military to prevent future cholera outbreaks. AFRICOM and its interagency and non-governmental partners can be important factors in the future prevention and elimination of the disease through support of the Nigerian government and health system.

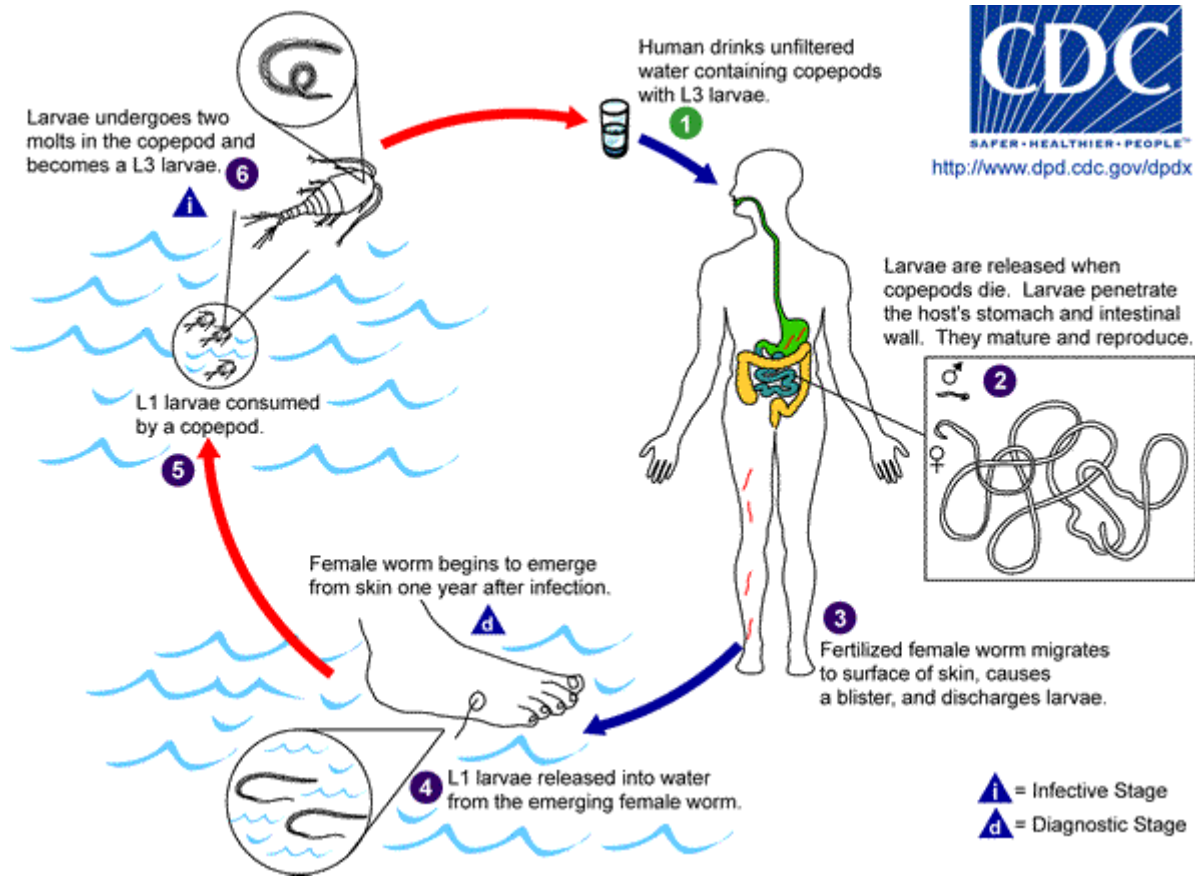
### **Guinea Worm**

The Centers for Disease Control (CDC) gives the following definition and description of Guinea worm: “Dracunculiasis, more commonly known as Guinea worm disease (GWD), is a preventable infection caused by the parasite *Dracunculus medinensis*. Infection affects poor communities in remote parts of Africa that do not have safe water to drink.”<sup>48</sup> Humans are the only reservoir for the nematode parasite, and symptoms are manifested by the invasion of the parasite into the tissues causing secondary infections. Symptoms may include fever, vomiting, nausea, diarrhea, arthritis, and other life threatening limb and joint conditions from secondary infections. The nematode will live inside the body and discharge its larvae, which can also cause symptoms, such as itching, blistering, and burning of the skin. Figure 2 displays its life cycle.

