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Pandemic Influenza A (H1N1) 2009 in sub-Saharan Africa:
A Literature Review

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An abstract of
A thesis submitted to the Faculty of the
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Abstract

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By Kwasi Owusu-Boakye

Background: In April 2009, a pandemic due to a new influenza virus, Influenza A (H1N1) affected many countries within six months of its discovery. Whereas most countries in Europe and the America's have well-planned surveillance systems to monitor outbreaks of influenza, most African countries, especially those south of the Sahara, do not have such systems to monitor influenza outbreaks.

Objective: This literature review examined the trends and effects of influenza, especially the recent pandemic 2009 A (H1N1) influenza strain, on sub-Saharan Africa. It focused on, the preparedness of the people and control systems in place and made recommendations on how to approach future outbreaks on the African continent.

Methods: Both private and public library sources were searched for current information on the topic. Some of the online databases that were accessed included PubMed, Ebsco, Emerald, and Phoenix.

Results: The study showed that influenza activity in Africa occurs throughout the year and peaks during the rainy seasons. However, it is hard to know the exact level of disease burden from influenza in general on this region, as most countries lack the necessary surveillance systems to monitor influenza activity. The same was true for the pandemic associated with the 2009 A (H1N1) influenza virus strain. Whereas a country like South Africa, have a well-established surveillance system to monitor influenza activities and produce abundant data, others, like Angola and DR Congo, do not. Attitudes towards, and knowledge about pandemic influenza (H1N1) strains differ within and among African countries, as does acceptance of vaccination against influenza viruses.

Discussion: It is difficult to determine the exact burden of influenza in sub Saharan Africa because of the lack of surveillance systems in most countries. To know the disease burden in Africa, a well-planned surveillance system must be put in place in the region. Surveillance for influenza and other diseases should be merged and make use of personnel trained in broad areas to help monitor the activity of influenza and other diseases. This will make efficient use of the limited resources available.

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INTRODUCTION

Influenza is a contagious respiratory illness caused by influenza viruses. It can cause mild to severe illness, and at times can lead to death. There are two main types (A and B) of the influenza virus which contribute to the prevalence of influenza in humans. Type A occurs more often and leads to more deaths globally than does type B, which is a significant source of morbidity. Additionally, influenza A is further classified into major subtypes based on genetic and antigenic differences in the membrane glycoproteins hemagglutinin and neuraminidase.[1] Currently, there are two major subtypes in circulation among humans, A/H3N2 (H3) and A/H1N1 (H1), with H3 accounting for more influenza-related mortality.[2] Antigenic evolution in influenza A is punctuated rather than continuous, characterized by the emergence of clusters of antigenically similar but genetically unique strains that dominate subtype incidence.[3]

Cases of influenza in developed nations are very well documented but the same cannot be said about cases in Africa. There is very little reporting on cases of influenza in Africa. Whereas influenza trends in temperate regions follow a clear seasonal variation, the occurrence of the disease in most tropical countries is continuous throughout the year. For a very long time, it was wrongly assumed that the burden of influenza in Africa was negligible. However, a study by Yazdanbakhsh and Kremsner showed that there have been sporadic reports of influenza in several Africa countries, which may indicate that the disease is circulating and may be causing epidemics regularly.[4] Also there is a tendency to diagnose influenza as other febrile illnesses, such as malaria, and this could further diminish the number of recognized cases in Africa and other tropical regions.

With the recognition of the avian influenza H5N1 strain about three years ago and of the pandemic Influenza A H1N1 virus in 2009, and with increasing prevalanceof both strains the

world over, there is a genuine concern about the effect that influenza disease will have on Africa. Most of Europe and North America have a well-established surveillance network; WHO Flu Net provides continuous data on influenza burden and the spread of viral types and subtypes.[5] However, the majority of countries on the continent of Africa does not have a surveillance network in which to report both virological isolation and epidemiological data. Also important as a primary responsibility of the surveillance system is the reporting of the prevalence and incidence of this virus. Recent threats of pandemic influenza have prompted similar active monitoring in parts of Southeast Asia and Latin America.[4]

The main goal of this study is therefore to do a literature review to determine the true prevalence and incidence of pandemic Influenza A , H1N1 2009 in Africa. The specific objectives of the study will be:

1. To describe pandemic influenza A, H1N1 2009,
2. To determine the trends and effects of the recent pandemic due to the Influenza A, H1N1 2009 in Africa and
3. To make recommendations on how to best approach Influenza in Africa based on the finding from the above.

