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FOREWORD

We are pleased and honoured to launch the inaugural issue of our monthly online open access publication of *The Health Press – Zambia* (THP-Z) this January 2017. A quarterly print version is planned for April 2017 onwards.

The Health Press - Zambia is a publication of the Zambia National Public Health Institute, which was established in February 2015. Even though every public health threat can be reduced if its scope and cause are not only known, but shared with policy makers and the public, much information gathered about public health concerns in Zambia is buried in reports that are not well used for decision making. *The Health Press – Zambia* has been established in recognition of the need to communicate reliable health information to policy makers, public health practitioners, and the general public. The contents of the publication are selected by the Editor in Chief; the publisher is the Zambia National Public Health Institute. The financial obligations including staff salaries and publication costs are provided by the Zambian government and Bloomberg Philanthropies though the CDC Foundation.

The Health Press – Zambia aspires to be a leading publication that informs policy makers, public health practitioners, and the general public by effectively and expeditiously disseminating influential scientific information and recommendations that will improve public health in southern Africa and beyond, especially for underserved and poor populations. The long-term goal is to provide a platform for public health professionals in this region and beyond to publish their work as a means to advance the science of public health. *The Health Press Zambia* aims to publish a variety of articles of public health significance including analyses of surveillance data, outbreak reports, reviews of public health problems and policies, and other reports with information of use to persons concerned about public health.

The Health Press – Zambia online issue will be accessible worldwide cost-free via the internet. There are no processing fees for publishing in the bulletin. No subscription fees will be charged, but readers are expected to subscribe to the publication to enjoy continuous access. Our editorial policy is guided by a commitment to high standards, ensuring quality and integrity, and is managed by a team of Associate Editors with diverse expertise. All policies guiding authorship, editorial processing, and copyright matters are spelled out on the website. This being our inaugural issue, we will be getting back to you with a survey to get feedback on the bulletin. We encourage you to subscribe to *The Health Press - Zambia* on http://znphi.co.zm/thehealthpress/ and 'like us' on our Facebook page, The Health Press - Zambia and follow us on LinkedIn and Twitter.

This inaugural issue of *The Health Press - Zambia* focuses on anthrax in Zambia, with a review of anthrax outbreaks in Zambia, a report on the 2015 anthrax outbreak in Chama district, a report on an anthrax outbreak in Western province, and a report on the anthrax policy in Zambia. Other reports include an article on laboratory-confirmed urinary tract infections, a communication on the antimicrobial resistance program in Zambia, a case study from a forensic pathologist, and a report on trends in population health.

Mazyanga L. Mazaba
Editor-in-Chief

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EDITORIAL

Anthrax— A worldwide, regional and national disease of public health of importance

ML Mazaba

Editor-in-Chief, *The Health Press- Zambia*, Zambia National Public Health Institute, Lusaka, Zambia

Anthrax has a long history in public health from ancient times to the present. It is a zoonotic disease caused by the gram-positive spore-forming bacterium *Bacillus anthracis* primarily affecting domestic and wild herbivores including cattle, sheep, goats, bison, deer, antelope and hippos among others [1]. Although primarily an animal disease, it is transmissible to human beings. Human to human transmission is very rare. A literature review on the history of major anthrax outbreaks globally indicates serious losses among animals including one that is believed to have killed 40,000 horses and 100,000 cattle herded by the Huns as they trekked across Eurasia, another in the 14th century in Germany, and one in the 17th century that killed over 60,000 cattle in Europe [2]. Although controlled in some regions such as the United States of America and Canada, anthrax is distributed globally and more commonly enzootic in sub-Saharan Africa, Asia and Central and South America [3]. Although a rare infection among humans, anthrax continues to be a disease of public health concern despite a vaccine being available. In 2016, multiple outbreaks were documented: an outbreak among reindeer occurred in Siberia affecting dozens of persons, several outbreaks in Kenya affected animals and humans including an outbreak in Nakura associated with contact with infected buffalos [4]; another affecting over 70 persons in Maragua and Sanbura counties associated with anthrax-infected cattle, sheep and zebra. Human fatalities were recorded including a 73-year-old in Maragua and 7-year-old in Sanbura who tested positive for anthrax. Several animals that were ill or died tested positive for anthrax infection [5]. Other outbreaks in 2016 were reported in Shirajganj, Bangladesh affecting up to 125 persons associated with eating meat from anthrax-infected animals [6]. Up to six human fatalities linked with eating anthrax-infected beef in the Niger Republic were reported in October 2016 [7]. In France, anthrax outbreaks were found among sheep and cattle while in northeastern Bulgaria, only were affected with four fatalities among the animals. The outbreak in north-eastern Bulgaria could be linked to the

2015 outbreak that affected both humans and animals [8]. Zambia experienced two outbreaks in 2016 affecting over 80 persons and 20 animals in Chama district in Muchinga province and dozens of people and animals in four districts, namely Shang'ombo, Nalolo, Limulunga and Kalabo of Western province. In both outbreaks, infections among humans was associated with infections in hippos and buffalos in the former and dozens of cattle in Western province [9]. The outbreak in Western province is still ongoing in 2017 but under control with animals being vaccinated and patients being given medical treatment. A cumulative total of 67 persons (with one fatality) and dozens of animals are affected [10]. All outbreaks among humans have been associated with contact with or consumption of anthrax-infected meat.

The natural transmission of anthrax to humans from the natural hosts, wild and domestic animals, is through direct or indirect contact with carcasses of animals that died from anthrax; consumption of meat from infected animals; or inhalation of spores aerosolized during work with contaminated materials such as animal hides and wool. However, infection has also resulted from inhalation through acts of bioterrorism [11]. Quite recently, an emerging form of anthrax infection is injection anthrax among injection drug users [12]. Since 2009, cases of injection anthrax have been reported from Denmark, France, Germany and the United Kingdom. Berger et al. [13], who reviewed reporting systems until through December 2013, reported 70 confirmed cases with 26 fatalities (case fatality rate = 37%).

Natural anthrax infections occur in three forms including lung (pneumonia), skin (cutaneous) and intestinal anthrax. Cutaneous anthrax is the most common (>95%) form of naturally occurring anthrax among humans [14]. The common characteristic of cutaneous anthrax is a black eschar on the skin of an infected person, hence the name anthrax derived from the Greek word *anthrakos* meaning coal [15]. In 2001, several media offices and two United States senators were exposed to anthrax spores sent through the post leading to 17 infections and five deaths [16]. Lung anthrax most often occurs as a result of a bioterrorism act, when anthrax spores are inhaled. In 1979, the largest outbreak of human inhalation anthrax ever documented occurred in Sverdlovsk near a Soviet military microbiology facility [17]. Intestinal anthrax occurs after ingestion of undercooked anthrax-infected meat [1].

Although control and awareness programs are being implemented in most countries, there is a need for a "one health" approach to prevent and control further outbreaks. There is a need for authorities to address the connections between anthrax outbreaks, environmental concerns, and food insecurity.

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RAPID COMMUNICATIONS

Antimicrobial Resistance (AMR)- A growing global health threat

O Kapona

AMR National focal point, Ministry of Health, Lusaka, Zambia

Correspondence: Otridah Kapona (O.Kapona@znphi.co.zm)

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Antimicrobial resistance (AMR) is the ability of a microorganism to withstand treatment with an antimicrobial drug. The rapid emergence of AMR has for several decades been a growing threat to the effective treatment of an ever-increasing range of infections caused by bacteria, parasites, viruses and fungi. The magnitude of the problem, the impact of AMR on human health, the costs for the health-care sector and the wider societal impact are potentially immense.

Globally it is estimated that AMR will be responsible for up to 10 million deaths annually by 2050 if nothing is done to contain and prevent its spread [1]. Therefore, AMR is currently a major emerging international public health concern with potential to slow down human development (SDG-3).

In Zambia, like in many other countries, there is emerging evidence of antimicrobial resistance (AMR) in several pathogens. The University Teaching Hospital, the highest-level hospital in Zambia has been detecting multi-drug resistant pathogens, resistant to the first, second and third line antimicrobial agents, which has left very limited options for antimicrobial therapy for infectious diseases Superbugs, which are difficult to treat microorganisms have been detected. These include pathogens such as Methicillin Resistant Staphylococci (MRSA), Extended Spectrum Beta-lactamase producing *Klebsiella pneumoniae*, and other multidrug resistant enterobacteria. High resistance to most antibiotics used to treat serious conditions such as blood stream infections have been reported. Resistance as high as 80% ciprofloxacin, ceftriaxone 90%, and Gentamicin 70%, has been reported in some blood stream strains with very limited expensive options for therapy [2]

Because antimicrobial resistant organisms have the potential to move between food producing animals and humans by direct exposure or through the food chain or the environment, AMR is therefore, a multisectoral problem encompassing the interface between humans, animals and the environment [3]. The fact that human and veterinary health, food and feed production systems and agro-ecological environments all contribute to and are affected by AMR, indicates the need for multi-sectoral and multi-dimensional "One Health" approach to curb its occurrence. The FAO/OIE/WHO tripartite, together with public and private organizations, share responsibilities for addressing global activities regarding AMR at the animal-human-ecosystem interfaces.

Zambia has adopted this "One Health" approach and, over the past one year, there has been activities being undertaken to develop a multisectoral National Action Plan (NAP) to combat and stop the spread of AMR. The NAP is intended to institute strategic interventions in all key sectors relevant to this fight, that is, the human, animal, plant, and environment sectors. Currently, a nationwide situation analysis study is underway to establish the baseline in all sectors in terms of antimicrobial use and assess capacity to carrying out effectively AMR related control and mitigation measures.

It is expected that the findings from the situation analysis will be utilized in finalizing the NAP, which is due to be presented to the World Health Assembly (WHA) in May 2017, by the Minister of Health.

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SURVEILLANCE REPORT

Tuberculosis burden in Southern province, Zambia, 2004 to 2013: Analysis of routine Tuberculosis surveillance data

F Hadunka[1,2], R Kumar[3], NW Chilembo[2], CN Jacobs[4], R Hamoonga[5], J Chinyonga[2], C Michelo[4]

1. Zambia Field Epidemiology Training Program, Lusaka, Zambia
2. Ministry of Health, Lusaka, Zambia
3. ASPPH/CDC Allan Rosenfield Global Health Fellow
4. University of Zambia School of Medicine, Department of Public Health, Lusaka, Zambia
5. Zambia National Public Health Institute (ZNPHI), Lusaka, Zambia

Correspondence: Francis Hadunka (fhadunka@yahoo.com)

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Tuberculosis (TB) burden in Zambia is high (410/100,000 population incidence in 2013), but few data at subnational level for monitoring trends in incidence, case fatality rate (CFR), or district distribution are available and routinely collected surveillance data are not regularly analysed. The aim of this work was to determine the TB trends in incidence, treatment failure, HIV testing and positivity, and fatalities in Southern Province, Zambia, during the period 2004 to 2013.

Print and electronic TB registers in Southern Province were reviewed. The data were entered into MS Excel and descriptive analyses were performed. The annual incidence of TB by district and for Southern Province was calculated using population projections from Central Statistical Office. The proportion of TB patients tested for HIV was calculated. Additionally, the proportion of TB patients who tested positive for HIV in each year.

The results indicated a 42% decline in TB incidence from 425/100,000 persons in 2004 to 248/100,000 in 2013. Incidences of TB in by districts varied from year to within the districts. Percentage of sputum-positive TB patients with a negative sputum smear result after completing two months of rifampicin-based therapy improved from 86% (2008) to 88% patients (2013). Percentage of sputum positive TB patients with a negative sputum smear result after six months of the same regimen increased from 86% (2008) to 95% (2013). Percentage of all TB patients who were tested for HIV increased from 78% in 2008 to 96.5% in 2013, while HIV positivity among those tested decreased from 73% (2008) to 65% (2013). CFR among TB patients fluctuated from 7% in 2008 to 5% in 2012 and 8% in 2013.

Although Southern Province experienced overall improvements in trends in TB incidence, cure rates, and HIV testing and positivity, TB CFR remained above the MOH target of 5%. Factors associated with TB mortality in Southern Province require further investigation.

Introduction

In 2013, an estimated nine million people developed TB and 1.5 million died from the disease globally, 360,000 of whom were HIV positive [1]. Over half (56%) of the nine million people with TB were from Southeast Asia and the Western Pacific Region. India and China accounted for 24% and 11% of the total, respectively [1]. In 2013, the treatment success rate continued to be high at 86% among all new TB cases and the HIV testing rate increased to over 75% in 2013 globally [1]. Although TB is slowly declining each year with an estimated 37 million lives being saved between 2000 and 2013 through effective diagnosis and treatment, TB remains a global challenge [1].

An estimated 1.1 million (13%) of the 9 million people who developed TB in 2013 were HIV positive [1]. In combination, HIV and TB enhance each other's progress [1]. People who are infected with HIV are 21 – 34 times likely to become infected with TB depending on the stage of HIV [1,3] as HIV lowers the immune system [4]. Previous research in India [8], Russia [12], Chile [15], Ethiopia [13], and Zambia [10] reported that there is no marked difference on TB treatment outcomes between HIV positive and HIV negative TB patients.

A further 25% of the globally estimate of TB patients in 2013 were from the African region, which also had the highest rates of cases and deaths relative to the population [1]. The African continent also accounts for more than 20% of the TB/HIV co- infection, with more than 30% of these from the sub-Saharan region [1,5].