As Figure 2 depicts, the mode of transmission for Guinea worm is through consumption of untreated and unfiltered drinking water. Once the vector for the nematode is consumed by humans, they are released in the stomach, and cross into the intestines where they grow and become mature adults. The female will release her larvae through blisters in the skin, which come in contact with water.<sup>49</sup> This starts the life cycle process over for the Guinea worm and ensures its survival.

Guinea worm has an extremely long incubation period, which generally lasts for 12 months. During this period, the female nematode grows and matures in the human body without

being noticed by the host. The male nematode dies after mating with the female. Unfortunately, there is no specific pharmaceutical treatment to eliminate the Guinea worm in the body, but



Humans become infected by drinking unfiltered water containing copepods (small crustaceans) which are infected with larvae of *D. medinensis* ①. Following ingestion, the copepods die and release the larvae, which penetrate the host stomach and intestinal wall and enter the abdominal cavity and retroperitoneal space ②. After maturation into adults and copulation, the male worms die and the females (length: 70 to 120 cm) migrate in the subcutaneous tissues towards the skin surface ③. Approximately one year after infection, the female worm induces a blister on the skin, generally on the distal lower extremity, which ruptures. When this lesion comes into contact with water, a contact that the patient seeks to relieve the local discomfort, the female worm emerges and releases larvae ④. The larvae are ingested by a copepod ⑤ and after two weeks (and two molts) have developed into infective larvae ⑥. Ingestion of the copepods closes the cycle ①.

Figure 2 – Life Cycle of Dracunculiasis<sup>50</sup>

surgical removal can be quite effective procedure. Vaccination with tetanus toxoid is

recommended along with treatment of wounds caused by the nematode releasing larvae.<sup>51</sup> The

nematode will eventually remove itself from the body after completion of its stage of the life cycle.

Dracunculiasis continues to plague the Nigerian population, but this burden is a direct result of the inability to provide safe drinking water. Chin states, “The provision of safe, filtered drinking water and health education of the populations at risk could lead to eradication of the disease.”<sup>52</sup> This is additional evidence for the necessity of intervention strategies to assist the Nigerian government, military, and public health infrastructure. Although the priorities of AFRICOM are focused on counter-terrorism, resources, and other national security interests, a disease burden on the poor can lead to further instability.<sup>53</sup>

## **Hepatitis A**

Hepatitis A is a viral disease affecting the liver and is characterized by the symptoms of fever, nausea, abdominal pain, eating disorders, and eventually leading to jaundice. The hepatitis A virus symptoms are usually mild at the onset, but they can last for several months. Fortunately, the effects of the virus on the liver are rarely chronic, which means that most cases of hepatitis A infection have a full recovery. The concern surrounding a hepatitis infection is for the segment of the population with chronic liver disease, such as cirrhosis, carcinoma, sarcoidosis, or another form of hepatitis viral infection (B, C, D, or E). The case fatality rate for hepatitis infection is generally very low.<sup>54</sup> Figure 3 shows the worldwide hepatitis A virus antibody prevalence, which means the virus is endemic in the areas designated as high.

The mode of transmission for hepatitis A virus is typically from person-to-person via the fecal-oral route, which means direct contact with infected human feces.<sup>55</sup> This occurs from improper hand washing, inappropriate sexual activity (emphasis on fecal-oral contamination), and not implementing standard precautions when dealing with bodily waste. The other mode of

transmission for hepatitis A virus is by contaminated water and food. This generally occurs as a result of poor personal hygiene, improper sanitation, and lack of public health education.