METHODS

This research study is founded on analysis of secondary data. The research encompasses publications, articles and similar studies accessible on the internet. Keeping in view the approach taken in earlier studies the research began with a broad analysis of the existing literature. The findings are based on these secondary data. The conclusions are drawn on the basis of the literature resources listed in the references.

The research approach used is qualitative. It used keyword search of the National Library of Medicine through PubMed for ("pandemic influenza A 2009" AND "Africa") OR (“Africa” AND “Swine flu” OR “H1N1”)) OR ("pandemic influenza A 2009" AND "Angola") OR ("pandemic influenza A 2009" AND "Benin") OR ("pandemic influenza A 2009" AND "Botswana") OR ("pandemic influenza A 2009” AND "Burkina Faso") OR ("pandemic influenza A 2009" AND "Burundi") OR ("pandemic influenza A 2009" AND "Republic of Cameroon") OR ("pandemic influenza A 2009" AND "Cape Verde") OR ("pandemic influenza A 2009" AND "Central African Republic") OR ("pandemic influenza A 2009" AND "Chad") OR ("pandemic influenza A 2009" AND "Comoros") OR ("pandemic influenza A 2009" AND "Republic of Congo") OR ("pandemic influenza A 2009" AND "Democratic Republic of Congo") OR ("pandemic influenza A 2009 " AND ("Cote d'Ivoire" OR "Ivory Coast")) OR ("pandemic influenza A 2009" AND "Republic of Djibouti") OR ("pandemic influenza A 2009" AND "Equatorial Guinea") OR ("pandemic influenza" AND "Eritrea") OR ("pandemic influenza" AND "Ethiopia") OR ("pandemic influenza A 2009" AND "Gabon") OR ("pandemic influenza A 2009" AND "The Gambia") OR ("pandemic influenza" AND "Ghana") OR ("pandemic influenza" AND "Guinea") OR ("pandemic influenza A 2009" AND "Guinea-Bissau") OR

("pandemic influenza A 2009" AND "Kenya") OR ("pandemic influenza A 2009" AND "Lesotho") OR ("pandemic influenza A 2009" AND "Liberia") OR ("pandemic influenza A 2009" AND "Madagascar") OR ("pandemic influenza A 2009" AND "Malawi") OR ("pandemic influenza A 2009" AND "Mali") OR ("pandemic influenza A 2009" AND "Mauritania") OR ("pandemic influenza A 2009" AND "Mauritius") OR ("pandemic influenza A 2009" AND "Mozambique") OR ("pandemic influenza A 2009" AND "Namibia") OR ("pandemic influenza A 2009" AND "Niger") OR ("pandemic influenza A 2009" AND "Nigeria") OR ("pandemic influenza A 2009" AND "Rwanda") OR ("pandemic influenza A 2009" AND "Sao Tome and Principe") OR ("pandemic influenza A 2009" AND "Senegal") OR ("pandemic influenza A 2009" AND "Seychelles") OR ("pandemic influenza A 2009" AND "Sierra Leone") OR("pandemic influenza A 2009" AND "Somalia") OR ("pandemic influenza A 2009" AND "South Africa") OR ("pandemic influenza A 2009" AND "Republic of South Sudan") OR ("pandemic influenza A 2009" AND "Republic of Sudan") OR ("pandemic influenza A 2009" AND "Swaziland") OR ("pandemic influenza A 2009" AND "United Republic of Tanzania") OR ("pandemic influenza A 2009" AND "Togo") OR ("pandemic influenza A 2009" AND "Uganda") OR ("pandemic influenza A 2009" AND "Zambia") OR ("pandemic influenza A 2009" AND "Zimbabwe"); sub-Saharan African country was defined using the United States Department of States definition for sub-Saharan Africa.[6] The search was limited to studies conducted between April 2009 and January 2012. The starting date of April 2009 was selected because that was the month the first pandemic Influenza A 2009 virus strain first was discovered. A number of selected articles, abstract and references were reviewed and if they were thought to be relevant to the topic, they were included.

RESULTS

Literature Review 1: Influenza and Influenza Disease

Influenza Disease

The word influenza derives from the Latin word "influential" and the medieval understandings of the term influenza were conveyed by the usage of the word "influence" in medieval literature.[7] This Literature Review will endeavor to outline the influence of this infectious disease, 'influentia' in Africa especially the recent pandemic influenza A (H1N1) 2009.