In Zambia, the incidence of TB has been declining from 591/100,000 in 2004 to 500/100,000 in 2008, 421/100,000 in 2012 and 410/100,000 in 2013 [1, 16, 14, 15]. Zambia has an HIV prevalence of 14.5% distributed among both males and females. Approximately 67% are co-infected with TB [6]. Southern Province is equally affected by HIV with a prevalence of 14.7%. The rural districts are less affected than the urban ones [6, 11].

However, the HIV disease burden is in Zambia is also among the highest globally [17]. And there are few data on the proportion of TB patients who are co-infected with HIV, or the percentage of TB patients who die while on treatment. Although the national TB burden was high in Zambia in 2013 [1], there are few data on the prevalence, incidence, or distribution of tuberculosis and no previous analysis of routinely collected surveillance data has been conducted in Southern province.

In a country with a high burden of TB and HIV, local data are important to inform clinical management recommendations for HIV- TB co-infected patients to reduce morbidity and mortality. The results of this review may be used at various levels of health care to inform targeted and cost effective decisions concerning medical supplies, drugs, and lab testing by policy makers and medical practitioners. Less than a quarter of health institutions have laboratory facilities able to diagnose TB while almost all the health facilities can treat TB.

The objectives of this study were to determine the trends in TB incidence, cure rates, HIV testing and positivity, and case fatalities in Southern Province, Zambia from 2004 to 2013.

Methods:

A descriptive analysis was carried out on secondary data, which were routinely collected at the health facility level in Zambia's Southern Province. Only Livingstone district is urban while the rest of the districts are peri-urban and rural. The TB surveillance system in Southern Province is a paper-based from community level to the first level hospital becoming electronic from the district to national level. This surveillance system is passive from the community to first level hospital becoming active from the district to national level. (Figure 1)

Secondary data were extracted from the paper based and electronic TB registers which included children, women and men of all age groups. All cases diagnosed with and recorded as TB patients regardless of their sputum result and treated from 2004 to 2013 were included. TB/HIV officers extracted routinely collected TB data from both manual and electronic registers kept at the provincial medical office.

The surveillance case definition of a suspected case of pulmonary tuberculosis was any person who presented to any health facility in Southern Province between January 2004 and December 2013 with a cough of more than two weeks in duration with any of the following: night sweats, weight loss, fever, lymphadenopathy, general fatigue, loss of appetite. A confirmed case of tuberculosis was defined as any suspected case with any of the three sputum samples that were collected consecutively and testing positive for tubercle bacilli with Zeil-Nielsen (ZN) stain.

Sputum conversion rate was defined as the percentage of TB patients who were originally sputum positive and tested sputum negative, after completing two months of treatment. Cure rate was defined as the TB patients who were originally sputum positive and tested sputum negative after completing six months of treatment. Death rate was calculated as the percentage of all TB patients who died while on treatment, regardless of their sputum result at diagnosis.

Data on geographical location of patients, sputum results, HIV status, and outcomes of treatment were collected; however, no laboratory tests were done although some cases of TB had sputum results available while others did not. Using a data extraction tool in MS Excel, all the data from all TB cases routinely documented and notified as positive between 2004 and 2013 regardless of laboratory confirmation were extracted.

The annual incidence (per 100,000 persons) of TB for each district was calculated using total population of each district for that year as given by the Central Statistical Office. The overall incidence of TB for Southern Province was calculated by adding all the reported TB cases for all the districts for each year and dividing this by the total population of Southern Province. The percentage of sputum-positive TB patients who recorded a sputum-negative result after two and six months of Rifampicin-based therapy was calculated.

The percentage of TB patients who died while on treatment, the proportion of TB patients who were tested for HIV, and the proportion of TB patients who tested positive for HIV were calculated.
Ethical waiver was obtained from the UNZABREC Ethics committee.

Results:

During the period under review, it was observed that the incidence of TB declined gradually by 42% from 425/100,000 population in 2004 to 248/100,000 in 2013 (Table 1). TB is prevalent in all districts of Southern Province with some districts having higher incidences than others. The district incidences also varied from year to year in the period under review 2004 – 2013.

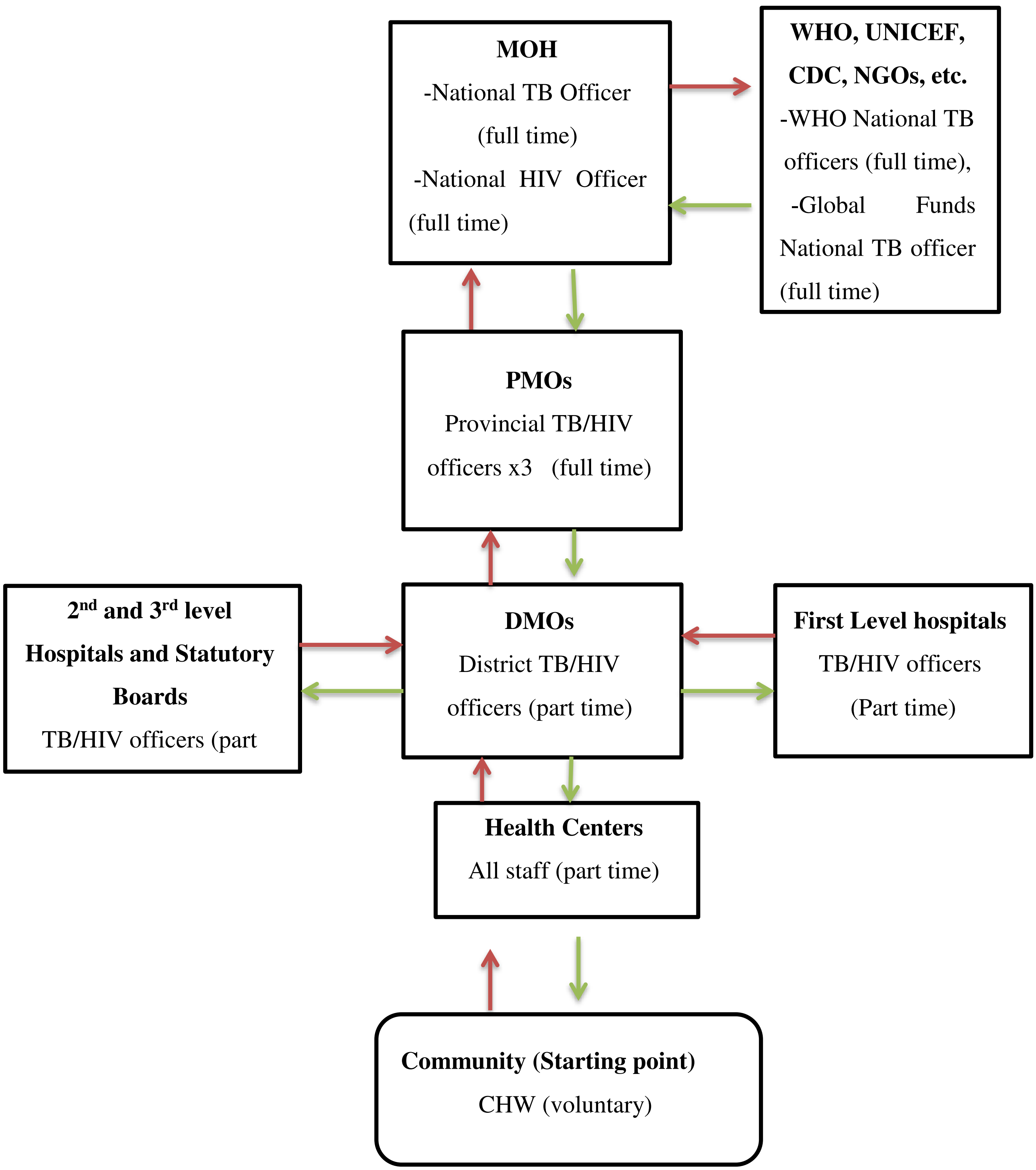

Figure 1. Summary of Southern Province Tuberculosis Surveillance System flow chart with red arrow for reporting while green arrow for feedback

Analysis of the sputum results revealed that the percentage of sputum conversion (sputum positive TB patients who recorded a negative sputum smear result after completing two months of Rifampicin-based therapy), increased from 86% in 2008 to 88% patients in 2013 (Figure 2). The percentage of cure rate (sputum positive TB patients who recorded a negative sputum smear result after completing six months of rifampicin-based therapy), increased from 86% in 2008 to 95% in 2013 (Figure 2).

A review of the HIV testing data showed that the percentage of total TB patients who were tested for HIV at the time of TB diagnosis increased from 78% in 2008 to 96.5% in 2013. Among the total tested for HIV, the percentage of those who tested HIV positive decreased from 73% in 2008 to 65% in 2013. The case fatality rate (CFR) among the patients on TB therapy in Southern Province decreased from 7% in 2008 to 5% in 2012 then went up to 8% in 2013 Zambia.

Discussion

The overall trends of TB incidence and treatment failure and HIV positivity declined over the study period in Southern province, while the HIV testing rate and TB cure rate increased. The case fatality rate fluctuated above the ministry of health (MoH) target rate throughout the period under review.

The provincial 2013 TB incidence declined to just over half of the 2006 incidence, while some district-specific incidences increased as others declined by different proportions. The declining incidences are consistent with the national decline in incidence and a global decline in TB incidences [1, 2, 15]. We hypothesize that this decline could be attributed to improved TB treatment regimen leading to reduced sputum positive cases in

Table 1Reported Cases of Any Tuberculosis by District in Southern Province, Zambia, 2004 – 2009

Cases	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Choma	849	1176	1073	994	956	1050	1029	1002	926	630
Gwembe	34	79	64	54	54	109	120	100	79	77
Itezhi tezhi	88	114	73	177	139	115	0	0	0	0
Kalomo	232	376	406	407	348	417	411	458	220	267
Kazungula	43	260	194	152	142	104	106	122	113	103
Livingstone	909	1337	1463	1586	1630	1410	1361	1184	1180	971
Mazabuka	744	963	848	802	822	84	1007	999	847	681
Monze	577	750	967	1102	1072	874	868	958	729	680
Namwala	71	164	300	181	219	137	139	177	140	173
Siavonga	433	444	490	530	543	530	610	591	537	291
Sinazongwe	242	199	157	150	126	178	141	132	148	151
Total	4222	5942	6120	6145	6051	5008	5792	5694	4912	3994

the community spreading the disease. The decline in incidence could also be attributed to improved accessibility to anti-retroviral therapy, leading to overall improved cellular immunity of the population living with HIV.

The percentage of sputum conversions and cure rates increased to just over 75% over study period. This increase is consistent with global picture as shown in the WHO annual TB report of 2015. This increase in sputum conversions and cure rates could be due the introduction of the rifampicin-based, short and effective therapy, which encourages adherence to treatment.

Almost all TB patients were tested for HIV during the study period, and the proportion of those who tested positive for HIV among those tested in Southern Province reduced from 75% to 67% over the study period. The improved HIV testing rates could be due to the availability of antiretroviral drugs provided with support of The United States President's Emergency Plan for AIDS Relief (PEPFAR) and an increase in the numbers of patients currently on ART by more than three times in the period under review. The reduction in HIV positivity among TB patients could be due to increasing numbers of people tested, thereby increasing the total population at risk. However, the decrease in HIV positivity in Southern Province could also reflect a true decrease in the HIV prevalence of the general population in Zambia [6,7].

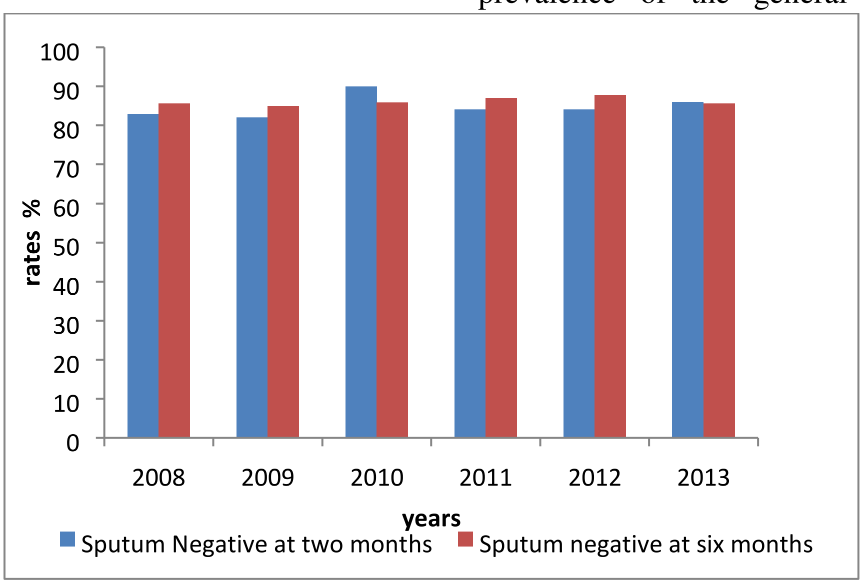

Figure 2 Proportion of Patients with Sputum Smear-Positive Tuberculosis (TB) with a Negative Sputum Smear after Two Months and After Six Months of Anti-TB Therapy – South Province, Zambia, 2008-2013

The CFR among TB patients on TB therapy though not consistent throughout the period under review remained above the MOH target throughout the study period. This result is contrary to the expected finding of reduced TB CFR, considering improved case management of TB with the rifampicin-based regime. Important to note as a study limitation is that the cause death on TB treatment is not the same as TB-caused death. This CFR defined is deaths while on TB treatment, which may not be a true reflection of death due to TB infection.