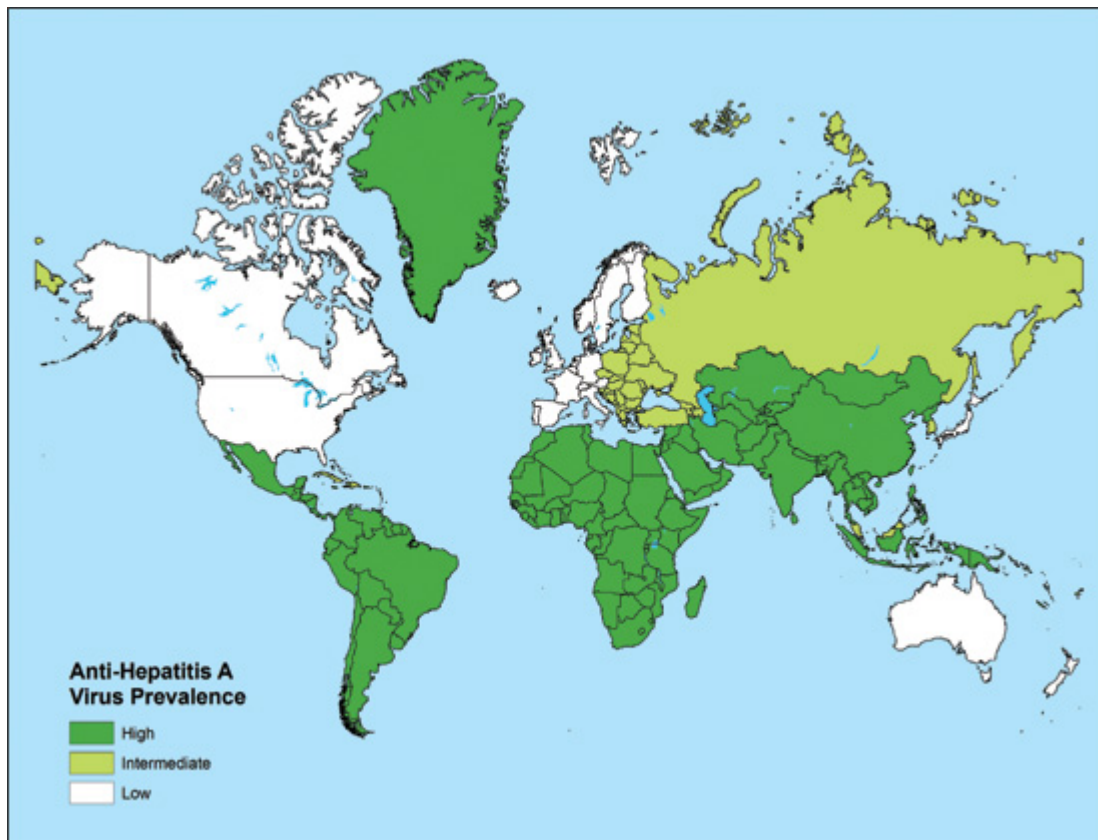


Figure 3 – Hepatitis A Virus Antibody Prevalence<sup>56</sup>

The incubation period for hepatitis A virus is usually between 15 and 50 days with an average of 29 days. Hepatitis A is one of the few waterborne diseases that have an intervention that will prevent a person from acquiring the disease. The hepatitis A vaccine became available in 1995 and is highly recommended for travelers to foreign countries where the incidence of hepatitis A is high. It is also recommended in the standard vaccination schedule for growing children in the United States. Unfortunately, most developing nations do not have access to the vaccine, so they continue to battle the burden and symptoms of the infected population. For infected persons who have not been vaccinated, there is no specific treatment, but contacts of

infected persons can be immunized with immune globulin.<sup>57</sup> This is referred to as passive immunity.

Hepatitis A virus will continue to plague the Nigerian population as long as unsafe water is provided for consumption. Even though infection from the virus is typically not fatal, the psychological and economic burden continues to threaten stability of the government. Education of the general population on waterborne diseases needs implementation and funding.