Influenza is an ancient disease, with a long history of influence in human societies. It dates back to the eighteenth and nineteenth centuries, when influenza epidemics occurred, repeatedly and regularly, in different parts of the world. Back in those days, very little was known about the causes of the disease or the best forms of treatment to control it. In those times, as noted by Charles Graves, the sudden appearance of influenza was not met with fear and trepidation as it would be in the twentieth century; it was less consequential than other prevailing infections such as smallpox, typhoid and typhus, which were often fatal in those times. [7] There were many speculations as to the cause of the ailment. "Some speculated that seeds or germs caused the respiratory disease, where as many others saw it as a deadly disease sent by a wrathful god to punish his sinful people."[7]

Today, the disease influenza is known to be a highly contagious airborne viral infection that that causes an acute febrile illness and results in variable degrees of systemic symptoms, ranging from mild fatigue to respiratory failure and death. The signs and symptoms of influenza may differ depending on the age of the victim.

Some of the symptoms of influenza include fever or feeling feverish/chilly, cough, sore throat, runny or stuffy nose, muscle or body aches, headaches, and fatigue (tiredness). Some people may have vomiting and diarrhea, though this is more common in children than adults. Also, not everyone with the flu has a fever. The disease is sometime mistaken as the common cold mainly because of its symptoms. See Table 1 for differentiation between the two entities.

Table 1: Differences between influenza and the common cold.[8]

Symptom	Influenza	Cold
Fever	Usually present and high (102°F to 104°F or 38°C to 41°C); lasts 3 to 4 days	Uncommon
Headache	Very common (can be severe)	Uncommon
Aches and pains	Common and often severe	Slight
Fatigue and weakness	Starts early; can be severe and can last up to 14 to 21 days	Mild
Extreme exhaustion	Very common at the start	Never
Stuffy nose	Sometimes	Common
Sneezing	Sometimes	Common
Sore throat	Sometimes	Common
Chest discomfort, cough	Common	Mild to moderate, hacking cough
Complications	Can lead to pneumonia or respiratory failure; can worsen a current chronic condition; can be life-threatening	Can lead to sinus congestion or earache

There are three main influenza virus types. They are A, B and C with types A and B being the most important in humans.[6] Type A virus causes the greatest morbidity and mortality. Type A viruses can be sub-typed. The 2009 pandemic influenza A (H1N1) and H3N2 are currently prevalent subtypes. The influenza virus is one of the most elusive viruses known to medical science because of its constant change to circumvent protective antibodies that have developed after prior exposure to or flu vaccines. The virus undergoes minor changes changes every two to three years [9], after much of the world population has achieved some degree of resistance to these minor changes, the virus evolves drastically, allowing it to easily infect large populations around the world and often affecting hundreds of millions of people whose immune defenses are not adequate to withstand the onslaught. Mike Adams gives a vivid timeline of influenza outbreak in his article in Nature News.[10]

Influenza A H1N1 Viruses

The influenza A H1N1 strain (also known as swine influenza or swine flu) is a descendant of the virus that caused Spanish Flu, which was a pandemic disease in the earlier decade of the 20th century between 1918-1920.[52] After that pandemic, some of the virus persisted in pigs and has circulated in pigs, humans and birds throughout the twentieth century, contributing to the annual seasonal influenza. The influenza A H5N1 virus does not regularly affect the human population, however, there are sporadic cases of infections due to this virus in humans usually among pig and poultry workers. [11,12] The influenza A virus can mutate and it is feared that additionally, through a process called reclassification, it might acquire characteristics that allow transmission between people. Direct transmission from pigs to humans was rare, with only 12 recorded cases in the U.S. since 2005 until the recent pandemic of 2009.[13]

The pandemic due to influenza A (H1N1) of 2009-2010 in humans (which is the topic of this review), was not caused by a virus exclusive to a pig. Its cause was a new strain of influenza A H1N1 that contained genetic material combined strain of human influenza virus, a strain of bird flu virus, and two separate strains of swine flu virus. [14] The origin of this virus was initially unknown and in May 2009, the World Organization for Animal Health (OIE) reported that the virus has not been isolated in pigs.[15]

Background of Pandemic Influenza A H1N1 2009

Swine influenza viruses are native to swines in North America[16,17] and since 1970, there have been a and isolated reports of human infection with these viruses.[18] Globally, there have been over 50 reported cases of swine influenza virus[18,19]