No laboratory tests were done as secondary data were analysed, additionally not all cases of tuberculosis had sputum results available, and less than a quarter of all health facilities in southern province have laboratory facilities. The limitation mentioned above may not have much influence on this study because secondary data was analysed to give us an idea of what happened over this period. The national TB reports show similar declining incidences in other provinces [8].

Despite the limitations, the study appears to have a number of strengths as these results describe trends as they were recorded over time. Therefore, this study may provide new information on outcomes of TB treatment as the results suggest that improving outcome of treatment by increasing HIV testing among TB patients, increasing ART uptake among HIV infected TB patients and ensuring all TB drugs are in place may not necessarily reduce TB mortality.

The possible causes of the persistent case fatality rate of over 5% in a situation where all the other parameters have improved could be due to various reasons including existence of Multi Drug Resistance TB, poor adherence to treatment by some patients. The health and lives of the people may be improved by investigating further the factors affecting TB mortality and using this information to improve case management of TB patients.

Our findings of declining incidences suggest the effectiveness of control measures and case management. This seems to indicate that even with the improvement in the prevention and treatment of tuberculosis, both morbidity and mortality due to tuberculosis still occurs in Southern province and that routinely collected data can be analysed and help in informed decision making and guiding policy.

Public health officials at district, province, and national levels in Zambia should regularly analyse routinely collected TB data to use for planning and policy direction. Surveillance officers at the district level should work closely with health facilities and local laboratories to maintain and update electronic TB registers to enable regular analysis. Although incidence trends in Southern Province cannot be generalized to the whole country, other provinces use a similar surveillance system and should routinely analyse their data to monitor the effectiveness of TB management.

Further analytical studies should be pursued to understand risk factors associated with TB mortality in Zambia and why CFR in Southern Province has remained above MOH target level of 5%.

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CDC authorship disclaimer: "The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the Centers for Disease Control and Prevention."

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RESEARCH ARTICLES

Anthrax outbreaks and epidemics in Zambia, 1990-2011: A review

S Siziya

Michael Chilufya Sata School of Medicine, Copperbelt University, Ndola, Zambia

Correspondence: Seter Siziya (ssiziya@gmail.com)

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Anthrax is endemic in Zambia. A review was conducted for literature published on the epidemiology of anthrax in Zambia using google, google scholar and PubMed. A total of 7 publications were obtained using search words: anthrax, Zambia, epidemiology, outbreak and surveillance; and of these, 2 were full PubMed Central articles, 4 were abstracts without full articles and one was a citation. In Zambia in 1990, out of 220 human cases of anthrax, 19.1% died; between 1991 and 1998, 7.7% of 248 human cases died; between 1999 and 2007, out of 1790 human cases, 4.6% died; and in 2011, the case mortality rate was 1.2% out of 521 human cases. In Western province of Zambia, the overall cattle:human anthrax ratio was 1:1.47 and a reduction (Slope=0.738, 95% CI [-1.394, -0.083]) in the human case fatality rate was observed between 1999 and 2007. There is scanty information on anthrax in Zambia. The cattle:human anthrax infection ratio was lower than the expected ratio of 1:10 suggesting under-reporting of human cases or good outbreak/epidemic control. A reduction in the case fatality rate indicates good case management. An active surveillance of human cases of anthrax is recommended immediately there is an outbreak of bovine anthrax in order for people to start treatment early and avoid severe forms of anthrax.

Introduction

Anthrax is a disease of public health importance caused by the spore-forming gram-positive rod bacteria, *Bacillus anthracis* and its spores can remain viable in soil for a long time up to decades [1-5]. Outbreaks of anthrax generally occur after a prolonged hot dry period [6] and low pH [7]. Although there are inconsistencies in reports on effects of season, rainfall, temperature, soil, vegetation, host condition and population density on the epidemiology of anthrax, anecdotal evidence suggests that temperature and rains (or drought) and humidity are primary conditions affecting the seasonal variation of anthrax [8]. Animals are infected when they breathe in or ingest spores found in soil, plants, or water. Similarly, people are infected when they breathe in spores, eat food or drink water containing spores, or get infected when spores enter through broken skin [9].

CDC [10] suggests five forms of anthrax: Cutaneous characterized by a painless skin lesion with surrounding oedema, fever, malaise and lymphadenopathy; Inhalation characterized by a prodrome resembling a viral respiratory illness, hypoxia, dyspnoea or acute respiratory distress, mediastinal widening or pleural effusion; Gastrointestinal characterized by severe abdominal pain and tenderness, nausea, vomiting, hematemesis, bloody diarrhea, anorexia, fever, abdominal swelling and septicaemia; Oropharyngeal characterized by a painless mucosal lesion in the oral cavity or oropharynx, cervical adenopathy, oedema, pharyngitis, fever, and possibly septicaemia; Meningeal characterized by fever, convulsions, coma, or Meningeal signs; and Injection among injecting heroin users in which smoking and snorting heroin have been identified as possible exposure routes for anthrax [11]. The most fatal form of anthrax is the inhalation anthrax [12]. Mortality in untreated cutaneous cases can be up to 20% [13-15], 25-60% of untreated gastrointestinal form of anthrax [16,17] and 99% of untreated pulmonary anthrax cases [13,17].

Although antibiotics are not recommended for prophylaxis for fear of developing resistance, these can be given for a short time to persons who have been substantially exposed to anthrax [6]. The situations in which such exposure would occur include biological warfare and consumption of infected under-cooked meat. Generally, an outbreak of anthrax may be controlled by eliminating the source of infection, disinfection, correct dispose of infected materials and vaccination of exposed domesticated animals.

WHO [6] recommends use of antibiotics with penicillin as a drug of choice for treatment of anthrax. The other antibiotics that can be used in the treatment of anthrax are ciprofloxacin and doxycycline. In addition to the primary antibiotic (penicillin or ciprofloxacin), a supplementary antibiotic (clarithromycin, clindamycin, vancomycin, rifampicin, streptomycin, vancomycin or rifampicin) can be administered for severe cases. Whilst the epidemiology of anthrax worldwide is well known, there is scanty information on the occurrence, its magnitude and factors associated with anthrax in Zambia. The objective of the study was to review literature in order to tie up evidence on the epidemiology of anthrax in Zambia.

Methods

Zambia is a land locked country with three seasons: the rainy season (November to April), dry cool (May to August) and dry hot season (September to October/November). In the dry seasons, animals will congregate around watering holes and graze on short grass, thereby, exposing to spores in the soil. The disease is endemic in the Luangwa valley and Zambezi floodplain. The main source of the disease in the valley is game, while in the floodplain it is cattle [18]. Most livestock (cattle, goats and sheep) are found in Southern, Central, Lusaka, Copperbelt and Eastern provinces and mostly (83% of cattle, 64% of sheep and 97% of goats) reared by traditional farmers [19].

The Ministry of Health [20] adapted the WHO AFRO/CDC definitions for suspected and confirmed cases of anthrax as follows: A suspected case of anthrax is any person with acute onset of a disease characterized by several clinical forms of cutaneous form that is defined as any person with skin lesion evolving over 1 to 6 days from a popular through a vesicular stage, to a depressed black eschar invariably accompanied by oedema that may be mild to extensive; Any person with abdominal distress characterized by nausea, vomiting, anorexia and followed by fever is said to have gastro-intestinal form of anthrax; Any person suffering from Pulmonary (inhalation) form of anthrax has brief prodrome resembling acute viral respiratory illness, followed by rapid onset of hypoxia, dyspnoea and high temperature, with X-ray evidence of mediastinal widening; and any person with acute onset of high fever possibly with convulsions, loss of consciousness, meningeal signs and symptoms; commonly noted in all systemic infections, but may present without any other clinical symptoms of anthrax is said to have Meningeal anthrax. Meanwhile, a confirmed case of anthrax is defined as a clinically compatible case of cutaneous, inhalational or gastrointestinal illness that is laboratory-confirmed by isolation or *B. anthracis* from an infected tissue or site; or other laboratory evidence of *B. anthracis* infection based on at least two supportive laboratory tests.

Literature was searched using google, google scholar and PubMed. Literature not published in peer-reviewed journals as reports were obtained using google. Published works in peer-reviewed journals was gathered using google scholar and PubMed.

Results

A total of 7 publications were obtained using search words: anthrax, Zambia, epidemiology, outbreak and surveillance; and of these, 2 were full PubMed Central articles, 4 were abstracts without full articles and one was a citation.

Animals reported to be affected in Zambia by anthrax include: cattle [21-23], hippopotamus, giraffe, buffalo, kudu, elephant, puku, wild dog, waterbuck, impala, wildebeest and hyena [24].

In Western province of Zambia, the overall cattle:human anthrax infection ratio was 1.47 between 1999 and 2007 in Western province of Zambia [23]. However, between 1991 and 1993, a ratio of 0.10 was observed [21]. Table 1 shows the cattle:human anthrax infection ratios. A reduction of the human case fatality rate was observed in Zambia between 1990 and 2011 from 19.1% to 1.2% (Table 2; Siamudaala et al [22];

Munang'andu et al. [23]; Hang'andu et al. [25]). A similar observation was made between 1999 and 2007 in the upper Zambezi floodplain of western Zambia (Slope=-0.738, 95% CI [-1.394, -0.083]) as shown in Figure 1.

Table 2 Cattle:Human ratio by year

Year	Cattle	Humans	Cattle:Human ratio
1991	511	66	1:0.13
1992	111	13	1:0.12
1993	208	0	1:0
1991-1993	830	79	1:0.10
1999	253	262	1:1.04
2000	186	387	1:2.08
2001	129	253	1:1.96
2002	234	280	1:1.20
2003	234	289	1:1.24
2004	114	192	1:1.68
2005	10	74	1:7.40
2006	32	39	1:1.22
2007	24	14	1:0.58
1999 - 2007	1216	1790	1:1.47

The common forms of human anthrax were cutaneous and gastrointestinal.

Munang'andu et al [23] reported that human cases of the cutaneous form were higher than those for gastrointestinal in Western province. Meanwhile, Siamudaala et al [21] found that gastrointestinal was more common than cutaneous in humans in Western and North-western provinces. The signs and symptoms for cutaneous human anthrax cases were redness and oedema of the skin, oedema of the face, enlarged lymph nodes and fever. Meanwhile the signs and symptoms for gastrointestinal human anthrax cases were vomiting, diarrhoea, abdominal pain and gastroenteritis [20,22].

Hang'ombe et al [24] reported that *B. anthracis* was susceptible to penicillin, chloramphenicol, doxycycline, tetracycline, streptomycin, ciprofloxacin, amoxicillin and gentamicin. It was found to be resistant to vancomycin. Meanwhile, it was intermediate susceptible to cotrimoxazole and erythromycin.

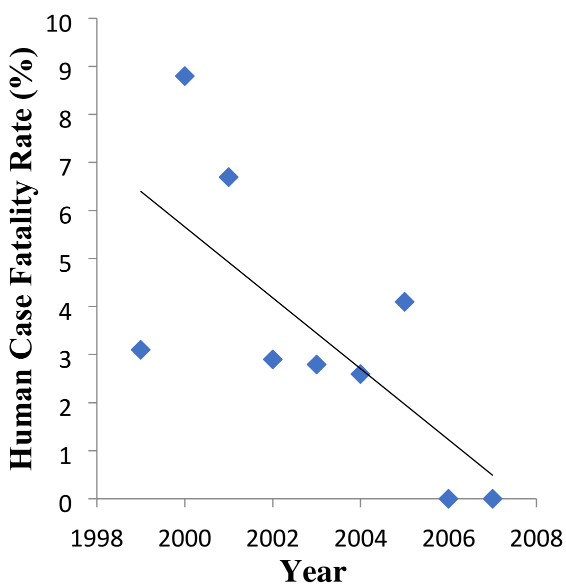

Figure 1 Adapted from Munang'andu et al [22]

Discussion

Little has been published on both human and bovine anthrax in Zambia despite the frequent outbreaks and epidemics reported in the country. Control of anthrax outbreaks and epidemic can only be effective if guided by results of research on the subject. Whilst control of anthrax in cattle through vaccination has a history of success in Zambia, it is practically impossible to control anthrax in game. WHO [6] estimates that for a single carcass, there are 10 cutaneous and enteric human cases in Africa. This high ratio may partly be attributed to hunger where people have to eat animals that died from anthrax [26,27]. Globally, WHO [8] estimates that there is one human cutaneous anthrax case to ten anthrax livestock carcasses. Although anthrax is a notifiable disease in Zambia, the observed numbers of human cases of anthrax in Western and North-western provinces are an underestimate partly due to inadequate disease surveillance and poor record keeping [28].

Cases of human anthrax cases maybe underreported because of fear of game rangers to suspect them to be poachers. The other reason for underreporting of human cases maybe due to some nonspecific signs and symptoms of anthrax that may go unnoticed as cases of anthrax. Alternatively, a timely and successful response to an outbreak would result in fewer infected humans in relation to infected cattle. This would partly reflect a good cattle vaccination programme against anthrax. Further, community's acceptance of avoiding coming into contact with an infected animal by skinning, butchering or eating meat of such an animal would reduce human infection rate.