### **Shigellosis**

Shigellosis is a disease caused by the bacteria, *Shigella dysenteriae*. The disease infects the small and large intestine and is characterized by the symptoms of bloody diarrhea, fever, nausea, cramps, and vomiting.<sup>58</sup> The *Shigella* genus of bacteria is made up of three other different types of species or serogroups, which are *S. flexneri*, *S. boydii*, and *S. sonnei*. The importance of *S. dysenteriae* is that has been identified as the main cause of epidemics worldwide and is commonly found in all developing countries.<sup>59</sup>

The mode of transmission for shigellosis is through person-to-person contact and food or water contamination with humans as the primary reservoir. The person-to-person contact involves the fecal-oral route and results from inadequate hand washing techniques. Foodborne transmission can occur during food processing or through vectors such as flies; waterborne transmission typically occurs as a result of water sources being contaminated by sewage.<sup>60</sup>

The incubation period for shigellosis is generally one to three days, but can be as long as one week for *S. dysenteriae*. In rare instances, the incubation period can be as short as 12 hours. The common treatment for shigellosis is antibacterial treatment, which can include ciprofloxacin, ceftriaxone, and ampicillin.<sup>61</sup> As with most bacteria presently, *Shigella* species have become resistant to antibacterial medications. Multi-drug cocktails are frequently prescribed by medical

providers to counter drug resistance. Underdeveloped countries and children typically experience most of the deaths from the disease.

As discussed with the three previous waterborne diseases, *Shigella* has drastic implications for the Nigerian population. The best method of prevention is to provide safe drinking water and proper disposal of sewage or wastewater treatment. AFRICOM and its partners can make enormous contributions to assist the Nigerian governmental infrastructure with providing these public services for its population. From the opinion of a public health professional, waterborne diseases and inability to provide safe drinking water is a dire problem. “Global access to safe water, adequate sanitation, and proper hygiene education can reduce illness and death from disease, leading to improved health, poverty reduction, and socio-economic development.”<sup>62</sup> But, national security interests will take precedence over public health threats unless the problem reaches a pandemic scale that can reach the shores of the US and directly affect its citizens. Human immunodeficiency virus (HIV)/acquired immunodeficiency disease syndrome (AIDS) is an example of a pandemic disease receiving the attention and funding of the US administration over the past two decades.<sup>63</sup>

### **United States Africa Command**

On February 6, 2007, the Bush Administration announced its intention to create a new unified combatant command, U.S. Africa Command or AFRICOM, to promote U.S. national security objectives in Africa and its surrounding waters. Prior to AFRICOM’s establishment, U.S. military involvement on the continent was divided among three commands: U.S. European Command (EUCOM), U.S. Central Command (CENTCOM), and U.S. Pacific Command (PACOM). The new command’s area of responsibility (AOR) includes all African countries except Egypt. AFRICOM was officially launched as a sub-unified command under EUCOM on October 1, 2007, and became a stand-alone command on October 1, 2008.<sup>64</sup>

## **Overview**

The United States has a long, often dark history with Africa and many of its independent nations. During the infant years of the New World and colonies, the slave trade provided the backbone of the labor that helped build a proud and mighty nation, gain its independence from Great Britain, and support its prosperity as a new country. As the country developed its foreign policy and military might throughout its history, Africa was never part of any of the combatant command structure until 1952; several countries in northern Africa became part of the EUCOM area of responsibility (AOR) and later in 1960, Sub-Saharan countries fell under the Atlantic Command after recently gaining independence from European imperialists.<sup>65</sup> Later involvement in Africa was centered around the Cold War and focused on the national security strategy of containment.

AFRICOM faces many challenges that include dealing with developing countries, instability, and the fight against terrorism. Fortunately, the command will not be concentrating on warfighting as much as other combatant commands. US officials claim, “Instead, the command will concentrate much of its energies and resources on training and assistance to professionalize local militaries so that they can better ensure stability and security on the continent.”<sup>66</sup> These efforts by AFRICOM will be essential in countries like Nigeria that lack the infrastructure to provide the basic public services for its population such as safe drinking water.