Between March and early April 2009, Mexico experienced outbreaks of respiratory illness which was subsequently confirmed by CDC and Canada to be caused by the novel virus.[20] The new influenza strain was genetically similar to viruses isolated in the US.[21] After the recognition of the novel influenza A (H1N1) 2009 virus in Mexico and the United States the disease spread across the world with lightning speed. At the beginning of May, the disease Influenza A (H1N1) had spread to 12 US states, [22] while Mexico had 260 confirmed cases with 12 deaths and an additional 21countries had reported cases of the disease. At that time there was a total of 1,882 confirmed cases worldwide. [18]

In April 2009, Adela Maria Gutierrez, a Mexican tax worker and a resident of Oaxaca, became the first reported H1N1 casualty in the world and the news coverage of this and other surrounding event send fears all over the world. This had a huge impact in the world especially in Mexico where tourism is one of the major income sources for the people. Before the current

outbreak of influenza A (H1N1) in 2009, there had been reported cases of illness including seven in both previously healthy persons and those with preexisting medical conditions (including pregnancy). [23,24] The signs and symptoms of influenza A (H1N1) infection in humans mimic that of an infection with seasonal influenza viruses and are often indistinguishable. [25]

Prevention and treatment of pandemic influenza A (H1N1) 2009

Prevention efforts for pandemic influenza (H1N1) are similar to those for seasonal influenza. They are most effective if taken collectively than individually. At the individual level, preventive measures are extreme hygiene measures: no kissing or shaking hands and avoiding crowded places (metro, auditoriums, schools, churches, banks, etc).[36] Use of masks and washing hands often with soap or disinfectants like alcohol also are recommended. Medical help should be sought when one develops a sudden high temperature or other symptoms of the disease. In offices and internet cafes, keyboards and mice should be cleaned with alcohol to disinfect and prevent a possible spread of the virus.[53] At risk-populations such as health care workers, pregnant and breastfeeding women, children, and immune-compromised patients, should be vaccinated against the disease usingthe vaccine designed specifically for the current swine flu virus H1N1. The strategies of vaccination for the prevention and control of pandemic influenza A (H1N1) 2009 virus typically include the use of much bivalent virus vaccine(a vaccine that contains two antigens.).[37] Antibiotics have no preventive value as the disease is viral in orgin and not bacterial. Antibiotics should only be used for the disease in cases where there is a simultaneous or secondary infection with bacteria and that should be done under medical care. At the community level, an epidemic can be prevented by taking precautionary measures at the population level such as change in certain patterns and/or habits. Such changes in pattern or

behavior include, but are not limited to, covering one's mouth and nose before sneezing, not exchanging kisses on the face, not contaminating food and water with fluids from the mouth or nose, repeated hand washing as often as possible, etc. [38]

All the above stated strategies would require community prevention campaigns through school, churches, media, hospitals, etc. Trying to raise social standards for these precautionary measures would probably have more impact than simply performing an informational campaign.

Treatment of symptomatic cases of the disease is primarily based on analgesics. Causal treatment is based on antiviral substances that interfere with virus replication, of which there are two classes. They are the viral enzyme inhibitors called neuraminidase and adamantanes. The neuraminidase preserves the effectiveness and the ability to prevent serious influenza development. There are two substances in this class, oseltamivir (Tami flu brand name in United States) and zanamivir (Relenza brand name in United States). Tests on viruses show that the pandemic influenza A (H1N1) virus is sensitive to neuraminidase inhibitors but resistant to the adamantanes (amantadine and rimantadine) [39]

Literature Review2: Influenza in Africa

Titles and abstracts of over 70 published articles were screened. About 30 of them are included in this report. There was a substantial variation in the studies on the basis of testing methods, clinical case definition, influenza isolates obtained, type of study (qualitative or quantitative), etc. Most of the countries in sub-Saharan Africa did not have information on the disease. A few countries such as Kenya, Nigeria, South Africa, Madagascar and others had published information. Asidefrom South Africa, which had consistent data on pandemic influenza A (2009), no other country in the region seemed to have consistent data. Madagascar also had consistent report during an outbreak of H1N1 in one of the high schools in that country. [41]

Pandemic Influenza A (H1N1) and its impact on sub-Saharan Africa

On May 29, 2009, an update on Pandemic influenza A (H1N1) 2009 published by the WHO showed the presence in 53 countries but non in any African county. [26] Four days later, the first confirmed case of influenza A (H1N1) 2009 on the African continent was reported in Cairo, Egypt on June 2nd, 2009, in a 12 year old girl returning from the USA with her mother after spending the summer there.[27] However, the first confirmed case of H1N1 apparently with origin in the WHO African region (mainly sub-Saharan Africa countries) was reported in South Africa on June 18th, 2009.[28] Almost 2 weeks after the first confirmed case, another case was reported in Kenya on July 1st.[29] Three days after that, there were new ten cases of the disease in five countries: Cape Verde, Algeria, Ethiopia and Cote d'Ivoire.[28] Due to the lack of surveillance and diagnostic resources in countries in sub-Saharan Africa, there was little report or understanding

of the disease. However, by January 31 2010, more than half of all sub-Saharan countries had reported a confirmed case of the disease.[30]