The change in the direction of the cattle:human anthrax ratio between 19911993 and 1999-2007 partly reflects changes in the control of the epidemic.

A reduction in the human case fatality rate indicates good case management. An active surveillance of human cases of anthrax is recommended immediately there is an outbreak of anthrax in bovine so that people can start treatment as soon as possible in order to avoid severe cases of human anthrax. Although the common forms of human anthrax in Zambia are cutaneous and gastrointestinal, there are rare cases of inhalation anthrax. People may be infected through the processing of hides and making of mats, drums or stools [23]. The most appropriate antibiotics to use to treat anthrax in Zambia include penicillin, chloramphenicol, doxycycline, tetracycline, streptomycin, ciprofloxacin, amoxicillin and gentamicin. Although WHO [6] recommends use of vancomycin as a supplementary antibiotic in severe cases, it was found to be resistant to *B. anthracis* in Zambia [25]. Susceptibility tests are recommended to be conducted from time to time to monitor antibiotic resistance to *B. anthracis.*

Conclusion

Anthrax is endemic in Zambia but literature is scanty. There is need for more research to inform policy. A reduction in the human case fatality rate indicates good case management. An active surveillance of human cases of anthrax is recommended immediately there is an outbreak of bovine anthrax in order for people to start treatment early and avoid severe forms of anthrax.

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RESEARCH ARTICLES

Antimicrobial susceptibility patterns and their correlate for urinary tract infection pathogens at Kitwe Central Hospital, Zambia.

J Chisanga[1], ML Mazaba[2,3], J Mufunda[2], C Besa[1], MC Kapambwe-muchemwa[1], S Siziya[1]

1. Michael Chilufya Sata School of Medicine, Copperbelt University, Ndola, Zambia
2. World Health Organization, Lusaka, Zambia
3. University Teaching Hospital, Lusaka, Zambia

Correspondence: Joshua Chisanga (chisajosh@gmail.com)

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Inadequate data on antimicrobial susceptibility patterns in the Africa region and indeed in Zambia have led to ineffective empirical treatment before the culture and sensitivity results are made available. The purpose of this study was to determine the antimicrobial susceptibility patterns amongst the most common bacterial causes of UTIs amongst patients presenting at Kitwe Central Hospital (KCH), Zambia. A 5-year record review of data captured in the laboratory urine register from 2008 to 2013 was conducted. Demographic data, culture and antimicrobial susceptibility data were entered in Epi Info version 7 and analysed using SPSS version 17.0. Associations were determined using the Chi-squared test at the 5% significance level. A total of 1854 records were extracted from the laboratory register. The highest frequency of UTI (43.9%) was in the 15–29 years age group. The overall sensitivity patterns indicated that *E.coli* was mostly sensitive to ciprofloxacin (69.8%), *Klebsiell*a species to ciprofloxacin (68.2%), *Proteus* species to cefotaxime (66.7%) and *Staphylococcus saprophyticus* to nitrofuratoin (63.7%). Sensitivity for *E. coli* to nalidixic acid was higher for males (58.6%) than females (39.5%). Sensitivity for *E. coli* to cefotaxime and norfloxacin varied with age (Chi-squared for trend=10.32, p=0.001). Our results have shown that UTI pathogens isolated at KCH were less than 70% sensitive to the recommended and used antibiotic. Studies to establish highly sensitive antibiotics to UTI pathogens are needed to effectively treat patients.

Introduction

Urinary tract infections (UTIs) account for one of the major reasons for most hospital visits and the determination of the antimicrobial susceptibility patterns of uropathogens will help to guide physicians on the best choice of antibiotics to recommend to affected patients [1]. Bacterial infections that cause community-acquired urinary tract infections and upper respiratory tract infections are most frequently treated empirically. However, an increase in antimicrobial resistance has raised challenges in treating outpatients [2]. The increases in antibiotic resistance of urinary tract pathogens can be attributed mainly to frequent and indiscriminate use of antibiotics [3]. Increasing resistance in bacterial pathogens been reported widely [4]. Despite the widespread availability of antimicrobial agents, UTIs have continued to be increase resistance to antimicrobial agents [5]. The prevalence of antibiotic resistance in UTIs varies according to geographical and regional location [4]. Studies conducted in Pakistan and Washington showed variations in resistance to antibiotics by sex and age group [6,7]. UTIs are caused by different microbial pathogens. The most prevalent bacteria causing UTI are *Escherichia coli, Staphylococcus saprophyticus, S. aureus*, *Proteus* sp., *Klebsiella pneumoniae, Pseudomonas aeruginosa,* and enterococci [1].

The Ministry of Health [Zambia] recommends antibiotic prescription for UTIs to be guided by sensitivity results [8]. The recommended drugs for the treatment of UTI in Zambia are as follows: amoxicillin, nitrofurantoin, nalidixic acid, ciprofloxacin, cefotaxime and ceftriaxone [8]. Limited data on urinary tract pathogens and their in-vitro susceptibility pattern hinder effective empirical treatment. A retrospective study was conducted to determine susceptibility patterns for some of the commonly used antibiotics for the treatment of urinary tract infections at Kitwe Central Hospital, Zambia.

Methods

The study was conducted at the Kitwe Central Hospital, which is a provincial referral facility for Copperbelt, North Western and Luapula provinces of Zambia.

Ethics clearance was obtained from the Tropical Diseases Research Centre Ndola reference number TRC/C4/07/2015 to conduct the study.

An analysis of secondary data was performed on data captured in the microbiology laboratory register from 2008 to 2013. The data were captured using Epi info version 7 and analyzed using SPSS version 17.0. Proportions were compared in 2 x 2 contingency tables using the Yates' corrected Chi-squared test, while the uncorrected Chi-squared test was used to determine associations in higher contingency tables. The Chi-squared test for trend was used to determine linear associations. The cut off point for statistical significance was set at the 5% level.

The culture and sensitivity results that were analysed were results from routine analysis of urine specimen collected from both in- and out-patients. Mid-stream urine and occasionally urine specimen collected suprapubically were analysed as outlined in the standard operating procedure. Culture was done on CLED agar. Susceptibility testing was done on Mueller Hinton agar using Disk diffusion method with the inoculums suspension in sterile distilled water prepared using a 0.5 McFarland standard.

Table 1 Susceptibility patterns of commonly isolated UTI pathogens at Kitwe Central Hospital (Zambia) from 2008-2013

Bacteria		**Antibiotic**						
		Cefotaxime	Chloramphenicol	Ciprofloxacin	Cotrimoxazole	Nalidixic acid	Nitrofurantoin	Norfloxacin
Escherichia coli	Total n(%)	326 199(61.0)	331 161(48.6)	368 257(69.8)	299 38(12.7)	588 229(38.9)	583 348(59.7)	505 323(64.0)
***Klebsiella* Species**	Total n(%)	144 86(59.7)	99 53(53.5)	154 105(68.2)	83 7(8.4)	230 103(44.8)	231 116(50.2)	180 121(67.2)
***Proteus* species**	Total n(%)	114 76(66.7)	116 49(42.2)	127 77(60.6)	96 17(17.7)	196 75(38.3)	211 102(48.3)	176 108(61.4)
Staphylococcus saprophyticus	Total n(%)	87 45(51.7)	66 29(43.9)	130 82(63.1)	60 7(11.7)	177 49(27.7)	193 123(63.7)	124 75(60.5)

Results

Table 1 shows susceptibility patterns of commonly isolated UTI pathogens to antibiotics. *E.coli* isolates were more sensitive to ciprofloxacin (69.8%), norfloxacin (64.0%) and cefotaxime (61.0%) and least to cotrimoxazole (12.7%). *Klebsiella* species isolates were more sensitive to ciprofloxacin (69.8%), norfloxacin (67.2%) and least to cotrimoxazole (8.4%). *Proteus* species were more sensitive to cefotaxime (66.7%), norfloxacin (61.4%), ciprofloxacin (60.6%) and least to co-trimoxazole (17.7%). *Staphylococcus saprophyticus* isolates were more sensitive to nitrofurantoin (63.7%), ciprofloxacin (63.1%) and norfloxacin (60.5%).

Sensitivity levels for *E. coli* to antibiotics varied by year. Overall, *E.coli* was most sensitive to ciprofloxacin (69.8%), norfloxacin (64.0%) and cefotaxime (61.0%) with least sensitivity to co-trimoxazole (12.7%) as shown in Table 2. Apart from ciprofloxacin and co-trimoxazole, sensitivity levels for the other drugs remained constant as shown in table 3. For both ciprofloxacin and co-trimoxazole, sensitivity levels declined between 2008 and 2013. A unit change in the year corresponded to about 6%(-6.48 for ciprofloxacin and -5.93 for co-trimoxazole).

No significant differences in antibiotic sensitivity to *E. coli* were observed between females and males, except for nalidixic acid ($p<0.001$) with higher levels of sensitivity for males (58.6%) than females (39.5%) as shown in table 5.

Table 2. Susceptibility by year for *E.coli* to antibiotics at Kitwe Central Hospital (Zambia) from 2008-2013

Year	Cefotaxime		Chloramphenicol		Ciprofloxacin		Cotrimoxazole		Nalidixic acid		Nitrofurantoin		Norfloxacin	
	Total	n (%)	Total	n (%)	Total	n (%)	Total	n (%)	Total	n (%)	Total	n (%)	Total	n (%)
2008	40	14(35.0)	-	-	45	37(82.2)	30	8(26.7)	121	49(40.5)	97	50(51.6)	102	60(58.8)
2009	42	28(66.7)	79	42(53.2)	135	101(74.8)	39	12(30.8)	152	64(42.1)	155	96(61.9)	139	83(59.7)
2010	39	29(74.4)	29	16(55.2)	54	43(79.6)	34	6(17.7)	89	47(52.8)	79	48(60.8)	76	54(71.0)
2011	29	21(72.4)	38	23(60.5)	23	16(69.6)	31	3(9.7)	83	38(45.8)	97	66(68.0)	101	66(65.3)
2012	91	62(68.1)	113	51(45.1)	56	34(60.7)	102	9(8.8)	7[a]	2(28.6)	8[a]	2(25.0)	73	48(65.8)
2013	85	45(53.0)	72	29(40.3)	55	26(47.3)	63	0(0.0)	136	29(21.3)	147	86(58.5)	14[a]	12(85.7)
Total	326	199(61.0)	331	161(48.6)	368	257(69.8)	299	38(12.7)	588	229(38.9)	583	348(59.7)	505	323(64.0)

[a]Caution: denominator less than 30

Sensitivity levels varied by age for cefotaxime ($p=0.010$) and norfloxacin ($p=0.010$) as shown in Table 4. Sensitivity levels for cefotaxime linearly decreased with age (Chi-squared test for trend=10.32, $p=0.001$) but not for nalidixic acid (Chi-squared test for trend=2.20, $p=0.138$). The lowest sensitivity level was observed among the 45 years or older patients (48.4% for cefotaxime and 54.5% for norfloxacin).

Discussion

This study provides the information about the antibiotic susceptibility patterns of common bacterial pathogens isolated from urine specimen of patients with urinary tract infections at Kitwe Central Hospital on the Copperbelt province of Zambia. In this study, 1854 urine culture and sensitivity results were analyzed covering the period 2008 to 2013.

Of the 1854 culture results that were analyzed, the most common organisms were *E.coli* (46.7%), *Klebsiella* species (17.1%), *Proteus* species (15.4%) and *Staphylococcus saprophyticus* (12.6%). These findings are slightly to what Ekwealor et al found in Nigeria that the most prevalent isolates were *S. aureus* (28%), *E. coli* (24.6%), and *S. saprophyticus* (20%) [1]. Analysis of the susceptibility pattern excluded *Enterobacter* species, *Enterococcus faecalis* and *Pseudomonas* because of small numbers. Susceptibility by age and sex were only done for *E.coli* because of large numbers.