## **Mission**

Unlike the other combatant commands, the mission of AFRICOM will be unique to meet the diverse and wide range of problems plaguing the African continent. If comparing combatant commands, AFRICOM’s mission will most closely resemble the mission of U.S. Southern Command (SOUTHCOM), which involves security cooperation, humanitarian assistance, and

the implementation of human rights initiatives.<sup>67</sup> The goal of the US administration for AFRICOM is to provide stability to the region in support of vital national interests, which are natural resources, counter-terrorism, and governmental stability. President Bush stated in support of AFRICOM, “Africa Command will enhance our efforts to bring peace and security to the people of Africa and promote our common goals of development, health, education, democracy and economic growth in Africa.”<sup>68</sup> To accomplish this policy, the plan is for AFRICOM to work very closely with other government agencies and all African nations.<sup>69</sup>

The developers of the AFRICOM structure and mission envision an organization that supports the Department of State and USAID through development and humanitarian initiatives.<sup>70</sup> This involves a complex coordination and unity of effort between the DoD and the State Department, which has been unprecedented at this level. The administration hopes AFRICOM will be the catalyst for interagency cooperation and action, and other combatant commands will emulate this new demonstration of the “whole of government approach.”<sup>71</sup> The tasks and mission of this new combatant command is daunting, but with the right mix of interagency cooperation, training initiatives, and host nation support, the new command is destined to succeed. Their success is important to countries, like Nigeria, that need relief from the burden of poverty, disease, and governmental corruption.

### **Mitigation Strategies**

One tenth of the global disease burden is preventable by achievable improvements in the way we manage water. Cost-effective, resilient and sustainable solutions have proven to alleviate that burden. Action is required to ensure these are implemented and sustained worldwide and especially to the benefit of the most-affected population – children in developing countries.<sup>72</sup>



## **Case Study**

The first case study examines a large outbreak of cholera that occurred in Nigeria between 1995 and 1996. This is a case-control study and its purpose is to determine the risk factors associated with cholera infection.<sup>73</sup> The study is conducted in Kano City, Nigeria at an infectious disease hospital with 102 case and 77 control patients for a total of 179 participants.<sup>74</sup> The study collected data from the participants and represented a sample of the actual outbreak victims.

Results from the study indicated that hand washing and untreated drinking water are the main risk factors associated with patients during this study. The untreated drinking water was a result of water obtained from street vendors; municipal water supply is not implicated in this study as contaminated.<sup>75</sup> Unfortunately, the Nigerian government is unable to provide municipal drinking water to every household, so drinking water is typically purchased from street vendors for households without a municipal water source. Lack of hand washing is an issue that results from a lack of education.

The major lessons of this case-control study are the following recommendations for mitigation of risks: “(1) improve the effectiveness of communication activities for improved hand hygiene practices, and (2) ensure the long term sustainability of interventions aimed at the introduction of safe water systems in communities at high risk of pathogens transmitted through the faecal(sic)-oral route.”<sup>76</sup> These are important strategies, because they lend evidence for the necessity of intervention in Nigeria by AFRICOM and interagency partners.

## **Epidemiological Review**

An epidemiological review of cholera outbreaks in Africa during 2004 is examined. The review focused on the worldwide incidence of cholera, but the focus of this research paper

concentrates specifically on Nigeria. This report by the WHO states 3,186 cholera cases and 185 deaths in 2004 for Nigeria.<sup>77</sup> These statistics are drastically different from the reports from the Nigerian government. The actual number is significant, but the public health infrastructure for collecting accurate data is lacking in most developing countries. Comparison to the US public health system is unfair and incorporates bias into the research. This review examined the pattern of transmission and outbreaks, which assists in determining appropriate mitigation strategies for future outbreaks.

The conclusions derived from this epidemiological review include the following constraints and challenges:

- Cholera remains a threat for developing countries with unsafe drinking water and inadequate sanitation
- No long-term prevention strategies have been implemented
- No effective cholera surveillance programs
- No standard case definition utilized by every country affected by cholera
- No dissemination of information on cholera
- Greater financial support for prevention required.<sup>78</sup>

These conclusions provide evidence that intervention strategies can be effective during an outbreak if implemented. The importance of AFRICOM and its interagency partners in mitigation strategies is repeated, but the leadership determines the priorities of the combatant command.