It appears most sub-Saharan African countries did not experience any significant pandemic activities compared to other parts of the world. See tables 2 and 3 below. Also, due to the lack of surveillance systems it is hard to estimate the effect that pandemic Influenza A (H1N1) 2009 had on most of these countries in sub-Saharan Africa. One cannot assume that the population in sub-Saharan Africa has a pre-existing immunity to pandemic Influenza A (H1N1) as is the case in amongst some other people in the developed world because there is not enough evidence to make such a suggestion. As such it can be said with confidence that the lack of cases in most sub-Saharan African countries was mainly due to lack of surveillance systems or the disease being mistaken for other febrile illness such as malaria, which mimics the clinical picture of influenza.

Table 2: Laboratory-confirmed cases of pandemic (H1N1) 2009 as officially reported to WHO by States that are arties to the IHR (2005), as of 23 August 2009[31]

Region	Cumulative total	
	As of 23 Aug 2009	
	Cases*	Death
WHO Regional Office for Africa (AFRO)	**3843**	**11**
WHO Regional Office for the Americas (AMRO)	110113	1876
WHO Regional Office for the Eastern Mediterranean (EMRO)	3128	10
WHO Regional Office for Europe (EURO)	Over 42,557	At least 85
WHO Regional Office for South-East Asia (SEARO)	15771	139
WHO Regional Office for the Western Pacific (WPRO)	34026	64
Total	Over 209438	At least 2185

*Given that countries are no longer required to test and report individual cases, the number of cases reported actually understates the real number of cases.

Table 3: The countries and overseas territories/communities that have newly reported their first pandemic (H1N1) 2009 confirmed cases since the last web update (No. 80). [32]

Region	Deaths*
WHO Regional Office for Africa (AFRO)	**130**
WHO Regional Office for the Americas (AMRO)	At least 6670
WHO Regional Office for the Eastern Mediterranean (EMRO)	693
WHO Regional Office for Europe (EURO)	At least 2422
WHO Regional Office for South-East Asia (SEARO)	1056
WHO Regional Office for the Western Pacific (WPRO)	1249
Total*	At least 12220

* The reported number of fatal cases is an under representation of the actual numbers as many deaths are never tested or recognized as influenza related.

The impact of trhe disease in South Africa, one of the few countries in sub-Saharan Africa that boasts of good and comprehensive surveillance system to monitor influenza disease, can be used a proxy for the impact of the disease in sub-Saharan Africa. In other words, I may try to extrapolate the impact of influenza disease on South Africa to other countries in that region. It must, however, be noted that South Africa is arguably the richest country in Africa and the climatic conditions in the country are different from other countries in the region. Also, there are cultural differences between and within the different countries of the region and so extrapolated assumptions may not hold true.

Figure 1: Map of South Africa and affected areas. [33]

The map above shows the provinces in South Africa and the areas in which pandemic Influenza A (H1N1) 2009 cases and casualties was reported in the country. By mid-February 2010 in Gauteng Province, there ware 5585 cases of pandemic influenza A (H1N1) 2009, with 13 deaths;

in the Kwazulu Natal province, there were 22 death from 2258 cases. A much higher death rate was reported in the Western Cape province, where there were 40 deaths among 2115 reported cases. Table 4 shows the number of cases and deaths in different parts of the country.

Table 4: Number of pandemic influenza A(H1N1) 2009 cases and deaths by Province, South Africa, 15 February, 2010 [34,35]

Province*	Laboratory-confirmed cases †		Laboratory-confirmed H1N1 deaths ‡		
	Cumulative total	Incidence rate (per 100 000 population)	NHLS	Private Sector	Total
Eastern Cape	682	10.26	7	3	10
Free State	314	10.82	2	0	2
Gauteng	5,585	53.03	9	4	13
KwaZulu-Natal	2,258	21.61	7	15	22
Limpopo	545	10.43	0	0	0
Mpumalanga	500	13.86	1	0	1
Northern Cape	134	11.68	2	1	3
North West	465	13.48	1	1	2
Western Cape	2,115	39.48	36	4	40
Unknown	42	-	-	-	-
South Africa Total	**12,640**	**25.63**	**65**	**28**	**93**

† An individual with acute respiratory infection in whom pandemic influenza A(H1N1) 2009 infection has been laboratory-confirmed. Incidence rate calculations based on 2009 mid-year population estimates published by Statistics South Africa .