Table 3 Linear trends in sensitivity levels by year

Drug	Equation	Standard error	p-value	R^2
Cefotaxime	52.38+2.63 year	3.796	0.526	10.7
Chloramphenicol	65.22-3.59 year	2.106	0.187	49.2
Ciprofloxacin	91.71-6.48 year	1.339	0.008	85.4
Cotrimoxazole	36.37-5.93 year	0.985	0.004	90.0
Nalidixic acid	52.88-4.10 year	2.313	0.151	44.0
Nitrofurantoin	61.20-1.97 year	3.970	0.646	5.8
Norfloxacin	53.01+4.20 year	1.596	0.058	63.4

In the current study, *E.coli* isolates were more sensitive to ciprofloxacin (69.8%), norfloxacin (64.0%) and cefotaxime (61.0%). The analysis of the trends revealed that apart from ciprofloxacin and co-trimoxazole, sensitivity levels for the other drugs in the table remained constant. For both ciprofloxacin and co-trimoxazole, sensitivity levels declined between 2008 and 2013. A unit change in the year corresponded to about 6%(-6.48 for ciprofloxacin and -5.93 for co-trimoxazole). A study conducted in Tumkur, Bangalore, revealed lower sensitivity level for *E.coli* to ciprofloxacin (24%), norfloxacin (25.5%) and co-trimoxazole (37%) [10]. Another study conducted in Chandigarh, northern India [11], revealed similar sensitivity for *E.coli* to ciprofloxacin (62%) among outpatients but higher than 48% sensitivity observed in in-patients. However, the sensitivity level for *E. coli* to cefotaxime in the current study was lower than the 96% observed among out-patients and 80% among inpatients. A retrospective study carried out in Brazil revealed rate of resistance of *E.coli* to ciprofloxacin was higher than expected with highest of 36.0% [12]. A study by Cho et al placed ciprofloxacin (20.7%), levofloxacin (22.7%), co-trimoxazole (34.3%) and ampicillin-clavulanate (42.9%) as the least active substance compared to nitrofurantoin (93.1%) and fosfomycin (100%) [13]. A study by Ahmad et al revealed that *E.coli* had higher rates of rates of resistance to ampicillin (90%), tetracycline (70%), erythromycin (70%) and Cotrimoxazole (50%) [14]. Fasugba et al concluded that ciprofloxacin resistance in UTI caused by *E.coli* is increasing hence a need to reconsidered

Table 4 *E.coli* Susceptibility by age group at Kitwe Central Hospital (Zambia) from 2008-2013

Antibiotic		Total	Age groups (years)				x^2; p value
			<15	**15-29**	**30-44**	**45+**	
Cefotaxime	Sensitivity	199 (61.0)	12(70.6)	102(69.9)	55(54.5)	30(48.4)	11.45; 0.010
	Total	326	17	146	101	62	
Chloramphenicol	Sensitivity	162 (48.8)	6(30.0)	75(53.2)	48(48.0)	33(47.1)	4.02; 0.260
	Total	332	20	141	100	70	
Ciprofloxacin	Sensitivity	257 (69.8)	15(75.5)	110(68.7)	86(74.5)	46(60.5)	6.04; 0.110
	Total	368	20	160	112	76	
Co-trimoxazole	Sensitivity	38 (12.7)	0(0.0)	19(13.7)	9(10.5)	10(17.2)	4.01; 0.260
	Total	299	17	139	85	58	
Nalidixic acid	Sensitivity	229 (38.9)	13(56.5)	107(40.7)	64(38.1)	45(33.6)	5.16; 0.160
	Total	588	23	263	168	134	
Nitrofurantoin	Sensitivity	348 (59.7)	14(51.9)	161(61.2)	101(59.8)	72(58.1)	1.08; 0.782
	Total	583	27	263	169	124	
Norfloxacin	Sensitivity	323 (64.0)	20(80.0)	136(61.8)	106(71.6)	61(54.5)	11.30; 0.010
	Total	505	25	220	148	112	

empirical treatment [15]. A study by Bryce et al revealed high rates of resistance ampicillin (23.6%), trimethoprim (8.2%), co-amoxiclav (26.8%) and lower rates for ciprofloxacin (2.1%) and nitrofurantoin (1.3%) [16].

Klebsiella species isolates were more sensitive to ciprofloxacin (68.2%), norfloxacin (67.2%) and the least sensitive to co-trimoxazole (8.4%). The study in Tumkur, Bangalore also showed that *Klebsiella* species had sensitivity of 63% (ciprofloxacin), 66% (norfloxacin) and 58% (co-trimoxazole) [11]. *Proteus* species were more sensitive to cefotaxime (66.7%), norfloxacin (61.4%) and ciprofloxacin (60.6%). A study done in Portugal revealed the sensitivity of *Proteus* species as 2.9% for nitrofurantoin, 75.1% for norfloxicin,75.0% for ciprofloxacin and 73.2% for cefotaxime [17]. *Staphylococcus saprophyticus* isolates were more sensitive to nitrofurantoin (63.7%), ciprofloxacin (63.1%) and norfloxacin (60.5%). A study in Iran showed the sensitivity of coagulase negative *staphylococci* as 100% for ciprofloxacin and nitrofurantoin, 69.2% for co-trimoxazole, 23.1% for cefotaxime and 0% for nalidixic acid [18].

The Sensitivity levels of *E.coli* varied with age for cefotaxime and norfloxacin. Furthermore, the sensitivity variation was linearly related to age for cefotaxime suggesting that the drug should be limited to younger age groups of <15 years. Although no similar pattern emerged for norfloxacin, the least sensitivity was observed in the 45 years or older age group, indicating that the drug should not be used for persons in this age group. Sensitivity to cefotaxime decreased as age increased and this was the same for nalidixic acid and nitrofurantoin. Cefotaxime had the highest sensitivity in the under 15 years of age (70.6%) and lowest in the 45 years or older age group (48.8%). Chloramphenicol had the highest sensitivity in the 15-29 years age group (53.2%) and lowest in the <15 years age group (30.0%). Ciprofloxacin had highest sensitivity in the under 15 years age group (75.5%) and lowest in the 45 years or older age groups (60.5%). Co-trimoxazole had the highest sensitivity in the 45 years or older age group (17.2%) and the lowest in the under 15 years age group (0.0%). Nalidixic acid had the highest sensitivity in the under 15 years age group (56.5%) and lowest in the 45 years or older age group (33.6%). Nitrofurantoin had the highest sensitivity in the 15-29 years age group (61.2%) and the lowest in the under 15 years age group. Norfloxacin had the highest sensitivity in the under 15 (80.0%) and lowest in the 45+ age group (54.5%).

The only sex difference in sensitivity levels was observed for nalidixic acid, with higher sensitivity for males (58.6%) than females (33.8%). However, the level of sensitivity was too low to recommend the use of nalidixic acid among males only.

A study done in Pakistan on the resistance of *E.coli* across age groups and sex revealed variation in resistance patterns of *E.coli* to antibiotics. Nitrofurantoin was about 2-fold more resistant in males than females, while trimethoprim, co-trimoxazole and ceftazidime showed 11% more resistance in males than females. Ceftriaxone, ciprofloxacin showed 13%, 14%, more resistance in males as compared to females, respectively. *E.coli* also manifested almost complete resistance to trimethoprim and co-trimoxazole in all the age groups. The isolates from below 40 years male patients and age groups 50-59 and 70-79 showed almost complete resistance to ciprofloxacin, while it was effective in half of male patients in age groups 40-49 and 60-69. Nitrofurantoin showed 33% resistance in age groups 0-9, 20-29 and 30-39 and was found almost sensitive in all other age groups. Ceftriaxone showed 60% resistance in age group 60+. Ceftriaxone was sensitive in age group 10-19, while it showed variable resistance among other age groups.

Table 5 *E.coli* Susceptibility by sex at Kitwe Central Hospital (Zambia) from 2008-2013

Antibiotic		**Total n (%)**	**Sex**		**x^2 ;p value**
			Female n (%)	**Male n (%)**	
Cefotaxime	Sensitivity	198 (60.7)	152(63.3)	46(53.5)	2.57; 0.140
	Total	326	240	86	
Chloramphenicol	Sensitivity	162(48.9)	117(49.4)	45(47.9)	0.02; 0.902
	Total	331	237	94	
Ciprofloxacin	Sensitivity	257(70.2)	186(71.3)	71(67.6)	0.32; 0.573
	Total	366	261	105	
Co-trimoxazole	Sensitivity	38(11.4)	23(9.7)	15(15.6)	1.78; 0.182
	Total	332	236	96	
Nalidixic acid	Sensitivity	229(33.8)	160(39.5)	160(58.6)	23.12; 0.000
	Total	678	405	273	
Nitrofurantoin	Sensitivity	348(59.7)	253(61.3)	95(55.9)	1.23; 0.207
	Total	583	413	170	
Norfloxacin	Sensitivity	325(64.5)	228(66.1)	95(59.9)	1.63; 0.201
	Total	504	345	159	

Ciprofloxacin, co-trimoxazole and trimethoprim showed variable resistance patterns in all age groups except 40-49 in which these antibiotics were effective among half the female patients [6]. A study done in USA reported that differences in antibiotic susceptibility to common urinary anti-infectives among *E. coli* isolated from males versus females was meaningful hence recommending that male sex alone cannot be used as a basis for empirical treatment [7].

Conclusions

Our results have shown that the UTI pathogens isolated at KCH were less than 70% sensitive to the recommended and used antibiotic. Studies to establish high sensitive antibiotics to UTI pathogens are needed to effectively treat patients.

Authors' contributions

JC obtained the data, conducted preliminary analysis and drafted the manuscript. JM revised the manuscript. CB research protocol development, analysed the findings and revised the manuscript. SS interpreted the findings and edited the manuscript MLM reanalyzed the data, interpreted the results and edited the manuscript.

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OUTBREAK REPORT

Cutaneous Anthrax outbreak in Chama District, Muchinga province, Zambia, 2016 as history repeats itself

P Mwambi[1], J Mufunda[1], P Mwaba[2], N Kasese-Chanda[2], CM Mumba[2], T Kalumbi[2], M Chaula[2], N Mweemba[1], MB Hang'ombe[3], H Higashi[4], R Akamatsu[4], ML Mazaba[1,5]

1. World Health Organization, Lusaka, Zambia
2. Ministry of Health, Lusaka, Zambia
3. Center for Zoonoses Control, University of Zambia, Lusaka, Zambia
4. Hokkaido University Research Center for Zoonosis Control, Global COE Program, N20W10, Kita-ku, Sapporo, 001-0020 Japan
5. University Teaching Hospital, Lusaka, Zambia

Correspondence: Patricia Mwambi (mwambip@who.int)

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An outbreak of anthrax has been confirmed in Chama district in Zambia affecting close to 80 persons. A previous outbreak in the same area was confirmed in 2011 with 521 humans affected and 6 human and over 80 hippos dead. To understand the disease situation and provide technical support the Ministry of Health in collaboration with the World Health Organization (WHO) in Zambia and Center for Zoonoses control University of Zambia investigated the outbreak in various villages. The index case, a 22-year-old male presented at Pondo rural health centre with eschar invariably accompanied by oedema on the cheek with onset 22nd September 2016. More patients mostly below 20 years of age from five RHCs were seen thereafter with varied lesions papules, vesicles and eschars and treated with ciprofloxacin. Most patients were associated with eating hippo meat. Various interventions were put in place to control the outbreak including case detection, case management, contact tracing and community awareness. Field investigations observed dead carcasses of Hippo and Buffalo. *Bacillus anthracis* was isolated from humans, buffalo, hippo and the environment confirming the outbreak link to Anthrax infection suggesting the need to strengthen surveillance, diagnosis, community sensitization and treatment of affected persons for effective disease control. The rapid response by the Ministry of Health, WHO Zambia, Center for Zoonosis Control, and ZAWA necessitated by the availability of financial resources provided by MOH and WHO Zambia contributed significantly to the timely containment of the outbreak and avoidance of any fatalities.

Introduction

Anthrax is a zoonotic disease with its natural reservoirs being hoofed animals that are known to carry the *Bacillus anthracis*. Most commonly it is found in grazing herbivores such as cattle, sheep, goats, camels, horses, and pigs [1], but has also been associated with transmission from wildlife to humans by various modes, notably buffalo and hippos in Zambia [2,3]. It is a serious bacterial infection caused by *Bacillus anthracis* that occurs primarily in animals. Cattle, sheep, horses, mules, and some wild animals are highly susceptible [4]. Humans become infected when the spores of *Bacillus anthracis* enter the body by contact with animals infected with *Bacillus anthracis* or from contact with contaminated animal products, insect bites, ingestion, or inhalation [5].

The developed world has no or lower incidence of anthrax infection, meanwhile it continues to be a problem of public health concern in the developing world and countries that do not have veterinary public health programs that routinely vaccinate animals against anthrax [6]. Continued outbreaks in areas with previous outbreaks may occur because anthrax spores survive for decades, even under adverse conditions, contaminating the soil [7]. Anthrax infections in humans occur in three forms including cutaneous, gastrointestinal and pulmonary depending on route of exposure, with up to 95 % being cutaneous [8, 9].

Table 1: Analysis of samples through culture, isolation and PCR

Source of sample	Number of samples	Number of positive
Wound swabs (Human)	12	3
Hippopotamus	18	0
Buffalo	7	2
Lagoon water	9	0
Soil from pasture/	35	3

Cutaneous infections initially appear as painless, itchy papules on the face, neck, forearms or hands and ulcerate within 7 to 10 days. These subsequently form a black painless eschar. The patient may also incur localised swelling, usually of the face and neck, with painful swollen lymph nodes and systematic symptoms. Literature reveals no human to human spread, no racial, sexual or age association with the disease, although commonly among young and middle ages as it is often related to industrial exposures, way of life and livestock farming [6]. A well managed outbreak with appropriate therapy will reduce and even exclude fatalities.

Zambia has had outbreaks of anthrax in human and animal populations with previous studies showing that clostridia infections and anthrax outbreaks are higher in the Western Province and Luangwa valley than the rest of the country [10-12]. Confirmed outbreaks affecting cattle in Western province from 1989-1995, in which 1,626 suspected cases of anthrax were identified, 51 cases were confirmed with *Bacillus anthracis* infection. During the 1990 outbreak alone, 220 cases of human anthrax cases and 248 human cases during 1991-1998 were confirmed with 19.1% and 7.7% case fatality rates, respectively [13].