### **Strategy # 1**

AFRICOM needs to develop educational training programs addressing waterborne diseases. This theory is based on the following statement: “To act effectively in preventing

disease and promoting health, it is important to know not only how much disease is caused by factors related to water, sanitation and hygiene, but also how effectively changes in their management can improve health.”<sup>79</sup> Management of health related threats starts with intervention strategies. Education is a key factor because it empowers the individual, local community, health authorities, and government officials with a responsibility that produces immediate results.

The impact and sustainability of hygiene improvement interventions are less well studied than those of interventions in the areas of sanitation and drinking water supply and quality, although improved hygiene behaviours have been shown to have a significant beneficial impact on the incidence of diarrhoeal and other diseases. Changed behaviours may be elicited more by factors such as perception of cleanliness and peer approval than by health messages. Targeting high-impact changes (such as hand washing with soap) is considered good practice. Changes may be most readily achieved when they are associated with other factors, such as increased availability of water for hygiene purposes or access to improved sanitation.<sup>80</sup>

An example of intervention strategy is the Carter Center’s Guinea Worm Eradication Program. The Carter Center utilizes health education and low technology techniques to eliminate the disease threat from drinking water sources.<sup>81</sup> AFRICOM should implement education strategies in Nigeria that are modeled after the Carter Center program for guinea worm disease. There is no evidence that these education programs will solve the instability and security issues plaguing the country, but improving the health and well-being of the population may improve the government’s credibility.

## **Strategy #2**

AFRICOM needs to work closely with the U.S. Embassy in Nigeria to provide direct support to the Nigerian government and military. This strategy is necessary to ensure stability and security within the country. Security and stability are required for Nigeria to attain respect for human rights and civil authority.<sup>82</sup> Decades of civilian unrest, military rule, and

governmental corruption produces future uncertainty. Religious divide and poverty compound the problems facing the Nigerian government and military.<sup>83</sup>

The new command has been budgeted \$389 million for fiscal year 2009 to cover the following tasks:

- Headquarters operation
- AFRICOM intelligence capability
- Theater Security Cooperation Command for AFRICOM
- Operational support aircraft
- Establish 2 regional offices on the continent
- Training, exercises, and theater security cooperation activities<sup>84</sup>

Funding and programs are available for AFRICOM to support the government of Nigeria in the arena of public health and drinking water. Although funds must be distributed throughout the continent, Nigeria is a country of particular interest for the US because of its security issues, petroleum resources, and assistance to other nations. Support for the Nigerian government can translate into public health assistance to the population, security, and stability. AFRICOM needs to be the catalyst or instigator for action towards disease burdens.

### **Strategy #3**

AFRICOM needs to mitigate unsafe drinking water and waterborne disease in Nigeria by working closely with inter-agencies, international organizations, and non-governmental organizations (NGO). There are numerous NGOs, inter-agencies, and international organizations supporting activities on the African continent. The list includes the U.S. State Department, CDC, U.S. Agency for International Development (USAID), WHO, Oxfam International, and Water Aid (this list is not all-inclusive). AFRICOM intends to work closely

with these agencies as expressed in the following statement: “In the development of AFRICOM’s theater campaign plan, for example, the leadership has sought to involve other U.S. government agencies at the earliest stages of the planning process, an effort that DOD hopes to employ more broadly as its new planning approach.”<sup>85</sup>

The United Nations has developed a robust program through the WHO that monitors and attempts to mitigate unsafe water in Nigeria. The WHO has a regional office in Nigeria and works closely with the local community to mitigate the disease burden caused by unsafe drinking water throughout the country. The following demonstrates the UN’s commitment to support in Nigeria:

There are 17 UN agencies in Nigeria, six of which provide support to the health sector: World Bank, UNDP, UNFPA, UNICEF, UNODCCP and WHO. The World Bank is developing two large health related project loans: Health Systems Development Project II and a cross-sectoral HIV/AIDS project. UNDP maintains a focus on poverty reduction activities and coordinates United Nations operational activities in the country. A sizeable number of local and international NGOs are operating in the Nigerian health sector. During the last decade, NGOs were the preferred channels for the flow of external funding into the country. This trend has reverted in favour of direct bilateral and multilateral assistance to the government. The private sector also supports the health sector a great deal.<sup>86</sup>

The framework for inter-agency, international, and non-governmental organizations is in place for AFRICOM to embrace and implement some interventions for relief from the burden of disease resulting from unsafe drinking water. This investment in intervention strategies could have long-term security and stability implications for Nigerians. Predicting the future is impossible, but addressing public health threats through cooperation with other organizations is proven effective.

### **Conclusion**

AFRICOM’s mission on the continent of Africa is daunting, but it is a mission that is embraced with skepticism by some African countries. Each individual country has its own

unique challenges that AFRICOM must encounter. One common problem that has been experienced by many African nations is the disease burden caused by unsafe drinking water. Unfortunately, the diseases caused by unsafe drinking water tend to be overshadowed by high profile and pandemic diseases, such as HIV/AIDS. Additionally, public health threats are typically not a priority of the U.S. administration when dealing with international policy and relations. This theory applies to AFRICOM's relationship with Nigeria and ultimately impacts the improvement of safe drinking water access.

Nigeria is dealing with many economic, political, social, and health related issues that need the support of the international community. The disease burden on the Nigerian population from cholera, shigella, guinea worm, and hepatitis and unsafe drinking water needs to be addressed. The question that remains is whether the government of Nigeria can intervene or is willing to intervene. The same question can be posed for AFRICOM and whether it is willing to invest in the Nigerian public health threats. From this vantage point, neither question can be appropriately answered since the future can't be predicted. But, public health professionals are obligated to recommend strategies, methods, and tools for eliminating threats to health and well-being of populations at risk. In this case, the Nigerian government and AFRICOM should display the desire to provide human security in the form of protection from health threats.

To alleviate the burden of disease in Nigeria, it is recommended that AFRICOM should take the following mitigation steps:

- Develop educational training programs addressing waterborne diseases
- Work closely with the U.S. Embassy in Nigeria to provide direct support to the Nigerian government and military

- Mitigate unsafe drinking water and waterborne disease in Nigeria by working closely with inter-agencies, international organizations, and NGOs

These efforts can have a positive impact on the Nigerian population, government's credibility, and possibly security/stability within the country.

## Endnotes

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  - <sup>4</sup> UNICEF, “Water, Sanitation and Hygiene in Nigeria: February 2007”
  - <sup>5</sup> Ibid
  - <sup>6</sup> Ibid
  - <sup>7</sup> AFRICOM Website
  - <sup>8</sup> Ibid
  - <sup>9</sup> Pruss-Ustun, “Safer Water, Better Health: Costs, benefits and Sustainability of Interventions to Protect and Promote Health”
  - <sup>10</sup> AFRICOM Website
  - <sup>11</sup> Tayler, “Worse than Iraq?”
  - <sup>12</sup> Bojang and Bowden, *Focus on Nigeria*, 6
  - <sup>13</sup> Ibid, 60
  - <sup>14</sup> Ibid, 14-15
  - <sup>15</sup> [http://www.bestcountryreports.com/Population\\_Map\\_Nigeria.html](http://www.bestcountryreports.com/Population_Map_Nigeria.html)
  - <sup>16</sup> WHO, “WHO Country Cooperation Strategy: Nigeria (2002-2007)”
  - <sup>17</sup> WHO, “WHO Country Cooperation Strategy: Nigeria (2002-2007)”
  - <sup>18</sup> Hanson, “Nigeria’s Creaky Political System”
  - <sup>19</sup> Herskovits, “Nigeria’s Rigged Democracy”
  - <sup>20</sup> Rice and Patrick, NSCB, 266
  - <sup>21</sup> National Bureau of Statistics
  - <sup>22</sup> Margonelli, *Oil on the Brain: Petroleum’s Long, Strange Trip to Your Tank*, 260
  - <sup>23</sup> Ploch, “Africa Command: U.S. Strategic Interests and the Role of the U.S. Military in Africa,” 11
  - <sup>24</sup> Hackett, *The Military Balance 2008*, 309
  - <sup>25</sup> Ibid
  - <sup>26</sup> CIA Factbook
  - <sup>27</sup> Hackett, *The Military Balance 2008*, 309
  - <sup>28</sup> Ibid
  - <sup>29</sup> Ibid
  - <sup>30</sup> Ibid
  - <sup>31</sup> <http://nigerianairforce.net/index.htm>
  - <sup>32</sup> Hackett, *The Military Balance 2008*, 309
  - <sup>33</sup> Rice and Patrick, NSCB, 266
  - <sup>34</sup> AFRICOM Website
  - <sup>35</sup> Ibid
  - <sup>36</sup> WHO Website
  - <sup>37</sup> Pruss-Ustun, “Safer Water, Better Health: Costs, benefits and Sustainability of Interventions to Protect and Promote Health”
  - <sup>38</sup> National Bureau of Statistics
  - <sup>39</sup> CDC Website
  - <sup>40</sup> Chin, *Control of Communicable Diseases Manual*, 100-101
  - <sup>41</sup> Ibid, 103
  - <sup>42</sup> Ibid, 577
  - <sup>43</sup> Ibid