Table 5: Selected clinical characteristics of pandemic influenza A(H1N1) 2009 related deaths, South Africa, 15 February, 2010. [34,35]

Factor	Frequency of factor / Number of cases with data available	%
HIV infected	19 / 38 tested	50
Pregnant or puerperium	26 / 91	28
No co-morbidities identified	20 / 85	23
Diabetes	11 / 83	13
Obese	18 / 84	21
Cardiac disease†	8 / 82	10
Active tuberculosis (TB)	9 / 83	11

†Cardiac disease includes: previous stents, mitral stenosis, cardiomyopathy, congestive cardiac failure, previous valvular replacement, recent myocardial infarction, and previous cardiac bypass surgery; excludes hypertension.

The tables above shows the distribution of the disease in the different provinces of South Africa and the population that were most affected. Most of the people affected were those with underlying conditions such as HIV, active TB, pregnancy, cardiac disease, etc. Because these conditions are in abundance in the sub-region, it can be assumed that, but for lack of comprehensive surveillance system, most countries would have reported similar results. It can therefore be concluded that the disease had an unconfirmed but severe impact on child and maternal mortality, mortality rates amongst TB and HIV infected patients, as well as the poor throughout the region.

DISCUSSION

Most of the published data are from models and extrapolation conducted by European Union (EU) members such as Britain; therefore, there was bias towards EU data and policy. Data from South Africa and Nigeria were reported in 3 or more studies each. However, two of the studies from Nigeria were excluded from this review, as they were based on animals. Some of the studies had inconsistencies between the report and the abstract. In addition, not all the data was peer-reviewed.[40]

Two studies in Nigeria and Kenya sought the knowledge of health care workers about the pandemic influenza (H1N1) virus[40,42] while about three studies discuss the capabilities of the healthcare system in sub-Sahara Africa to handle an epidemic. [41,45] Others reports studied the resistance of the virus to Oseltamivir and the effect this would have on the populace should there be an outbreak of the disease. However one theme runs along all the studies and that is the lack of comprehensive surveillance systems and personnel in the region to monitor any outbreak or epidemic in the region.

Limited available data suggest that health care workers do not have a complete knowledge of H1N1 infection and disease. A study by Fatiregun et al on the knowledge among senior healthcare workers at a secondary heath care institution in Southwest, Nigeria showed that health care workers demonstrated a fair knowledge of disease due to influenza H1N1 strain.[43] Out of 91 senior health care workers (HCW), which included medical doctors, nurses, laboratory scientists, pharmacists, etc., only 31% of the 92 HCW who took part in the studies knew that swine flu virus is Influenza A(H1N1) (see Appendix 1).[40] About half (51.6%) knew the virus can be transmitted from one person to another while 31.9% knew that transmission can occur following contact with contaminated objects.[40] Also, according to Martin Enserink, researchers

and practitioners in Africa know very little about influenza pattern of spread and severity in Africa as shown by the 2002 and 2003 outbreak of influenza in Madagascar and the Democratic Republic of Congo that killed many of people.[45]

Similarly, another study in Kenya that sought to determine HCW willingness to receive H1N1 vaccine showed that most workers were willing to receive it (89%) so long as they received enough information on it and administration was free (see Appendix 2).[42] However in many group discussions, the authors found that most of the respondents were adamant against being vaccinated because of the lack of evidence of vaccine safety and efficacy.[42] Nevertheless, the overall willingness to accept the vaccine among health care workers in Kenya (89%) in this study is far higher than reported acceptance levels of HCWs for the vaccine in some developed countries.[42,46,47] For example in a recent survey of HCWs in Greece, an acceptance rate of 17% for pH1N1 vaccine was reported.[46] Another survey in Hong Kong in 2009 reports only a 27% acceptance rate. [47]

Limited Surveillance Ability of Health Systems in Africa

This review found little available information about the activity of pandemic influenza in most African countries. Yazdanbakhsh and Kremsner suggest relatively little is known about influenza behavior in tropical countries, and even less about the disease on the African continent, and that it is important to have a comprehensive surveillance facility in this as well as all other parts of the world.[4] The recent pandemic due to 2009 H1N1 influenza virus has shown the need for public health professionals and surveillance for a country to be able to attend to such emergencies rapidly. However, many countries in sub Saharan Africa lack public health personnel as well as surveillance systems.[50]