Recurrence of anthrax outbreaks have been linked to various ecological factors such as cycles of heavy rainfall followed by periods of dry weather, high evaporation potential of flood water, the presence of calcareous soils and ambient temperatures above 15.5 degrees [14-16]. The Anthrax spores are very resistant, remaining dormant and viable in nature for >100 years [2]. Chama district recorded an outbreak of anthrax in August 2011 that saw over 80 hippopotamuses die after showing signs of infection with *Bacillus anthracis*, followed by 521 suspected human cases resulting in six human community deaths associated with *Bacillus anthracis* infection and about 80 hippopotamus deaths [3, 17]. Five years later, Muchinga Provincial Medical Office received a report of a suspected anthrax outbreak on 27th September 2016 in the southern part of Chama district, recording up-to 79 human cases and 25 animals including hippos and buffalos by end of October 2016. A quick response team consisting of surveillance officers, epidemiologists, clinicians, laboratory scientists, veterinary staff and health promotion staff from the Ministry of Health, the World Health Organization in Zambia, Center for Zoonoses control University of Zambia, the Ministry of Fisheries and Livestock (MFL) as well as National Parks and Wildlife (NPW) investigated and provided technical support in managing the outbreak

Methods

A descriptive cross sectional study of a recent outbreak in Chama was undertaken. The outbreak response team reviewed case records at the local facilities, undertook field visitations to affected areas and conducted interviews with health providers, NPW staff at the camps, village scouts, individual clients, Community Based Volunteers (CBVs), community leaders, school teachers/pupils and community members and visited the risk areas, that is, Baghdad lagoon on the Luangwa river (GPS coordinates S 1161221, E03268300 and elevation 617), NPW camps and the affected villages in the RHCs catchment areas.

Local health officials in the affected area collected specimens from affected patients which, included swabs from vesicular lesions and blood. The specimens were collected by swabbing of cutaneous lesions from suspected patients. A total of 12 swabs and blood specimens were submitted for anthrax detection and confirmation.

In case of animals, sections of tissues and bones from carcasses were obtained from hippo and buffalo, while soil samples from hippo and buffalo grave sites and soil on land where hippos graze from were obtained. Water samples from the lagoon where hippos were struggling to survive were also collected. The collected samples were carefully transported to the laboratory for analysis.

Cuttings of flesh from the tongue, buccal mucosa and neck area of a Hippo and buffalo, as well as soil samples from hippo grave sites, soil on the land where the hippos died and water samples from Baghdad lagoon were tested for anthrax.

Study area

Chama district is one of the 7 districts in Muchinga Province in the north-eastern part of Zambia. It is a Game Management Area (GMA) and it experiences a lot of human-animal conflicts. Most agricultural activities are undertaken on the plateau while in the valley they heavily depend on wildlife. Chama South, the area affected by the outbreak is predominantly a game reserve with some game camps and lodges for professional hunters and tourists. Cases were recorded in Chigoma, Chikwa, Lundu, Kapichilasenga and Pondo Rural Health Centres (RHCs).

Case definition of Anthrax A suspected case was defined as person with acute onset characterized by several clinical forms that are:

Cutaneous form-any person with skin lesion evolving over 1 to 6 days from a papular through a vesicular stage to a black eschar invariably accompanied by oedema that may be mild to extensive;

Gastro intestinal-any person with abdominal distress characterised by nausea, vomiting, anorexia and followed by fever;

Pulmonary (inhalation anthrax)-any person with a brief prodrome resembling acute viral respiratory illness, followed by rapid onset of hypoxia, dyspnoea and high temperature with x ray evidence of meditational widening.

A confirmed case of anthrax in human can be defined as clinically compatible case of cutaneous, inhalational or gastrointestinal illness that is laboratory confirmed by isolation of Bacillus anthracis from an affected tissue or site [18].

Public Health response

The response to the outbreak included case detection, case management, contact tracing, community sensitizations and stakeholders' involvement. All cases meeting the case definition were referred to the rural health centres for management as outpatients except for one who was treated as an inpatient for four days because of his presentation with abdominal pains, difficulties in breathing, extensive swelling of the face and head. The patient was discharged in a stable condition. A line list of cases was maintained and updated accordingly. Active cases were treated with oral ciprofloxacin of varied dosages according to age twice daily for 7 days: below 4 years 125mg; 4 to <15 years 250mg ; $\geq$ 15 years 500mg. Contacts traced were given a prophylactic stat dosage according to age as above.

Communication on the outbreak was strengthened at all levels and regular briefing reports were made at different levels and appropriate times. The Minister of Health issued a press statement about the outbreak that contributed to raising public awareness of the outbreak and response interventions that were in place. Community sensitization was conducted through the community radio, Zambia News and Information Services public address system, community and school meetings, door to door visitations by community health workers and meetings with different stakeholders and community leaders. Standard messages were developed on the types of anthrax, causes, signs and symptoms, risk factors, prevention, treatment and the importance of early care seeking and were disseminated widely in the community. Another key message given to the community was about the importance of reporting deaths of domestic and wild animals and to avoid getting into contact or eating such animals.

Decontamination using lime was conducted on animal grave sites both on the river banks and other grave site on the land and the bush. All the dead buffaloes and hippos remains were burned and buried on their grave sites. A Mobile Bio-safety level 3 laboratory for quick confirmation of cases both in human and animal populations was put in place.

Table 2 Anthrax cases by age groups, health facility and exposure

Characteristic	Number (%)
Sex:	
Male	48(61)
Female	31(39)
Age group (years):	
<5	14 (18)
5 – 14	22(28)
15 - 24	16 (20)
25 – 34	10 (13)
35 – 44	9 (11)
45+	8 (10)
Health Facility	
Chikwa	41(52)
Pondo	24(30)
Chigoma	11(14)
Kapichilasenga	2(3)
Lundu	1(1)
Exposure Type	
Patient ate Hippo meat	76(96.1)
Patient ate fish from Baghdad Lagoon	1(1.3)
Patient in contact with raw hippo meat	1(1.3)
Patient ate Buffalo Meat	1(1.3)

Laboratory investigations

A biosafety level 3 laboratory was deployed on site for analysis of samples from both human and animal cases. The samples were analysed for *B. anthracis* according to the World Health Organization (WHO) guidelines and involved culture, isolation and confirmation of the isolates by polymerase chain reaction (WHO, 2008).

Figure 1 Age distribution by sex

The swabs and blood from suspected patients were directly inoculated on Blood agar (Himedia Laboratories Ltd., Mumbai, India) containing 5% sheep blood. The samples from animals and soil were decontaminated by subjecting them to heating in normal saline at 75ºC for 5 minutes. The fresh samples of tissues were inoculated directly on Blood agar.

The confirmed isolates of *Bacillus anthracis* were then subjected to antimicrobial susceptibility tests to define the profile of antimicrobial sensitivity, using standard antimicrobial discs on Mueller-Hinton agar (Difco; Becton, Dickinson and Co, Franklin Lakes, NJ, USA) followed by an E-test to determine the minimum inhibitory concentration (CLSI, 2008). The antibiotics tested with the disc diffusion method were penicillin, chloramphenicol, cotrimoxazole, erythromycin, doxycycline, tetracycline, streptomycin and gentamicin (Himedia Laboratories Ltd., Mumbai, India). Others were ciprofloxacin, amoxicillin, ampicillin and vancomycin (Oxoid Ltd., Basingstoke, UK). The MIC was determined for chloramphenicol,doxycycline, tetracycline, cotrimoxazole (Oxoid), ciprofloxacin, penicillin and erythromycin (Himedia Laboratories Ltd., Mumbai, India)

Figure 2. Skin lesion of anthrax on the feet

Results

In this outbreak, 79 human cases and 25 carcasses (18 hippos and 7 buffalos) were identified. Of these human cases and animals, 12 human specimens and all animal samples were tested for *Bacillus anthracis.* Furthermore, lagoon water samples, soil samples from animal grave sites and land/pasture where animals graze from were also tested for *Bacillus anthracis*.

Figure 2. An ulcer and eschar with surrounding oedema

The tested hippo samples were negative while buffalo samples (2 buffalos) were positive for *Bacillus anthracis*. The water samples were negative while some soil samples from the hippo and buffalo grave site and pasture were positive (Table 1). Antimicrobial sensitivity patterns on the cultured 6 *B. anthracis* isolates indicated sensitivity to a range of drugs used. Intermediate sensitivity was observed with cotrimoxazole and erythromycin, while resistance with vancomycin was noted. The minimum inhibitory concentration of antimicrobial agents was observed at various points: chloramphenicol (8 µg/mL); doxycycline (0.5 µg/mL); tetracycline (1 µg/mL); ciprofloxacin (0.5 µg/mL); cotrimoxazole (16 µg/mL); penicillin (0.12 µg/mL); and erythromycin (4 µg/mL).Of the human cases of clinically confirmed anthrax identified the majority 41 (52%) were from

Chikwa RHC followed by 24 (30%) from Pondo RHC. Of the total anthrax cases 48 (61%) were males. Overall, most cases (28%) were from the 5 – 14 age group ($p<0.01$). These results are shown in Table 2. Analysis of age group in each sex group revealed that amongst the males, most of the cases were aged between the 15-24 age-group (33%) followed by the 5 -14 (29%) whereas for females, it was highest among the less than 5 years and 5 – 14 age-group at 26% in both groups followed by those above 45 years (23%), as shown in Figure 1. Analysis of differences between sexes in age groups showed a significant difference ($p<0.001$) between the sexes only in the 15 – 24 years age group. There was no significant difference ($p=0.525$) between children (<15 years) and adults (≥15years).

Clinical investigations noted the following signs and symptoms: eschar, rash like lesions among others. One patient had an allergic reaction features (figure 2 & 3). All cases except two were associated with consumption of dead hippo and/or buffalo meat. Of the two who had not eaten, one had eaten fish from the Baghdad lagoon where anthrax was confirmed and the other participated in butchering the carcasses.

The outbreak was contained within one month of onset between 19th September and 20th October 2016 (Figure 4). There were no fatalities

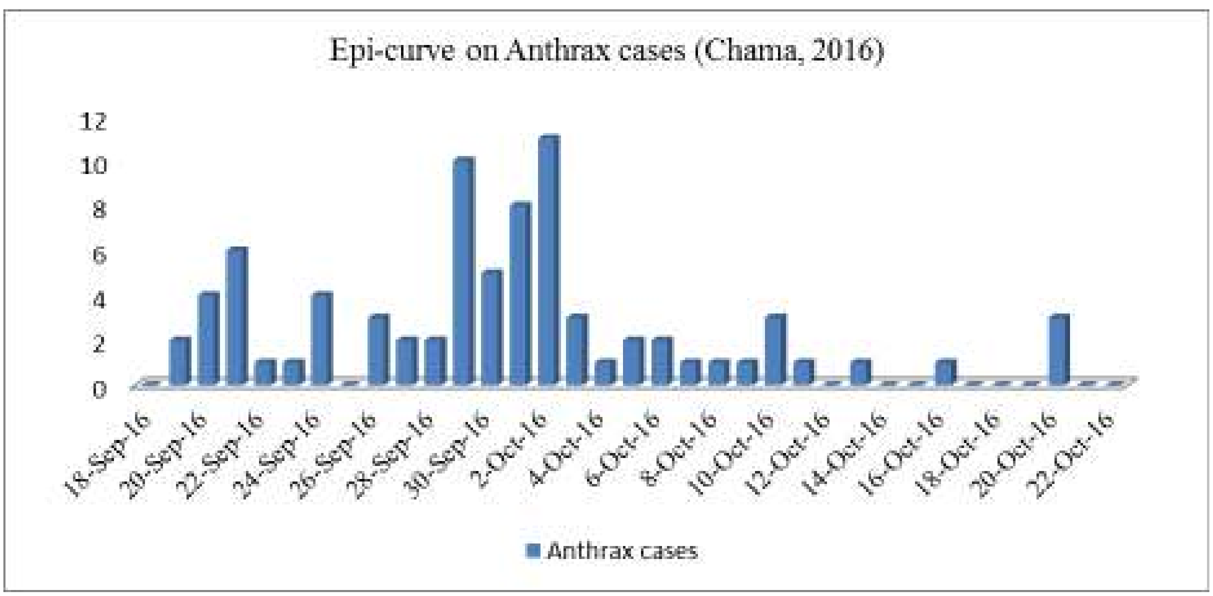

Figure 3 Epi-curve on anthrax outbreak in Chama, 2016

Discussion

An outbreak of cutaneous anthrax associated with *Bacillus anthracis* occurred in Chama district affecting almost a total of 80 children and adults with no significant difference between age groups and about 25animals. In this case another animal, the buffalo has come into the transmission pattern of anthrax. There were no positive results from hippopotamus. This could have been due to the decomposed carcasses. *Bacillus anthracis* is easily overrun by anaerobic bacteria upon death. This outbreak was less than that in the 2011 outbreak in the same district which affected about 520 humans with 6 deaths and 80 hippopotamus. Although there was no significant difference between age groups, it was noted on further analysis that in the 15 - 25 age group there was a significant difference between males and females, with males more likely to be infected than females. This could be attributed to the fact that the males of this age group were the ones handling the carcasses to dismember them for meat.