- <sup>44</sup> Ibid
- <sup>45</sup> Ibid
- <sup>46</sup> Ibid, 105
- <sup>47</sup> CDC Website
- <sup>48</sup> Ibid
- <sup>49</sup> Chin, *Control of Communicable Diseases Manual*, 173
- <sup>50</sup> Parasites and Health Website, “Dracunculiasis”
- <sup>51</sup> Ibid, 174
- <sup>52</sup> Ibid, 173
- <sup>53</sup> Henk, “Conceiving African Security: Cross-Cultural Challenges for US Military Leaders”
- <sup>54</sup> Ibid, 238
- <sup>55</sup> Chin, *Control of Communicable Diseases Manual*, 239
- <sup>56</sup> Traveler’s Health – Yellow Book Website, “Hepatitis, Viral, Type A”
- <sup>57</sup> Ibid, 242
- <sup>58</sup> Chin, *Control of Communicable Diseases Manual*, 451
- <sup>59</sup> DFBMD Website, “Shigellosis”
- <sup>60</sup> Chin, *Control of Communicable Diseases Manual*, 452
- <sup>61</sup> Ibid, 454
- <sup>62</sup> CDC Website
- <sup>63</sup> Ploch, “Africa Command: U.S. Strategic Interests and the Role of the U.S. Military in Africa”
- <sup>64</sup> Ibid, 15
- <sup>65</sup> Ibid, 11
- <sup>66</sup> Ibid, 18
- <sup>67</sup> Ibid, 5
- <sup>68</sup> Wood, “Africa Command Will Consolidate U.S. Efforts on Continent”
- <sup>69</sup> Ibid
- <sup>70</sup> Ploch, “Africa Command: U.S. Strategic Interests and the Role of the U.S. Military in Africa,” 5
- <sup>71</sup> Ibid, 7
- <sup>72</sup> Pruss-Ustun, “Safer Water, Better Health: Costs, benefits and Sustainability of Interventions to Protect and Promote Health”
- <sup>73</sup> Hutin, “A Large Cholera Outbreak in Kano City, Nigeria: The Importance of Hand Washing with Soap and the Danger of Street-Vended Water”
- <sup>74</sup> Ibid
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- <sup>76</sup> Ibid
- <sup>77</sup> “Cholera, 2004,” *Weekly Epidemiological Record*
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- <sup>80</sup> Ibid, 18
- <sup>81</sup> The Carter Center Website, “Guinea Worm Eradication Program”
- <sup>82</sup> Ploch, “Africa Command: U.S. Strategic Interests and the Role of the U.S. Military in Africa,” 16
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