Most countries have no lab capacity whatsoever, and surveillance systems cover only a tiny fraction of Africa's massive geography.[45] The absence of H1N1 in most African countries does not indicate the absence of the disease in these countries but rather that there is no one looking for the disease in these countries. Sub Saharan Africa has a high burden of many diseases which has already crippled the health system of most countries. Patients are hard to reach, antibiotics to treat secondary infections are in short supply, intensive care units are barely existent, and general awareness about influenza is minimal.[47]

Schoub, in his review paper on surveillance and management of influenza in Africa stated that because of the nonspecific clinical presentation of influenza, the disease is often mistaken as malaria and is treated as such.[49] However a study in Gabon at the Lambarene Research center showed that only 5% of nonspecified illness presents with pyrexia turned out to be malaria when evaluated by blood smear.[4]

An assessment of Swine influenza control and pandemic preparedness in Africa called the Integrated National Action Program on Swine and Human Influenza (INAP) was implemented in 26 African countries from 2006-2009 by the Africa Livestock Partnership (Alive), in collaboration with the Food and Agricultural Organization of the United Nations (FAO), World Organization for Animal Health (OIE), World Health Organization – Regional Office for Africa (WHO-AFRO), and African Union Interafrican Bureau for Animal Resources (AUIBAR).[51] The Integrated National Action Program on Avian and Human Influenza (INAP) identified weak surveillance and insufficient laboratory capacity to be the most serious concerns in the ability of countries to deal with H5N1 Highly Pathogenic Avian Influenza (HPAI) outbreaks or a pandemic.[51] With underinvestment from national governments, there will be implications for sustainable Swine influenza surveillance.

Communal transmission of pandemic H1N1 in Africa

A survey of pupils in a boarding school where an outbreak of Pandemic H1N1occured showed that the disease initially occurred in the school and within a few days it spread to the community.[41] The survey showed that after the first three days of the outbreak and after antiviral prophylaxis for all the boarders, no more boarders were reported ill during the following week. At the same time, attendance rates for the school showed an increase in absenteeism each day. Thus the outbreak was spreading in the overall school population while a decrease within the sub-population of boarders was observed. This also indicates that if transmission occurred first within the school, it subsequently occurred outside over the following weeks.[41]

Oseltamivir is not very efficacious in treating Pandemic H1N1 Influenza Infection

Most people who used antiviral drugs for prophylaxis after an outbreak of Pandemic H1N1 disease in a boarding school in Madagascar still subsequently developed symptoms of the disease.[41]A study by Rajatonirina suggest that about 50.6% of pupils who took at least one antiviral (Oseltamivir) still reported symptoms of the disease (See Appendix 3)[41]. Also, a high proportion of these schoolchildren also might have experienced adverse effects from oseltamivir medication. Over half of those who took the medication reported at least one possible adverse effect including headaches, difficulties concentrating, and tiredness. If these symptoms reflect the recognized adverse side effects of oseltamivir prophylaxis, they are higher in frequency compared with the manufacturer's information.[46] The manufacturer of the antiviral Oseltamivir has reported that the medication, when used for prevention purposes, has an 18% chance of causing headaches and 8% chance of causing asthenia. [48]

CONCLUSION

The findings from this study suggest that the surveillance of pandemic influenza (H1N1) in sub-Saharan Africa is poor and very limited. It is heavily dependent on donor investment from the West. It appears that some counrties have more support for surveillance, and from a greater number of donor agencies, than others. The countries with more donor support are clustered in the southern part of the region and this leads to bias in surveillance favoring the countries receiving more funds. The reason for this disparity in funding is not known; it is not clear whether this relates to greater funding for areas of greatest disease risk, as regional resources are limited.

Coordination between donor agencies is needed to prevent the duplication of programs in one country and none in another. There is the need to have one reference laboratory with subsidiaries in all countries in sub-Saharan Africa so that they can provide technical support and coordination to regional surveillance to allow data to be centralized. This would lead to a system producing a more comprehensive and meaningful epidemiological analysis, such as that by the Centers for Disease Control And Prevention (CDC) in the USA.

Pandemic influenza A did affect all countries in sub-Saharan Africa but it was not documented to have as significant an effect on the population as was anticipated. It is not known whether this was due to poor surveillance in the region, misdiagnosis of the disease, or due to high levels of preexisting immunity in the population for the disease. The findings from this literature review suggest that that the former two possible factors are true - that the poor surveillance system in region led to misdiagnosis of the disease and thus the low number of cases documented during the peak of the epidemic.