All human cases identified were associated with eating either one or both of hippo and buffalo meat obtained from carcases in the outbreak area. Literature documents an association of anthrax infection with eating meat from infected carcasses or drinking contaminated water, through the skin by contact with infected material or by insect bites, and through the lungs by inhaling spores has been documented [19]. Some parts of Zambia are endemic of anthrax as evidenced by continued outbreaks impacting negatively on the economy of the livestock industry and public health generally. Social and economic determinants include poor food security resulting from draught in Chama area have been noted as contributing factors in these outbreaks. Despite knowing the consequences of eating infected meat, people prefer to get the disease than die from starvation. Similar determinants are described in the outbreaks in Western province [10]. This gap between knowledge and behavior became a threat to the communication effort that was mounted and required more interactive communication methods within the community to emphasise the dangers of anthrax and the importance of prevention and to promote community ownership and local solutions

The Anthrax outbreak in Chama was fueled by human behaviour, particularly that of handling dead animals. These risky behaviours have been well documented in similar outbreaks of anthrax where the need to educate communities was emphasized [20, 21, 22]. Although the people in Chama were aware about anthrax from previous outbreaks, it was very critical to sensitise the community and reinforce the knowledge on the causes, risk factors, signs and symptoms and to promote early care seeking. Early reporting of deaths of animals and wildlife by community members can also prevent the spread of anthrax. Equally, effective communication during an outbreak is important particularly using credical sources and ensuring the use of channels which can reach all the target audiences. The practice of communicating at different levels on a regular basis helped to build and to maintain trust of the community in line with WHO recommendations [24].

Another anthrax outbreak occurred in the same area in 2011. Chama district is located within a wildlife sanctuary, where normal anthrax intervention strategies cannot be applied. It has been documented that while livestock anthrax is generally on the decline in many parts of the world, it remains enzootic in many national parks, for example, in southern Africa and North America. This scenario represents a persistent risk for surrounding livestock and public health [19].
The timely containment and lack of any case fatalities may be attributed to the rapid response by the Ministry of Health with the support of the WHO country office in Zambia that provided financial resources (USD$7,176) and technical support (NPO/National Surveillance Officer and NPO/Health Promotion), National Parks and Wildlife (NPW) and the University of Zambia (UNZA) School of Veterinary Medicine Laboratory and Centre for Veterinary Research Institute (CVRI) who provided laboratory confirmation. A paper by Siamudaala et al. (2006) on the ecology and epidemiology of anthrax in some parts of Zambia indicated that challenges of anthrax control are complex and comprise of socio-political, economic, environmental and cultural factors. They also site inadequate funding, lack of innovative disease control strategies and lack of cooperation from stakeholders as the major constraints to the control of the disease in Zambia [10].
Having confirmed a clear picture of anthrax, the response included as part of the disease containment and prevention measures the following activities: confiscation and destruction of hippo meat and carcasses; active surveillance and contact training; treatment of cases and prophylaxis management of contacts; and community sensitisation including discouraging the community from eating dead animals. As a preventive measure for another outbreak in

the same area, formalin and lime were applied to the soils where animas died from (animal graves) and where animals were being cut and shared by the people.

In order to ensure prevention and control for anthrax, enhanced surveillance which would include mechanisms for disease detection, confirmation of diagnosis, reporting, collation of data and feedback of the data to the source, must be employed [20].

Conflict of interest Statement

We declare that we have no conflict of interest.

Acknowledgements

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OUTBREAK REPORT

Outbreak of Anthrax among humans and cattle in Western province of Zambia, November 2016 to January 2017

N Kasese-Chanda[1], B Mulubwe[1], F Mwale[1]

1. Ministry of Health, Directorate of Public health, Lusaka, Zambia

Correspondence: Nancy Kasese-Chanda (kasesechanda@gmail.com)

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An outbreak of anthrax occurred in Western province on 11th November 2016. The outbreak was confirmed using PCR. Out of the 7 specimens examined for Bacillus anthracis, 3 were positive. Altogether 67 suspected cases were investigated out of which one death (1.5%) was reported. Over half of the cases were of age 15 years or older (56.1%) and males (56.7%). Four peaks were identified on the epidemiologic curve suggesting multiple sources of infection. Factors associated with the outbreak included: animal movement, belief that all the dead animals have to be eaten 'there is no grave for animals' and animals on loan (*mafisa*) cannot be disposed of without owners' approval, hunger land low levels of animal vaccination coverage. In conclusion, disposal of carcasses should be done by burning and burying followed by decontamination. Certificates should be issued to show that disposal was conducted by government. Anthrax vaccines should be given to farmers free of charge through Ministry of Livestock and Fisheries.

Introduction

Outbreaks of anthrax have been documented in Zambia affecting humans as well as wild and domestic animals. The disease, caused by *Bacillus anthracis,* has been reported in wildlife such as hippo and buffalo and among cattle [1,2]. There are three types of anthrax in humans: cutaneous, gastrointestinal, and pulmonary: cutaneous being the most common form. Humans generally acquire the disease from infected animals as a result of handling the animal carcass or ingestion of its meat. Anthrax is not known to be transmitted from person to person [3]. It continues to be reported from many countries in domesticated and wild herbivores, especially where livestock vaccination programmes are inadequate or have been disrupted [4].

Figure 1 District with suspected anthrax cases in Western province

Anthrax outbreaks continue to occur globally, more commonly in sub-Saharan Africa, Asia and Central and South America [4]. Zambia has experienced more recently in 2016 two anthrax outbreaks affecting humans and animals in Muchinga and Western provinces [2,5]. The objectives for the current outbreak investigation were to assess: the extent of the outbreak; effectiveness of the interventions in mitigating the outbreak; and determine the needs required to mitigate the outbreak effectively and efficiently.

Methods

The investigation was conducted in Western Province, one of the 10 provinces of Zambia, is located 22 degrees and 25.30 degrees east and 13.45 degrees and 17.45 degrees south. It has an area of 126 386-sq kilometres (16.8% of the total land of Zambia). It has 16 districts, five of which share an international boundary with Angola, while two districts share a boundary with Namibia. The poverty level in the province is at 80.4% (LCMS 2010). The province has varied communication challenges, with limited phone facilities in health centres, and poor road network posing limited abilities in referrals and challenges. The outbreak occurred in four districts of the Western province: Shang'ombo, Nalolo, Limulunga and Kalabo (Figure 1).

According to International Strategy for Disaster Reduction ISDR technical Guidelines of Zambia, anthrax is a notifiable disease with one case constituting an outbreak. WHO and CDC [6] defined a suspected case of anthrax as any person with acute onset characterized by several clinical forms that are: (a) cutaneous form: any person with skin lesion evolving over 1 to 6 days from a papular through a vesicular stage, to a depressed black eschar invariably accompanied by oedema that may be mild to extensive ; or (b) gastro-intestinal: any person with abdominal distress characterized by nausea, vomiting, anorexia and followed by fever; or (c) pulmonary (inhalation): any person with brief prodrome resembling acute viral respiratory illness, followed by rapid onset of hypoxia, dyspnea and high temperature, with X-ray evidence of mediastinal widening ; and has eaten and / or handled meat of a suspected or known confirmed case of anthrax in a human was defined as a clinically compatible case of cutaneous, inhalational or gastrointestinal illness that is laboratory-confirmed by isolation of *B. anthracis* from an affected

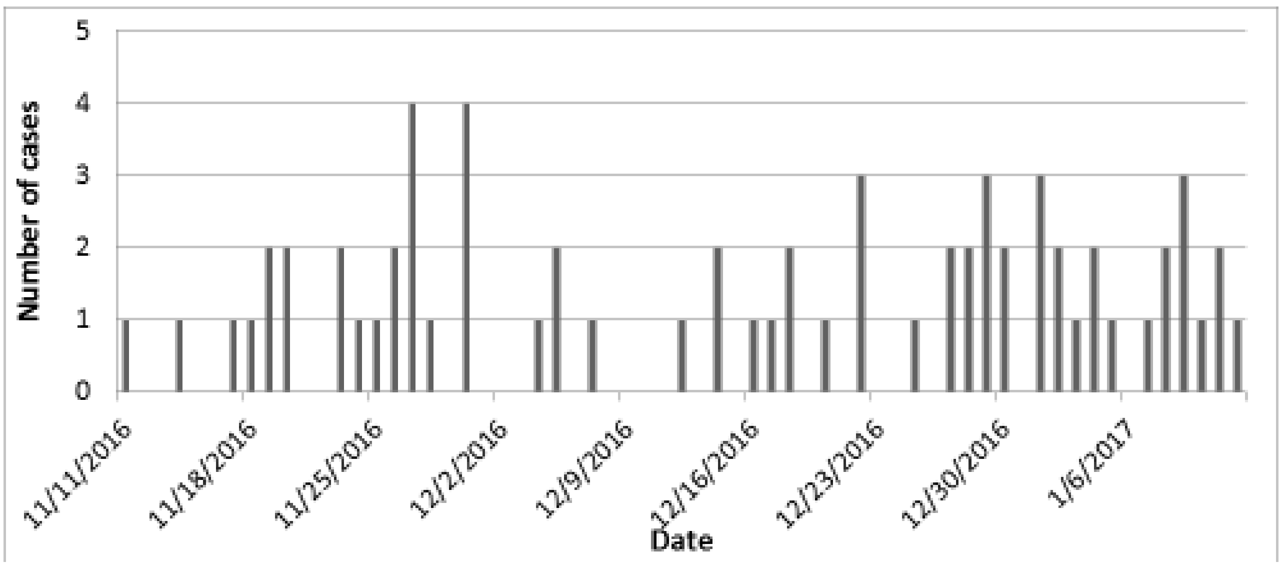

Figure 4. Epi curve for the 4 districts affected by anthrax 11-November 2016 - 19 January 2017

tissue or site; or other laboratory evidence of *B. anthracis* infection.

Data were collected using data reviews, interviews, meetings with various stakeholders and field visitations. Case records from health facilities were reviewed age, sex, physical address and day of onset.

Various stakeholders including health facility staff, veterinary assistants, agricultural field officers and community health committee members were interviewed. Meetings were also held with the district commissioners, district health officers, veterinary officers at the district and provincial level.

The University of Zambia School of Veterinary Medicine confirmed the presence of *Bacillus anthracis* by Polymerase chain reaction (PCR).

Results

The outbreak was first reported on 11th November, 2016 with the index case being a male farmer, from Shang'ombo, Western province. Altogether 67 cumulative cases as at 19th January 2017 were investigated with Kalabo reporting most of the cases (31).
Overall, one death (1.5%) was reported. In Kalabo, the estimate case fatality rate during the period 11th November to 19th January was 3.2% among 31 suspected cases. Table 1 shows the distribution of suspected cases of anthrax by district as at 19th January 2017. Figure 2 shows an Epi-curve for the 4 districts affected by anthrax 11-November 2016 - 19 January 2017. There are four peaks: one between 27-30 November 2016, one on 22nd December 2016, another one between 29 December 2016 and 1st January 2017 and the last one on 9th January 2017. The distributions of suspected anthrax cases by age, sex and district are shown in Table 2. Over half of the cases were of age 15 years or older (56.1%) and males (56.7%). These findings are shown in Table 2.
Out of the 7 specimens examined for Bacillus anthracis, 3 were positive.

Table 1 Suspected anthrax cases in Western province as at 19th January 2017

Factor	Number of cases
District	
Shangombo	26
Nalolo	9
Kalabo	31
Limulunga	1
Deaths (Kalabo)	1
Cummulative Deaths (Community death)	1
Current under treatment (OPD)	5
Total number of cases followed up	67

Factors associated with anthrax

The following were factors hypothesized to be contributing to the continued spread of the disease: (a) Animal movement: (b) Disposal of dead animals: (c) Poverty: (d) Lack of vaccination:

Discussion

The current anthrax outbreak in Western province was confirmed using PCR. The epidemiologic curve suggests an active transmission of the disease throughout the period with multiple sources of infection. Persons most affected were of age 15 years or older and were males. The risk group for acquiring anthrax of skinning and butchering cattle that could have died of anthrax are usually older males. On a smaller scale, this subpopulation of inhabitants of Western province is also involved in tanning the cattle hides and making stools and mats using them. While, health education intervention should be implemented to the entire population, older men should also be specifically targeted in order to curtail anthrax epidemics should they occur in Western Province. Women may have been infected whilst preparing infected meat for drying or cooking. Meanwhile, the younger age groups could have been infected by eating under-cooked infected meat.

anthrax cases was not done. However, we hypothesize that animal movement, disposal of dead animals, poverty and lack of vaccination in cattle are factors all associated with the occurrence of anthrax outbreak in the affected districts. There is an animal transportation corridor from Shangombo to Mongu as a result pasture contamination is possible as animals move from one place to the other. The community hold a belief that all the dead animals have to be eaten 'there is no grave for animals' and animals on loan (mafisa) cannot be disposed of without owners' approval. Additionally, an agriculture officer reported that mainly people are eating mango mixed with some mealie meal. Relish is rarely found and this could be one reason why they are opting to eat risk meat from diseased animals. Finally, less than 5% of cattle are vaccinated against anthrax in the Province. Anthrax is still

Table 3 Distribution of anthrax suspected cases by age, sex and district

					Provincial
Factor	**Shang'ombo (n)**	**Limulunga (n)**	**Nalolo (n)**	**Kalabo (n)**	**n (%)**
Age					
<5	2	0	1	3	6 (9.1)
5-14	7	0	6	10	10 (34.8)
15+	16	1	2	18	18 (56.1)
Gender					
Male	11	1	5	21	38 (56.7)
Female	15	0	4	10	29 (43.3)

The outbreak of anthrax in Western Province has persisted despite community sensitization messages in an area endemic for anthrax where the community should know better, suggesting need for targeted interventions. The results presented are limited in that both bivariate and multivariate analysis of risk factors associated with classified as a management disease and therefore it is the owner of animals who is to ensure that animals are vaccinated. This has proved not effective as seen from the coverage of vaccinated animals even though the cost of vaccination is as low as K2 ($0.2) per animal.