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Appendix 1: Knowledge of Influenza H1N1 by respondents in Kenya,2010.[42]

Knowledge areas assessed	**Mean Scores***
Knowledge of swine flu viruses	0.8±1.1 (5)
Mode of transmission	2.5±1.1 (5)
Common sign/symptoms	5.9±3.1 (10)
Knowledge of primary prevention	4.3±2.3 (8)
Knowledge of secondary prevention	5.8±2.8 (11)
Knowledge of indications of emergency care	4.3±2.4 (8)
Knowledge of care of infected persons	3.0±2.0 (8)
Knowledge about the current pandemic	3.1±1.4 (7)
Overall knowledge score	30.8±11.3 (62)

*± standard deviation per knowledge area assessed (maximum score)

Appendix 2: Healthcare workers' knowledge and attitudes towards infection with and vaccination against 2009 pandemic influenza A (H1N1), Kenya, 2010.[42]

	N/total (%)
What symptoms are associated with pandemic H1N1 flu?	
Cough	481/659 (73.0)
Runny nose	558/659 (84.7)
Diarrhea	72/659 (10.9)
Fever	575/659 (87.3)
Shortness of breath	224/659 (34.0)
Sore throat	357/659 (54.2)
Who is at high risk for complications from pandemic H1N1 flu?	
Healthcare workers	488/659 (74.1)
People over 60 years old	298/659 (45.2)
Pregnant women	332/659 (50.4)
Young children less than 5 years	406/659 (61.6)
People with chronic diseases like asthma	323/659 (49.0)
People with HIV/AIDS	340/659 (51.6)
Young, healthy adults	112/659 (17.0)
Do not know	15/659 (2.3)
Have there been cases of pandemic H1N1 flu in Kenya?	
Yes	598/652 (91.7)
No	34/652 (5.2)
Do not know	20/652 (3.1)

Have there been cases of pandemic H1N1 flu in your hospital or clinic?	
Yes	171/643 (26.6)
No	366/643 (56.9)
Do not know	106/643 (16.5)
Can pandemic H1N1 flu be severe enough to cause a person to be hospitalized?	
Yes	613/650 (94.3)
No	24/650 (4.6)
Do not know	13/650 (2.0)
Can people die from pandemic H1N1 flu?	
Yes	594/656 (90.5)
No	37/656 (5.6)
Do not know	25/656 (3.8)
If a pandemic H1N1 flu vaccine were available for free in Kenya, would you get it?	
Yes	575/645 (89.1)
No	43/645 (6.7)
Do not know	27/645 (4.2)
If yes, what would be your main reason for getting the vaccine?	
To protect myself from pandemic H1N1 flu	485/565 (85.8)
To protect my patients from pandemic H1N1 flu	22/565 (3.9)
To protect my family members from pandemic H1N1Flu	30/565(5.3)
Other	28/565(5.0)
Is pandemic H1N1 flu vaccine effective in protecting people from pandemic H1N1 flu?	
Yes	380/631 (60.2)

No	36/631 (5.7)
Do not know	216/631 (34.2)
Can vaccinating healthcare workers with pandemic H1N1 flu vaccine prevent the spread of pandemic H1N1 flu to patients?	
Yes	521/647 (80.5)
No	77/647 (11.9)
Do not know	49/647 (7.6)
Where do you get current information on health-related matters?	
Media (newspapers, radio, television)	497/645 (77.0)
Internet	268/645 (41.6)
Other health care employees	308/645 (47.8)
Communications from the Ministry of Health or continuing medical education	430/645 (66.7)
Community/religious leaders	168/645 (26.0)
Where have you learned the most about pandemic H1N1 flu?	
Media (newspapers, radio, television)	474/645 (73.4)
Internet	268/645 (41.6)
Other health care employees	138/645 (21.4)
Communications from the Ministry of Health or continuing medical education	319/645 (49.5)
Community/religious Leaders	68/645 (10.5)

Appendix 3: Frequency of different adverse effects among boarding school pupils in Antananarivo, Madagascar who took at least one oseltamivir tablet.[41]

Symptoms	Number of pupils	Percentage (%)
Nausea	10	8,1%
Headache	24	19.4%
Tummy ache	4	3.2%
Feeling tired	48	38.7%
Vomiting	4	3.2%
Hard to concentrate	28	22.6%
Sleeping sickness	15	12.1%
Diarrhoea	2	1.6%
Skin rash	4	3.2%

N = 124