In conclusion, disposal of carcases should be done by burning and burying followed by decontamination. Loaning of animals presented a problem of disposal as owners were not available. Issuing of certificates should be made to show that disposal was conducted by government. Anthrax vaccines should be given to farmers free of charge through Ministry of Livestock and Fisheries.

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OUTBREAK REPORT

Occurrence of cholera in Lukanga fishing camp, Kapiri-mposhi district, Zambia

R Murebwa-Chirambo[1], R Mwanza[2], C Mwinuna[3], ML Mazaba[1], I Mweene-Ndumba[1], J Mufunda[1]

1. World Health Organization, Country office, Lusaka, Zambia
2. Ministry of Health, Provincial Health Office, Kabwe, Zambia
3. Ministry of Health, District Health Office, Kapiri Mposhi, Zambia

Correspondence: Rufaro Murembwa-Chirambo (murembwar@who.int)

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Most of the cholera outbreaks in Zambia have been recorded from fishing camps and peri-urban areas of the Copperbelt, Luapula and Lusaka provinces. Cholera cases have been recorded every year in the Lukanga fishing camps in the last five years. This article documents a cholera outbreak reported at the Lukanga fishing camp in Kapiri Mposhi district in September, 2016. All cases that met the cholera case definition as prescribed in the Integrated Diseases Surveillance and Response guidelines were admitted and treated using WHO standard protocols. A total of 27 patients all adult except 1, 26 of whom were male were seen at the cholera treatment center. Two facility deaths were recorded during the outbreak. All cases were linked to the fishing camps, lack of clean drinking water and poor sanitary conditions among other factors. The incubation period was about 4 days. All patients responded well to treatment with doxycycline and intravenous fluids. There were 2 facility deaths recorded; Case Fatality Rate (CFR): 7.4%. All cases tested on RDT and the water samples were positive for cholera. The outbreak on the Lukanga swamps is associated with *choleravibrio*. There is need to employ interventions in the area of water and sanitation on the Lukanga swamps in order to address the annual cholera outbreaks.

Introduction

The first outbreak of cholera in Zambia was reported in 1977/1978, then cases appeared again in 1982/1983. The first major outbreak occurred in 1990 and lasted until 1993. Since then, cholera cases were registered every year except in 1994 and 1995[1]. A suspected cholera outbreak was reported at the Lukanga swamps / fishing camp in Kapiri Mposhi district in September, 2016.

Kapiri Mposhi district is situated about 180 km from Lusaka and 50km from Kabwe towns and lies along the Great-North road. It has 30 health facilities, managing a total population of 282,308. The Lukanga swamps are located 70km North West of Kabwe and 130km from Kapiri Mposhi District. The Lukanga swamps are shared among the four districts of Central Province namely, Kabwe, Mumbwa, Ngabwe, Chisamba and KapiriMposhi. The swamps are easily accessible through Kabwe and fall within the Waya health centre catchment area of Kapiri Mposhi district. Waya health centre has a catchment population of 16,000 and 5000 living on the upper land and the Lukanga swamps respectively (CSO, 2010).

Cholera is an acute secretory watery diarrhoea caused by the Gram-negative bacterium *Vibrio cholerae,* with 01 and 0139 types being the principal ones associated with epidemics and they thrive wherever crowded housing conditions exist and water and sanitary conditions are suboptimal [2,3,4,5]. It's transmitted by the fecal oral route. The organism produces an enterotoxin, promoting secretion of fluids and electrolytes into the lumen of the small intestine. Cholera epidemics have been increasing in intensity, duration, and frequency, showing the need for more effective approaches to prevention and control [6, 7].

Although most cholera infections are not detected, large cholera outbreaks, such as those seen in Haiti [6] Viet Nam [7] and Zimbabwe [8] in recent years, can occur. Industrialized countries have seen practically no cholera cases for over a century because of their good water and sewage treatment infrastructure, though it remains the significant cause of illness and death in many

African countries. The priority in management of any watery diarrhoea is replacing the lost fluid and electrolytes and providing an antimicrobial agent when indicated. Although the disease may be asymptomatic or mild, severe cholera can cause dehydration and death within hours of onset. Mortality is higher in pregnant women and children [7].

Mortality rates are lowest where intravenous therapy is available [9]. In the twenty-first century, sub-Saharan Africa bears the brunt of global cholera, with a high mortality rate [10]. Improving global access to Water, Sanitation and Hygiene (WASH), as well as cholera treatment is a critical step to reducing Africa's cholera burden [11]. The disease burden in most outbreaks is underreported. Fear of travel-related and trade-related sanctions may contribute to underreporting and may jeopardize efficiency of control measures [12]. Limitations in surveillance systems, inconsistencies in case definitions, variation in modalities, lack of standard terminology, completeness and lack of laboratory diagnostic capacities may also contribute to under- as well as overreporting[13, 14]. Most of the cholera outbreaks in Zambia in the past have been recorded from fishing camps and peri-urban areas of the Copperbelt, Luapula and Lusaka provinces. The article documents the epidemiological findings of the 2016 cholera epidemic within the Lukanga swamps in Kapiri-Mposhi district.

Methods

After having recorded several cases with diarrhoea and vomiting from the fishing camp, a suspicion of cholera was raised, followed by establishment of a Cholera Treatment Centre (CTC), 100 meters away, from Waya health centre.

Case investigation: All suspected cases were admitted and managed and the Cholera Treatment Centre. A suspected case of cholera was defined as any person admitted to the cholera treatment centre with acute watery diarrhoea, with or without vomiting. The demographics and clinical history on every suspected case were documented including age, sex, residency and symptoms.

Laboratory investigation: On admission, Rapid Diagnostic Tests (RDT) using SD Bioline-Cholera Ag 01/01/39 for cholera were conducted for all suspected cases.

Water sampling was also performed.

Case management: WHO cholera treatment protocols were implemented on all patients. Infection control was a top priority using disinfectants chlorine. All patients were treated with doxycycline, metronidazole and intravenous fluids.

Data analysis: Data on the progress of in patients and new admissions were sent 2 to 3 times daily to the Ministry of Health, WHO and other partners. A line list was compiled daily to keep track of new admissions. A descriptive analysis of the outbreak and review of literature was used to determine the extent and factors contributing to the epidemic.

Results

A total of 27 cases were seen at the cholera treatment centre from 13 different lagoons, with majority coming from Namabala lagoon 5/27. There were two facility deaths recorded; case ratality rate (CFR): 7.4%. All patients except one were male. Except for one 15 year old male, the rest were adults. The incubation period was about 4 days. There were 5 additional cases reported from Kapiri Mposhi urban, 3 from Kabwe and 1 from Chibombo districts, all linked to have had visited the Lukanga swamps or received visitors from there. The index case was reported on 11th September, 2016 and the last case on the 21st October, 2016, as shown in figure 1.

Laboratory results

Laboratory investigations for stool culture with TCB media revealed growth of *Vibrio Cholerae* on all the 10 samples tested confirming cholera. The sensitivity test results also revealed that the species organism was sensitive to doxycycline. The 22 samples tested using RDT were also positive. All water samples collected were positive for the cholera vibrio.

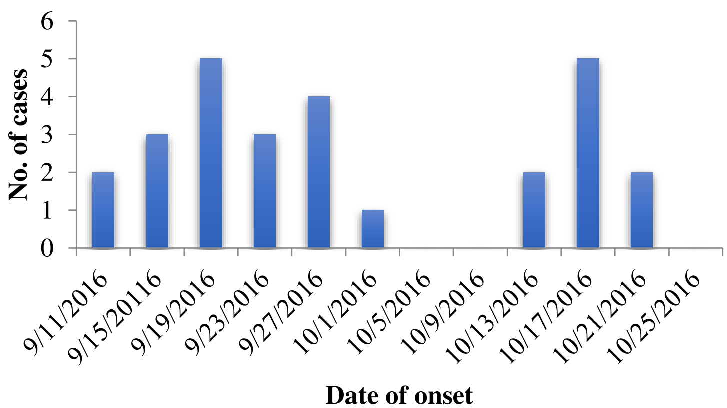

Figure 1 Cholera incidence in Lukanga swamps, September, 2016

Three water samples from selected lagoons were tested and were all positive for *Vibrio cholerae*. In addition, 14 RDTs were done on the water samples using Hydrogen Sulphide tests and they all showed heavy coliform contamination demonstrating the poor sanitary conditions.

Environmental findings

Environmental surveillance revealed non-availability of sanitation and clean drinking water infrastructure on the swamps being factors that precipitated the outbreak. The persons affected, most of whom are fishermen have no access to sanitary facilities and safe drinking water. They use the swamp waters for all need including drinking and sanitation.

Discussion

The outbreak that occurred in Kapiri Mposhi, in particular on the Lukanga swamps is linked to infection with *Vibrio Cholerae* as per laboratory confirmation. Close to 30 persons on the swamps were affected. Considering all those affected lived on the swamps which have no prescribed sanitation or clean water source, it can be assumed that the source of infection was the contaminated water from the swamps. There was evidence of water contamination with *Vibrio cholerae.* Other persons outside the swamps from Kapiri-Mposhi urban, Kabwe and Chibmbo districts which are in close proximity to the swamps who were exposed on visiting the swamp or in contact with persons from the swamps were affected.

There were two facility deaths recorded (CFR = 7.7%). WHO indicates CFRs up to 20% in rural areas. It is also possible that the denominator (cases investigated) is lower than the actual number of cases and so increasing the CFR. The actual number of deaths is smaller than in previous outbreaks and this could be attributed to high community sensitization, which prompted patients to seek treatment at the cholera center timely. The 2015 outbreak recorded 5 deaths [15]. Good case management of cases could have also led to adequately managing the cases. However, many deaths due to cholera have been reported from other places, including the same Lukanga swamps More than 40 years after its resurgence in Africa in 1970, cholera remains a grave public health problem, characterized by large disease burden, frequent outbreaks, persistent endemicity, and high Case Fatality Rates (CFR) [16]. Population density, poor sanitation and health infrastructure, and logistical obstacles to appropriate case management also contribute to a high case-fatality rate in epidemic settings [17]. Of the estimated 3 to 5 million cases that occur globally every year, about 100 000 to 120 000 die [18].

Analysis of reports from previous outbreaks indicate that cholera epidemics in Lukanga swamps occur in the dry season, just before the onset of the rains. The waters in the swamps are low and so the flow of water is poor. The cholera outbreak showed two peaks, with an initial sharp rise at the beginning of September, and the second peak occurred around mid-October within the hot dry season in Zambia which spans from September to November. Fishermen and their families usually spend several weeks every year in fishing camps, in which the swamps is the only source of water. Interventions prescribed such as boiling water are not adhered to due to lack of resources such as firewood, charcoal let alone electricity. Chlorinating water is also prescribed but most persons do not have resources to purchase it. Although chlorine was distributed within the population, it appears there was a shift of source of infection each time the people were provided with clean drinking water (through distribution of liquid chlorine), with people in other lagoons that did not have access to chlorinated water being exposed. It may have been more effective if distribution was done in all lagoons within the same period of time. This way, re-emergence of cholera cases from other sources would be reduced.

There is poor sanitation and clean drinking water infrastructures are likely the contributing factor to the continued outbreaks on the Lukanga swamps. The findings of this study show that there were poor sanitary conditions in the fishing camps, where the same water is used for drinking and all sanitary purposes. There is need to come up with ways of improving the sanitary conditions in the swamps or consider closing all fishing activities until a solution is sanitary conditions improve. Many countries are making important efforts to contain the spread of cholera, but concerns have been raised about the growing number of people living in unsanitary conditions who are at risk for outbreaks of cholera and other epidemic-prone diarrheal diseases [18].

The Lukanga swamps is one of the areas that was considered for cholera vaccination due to cholera endemicity. The first round of Oral Cholera Vaccine (OCV) was conducted from 28th October to 5th November 2016, while the second round was conducted from 26th to 30th November 2016. The target population was from 1year of age upwards, targeting 5,000 people living in Waya catchment area. WHO recommends instituting cholera immunization, in conjunction with other prevention and control strategies, in endemic areas, and perhaps in areas at risk for cholera outbreaks [5, 6]. In 2011, the 64th World Health Assembly adopted resolution WHA 64.15 recognizing the re-emergence of cholera as a significant public health burden and calling for the implementation of an integrated and comprehensive approach to cholera control [4, 7]. Local capacities for improving diagnosis, and for collecting, compiling and analysing data, need to be strengthened so that vulnerable populations living in high-risk areas may be identified and benefit from comprehensive control activities. This includes provision of safe water to all African populations. This requires considerable human and financial resources and time [4]. Prevention, preparedness and response all depend upon effective surveillance system and are linked and interdependent. There is a need to shift the emphasis from response to prevention in order to avert outbreaks in the fishing camps by providing safe water and means for disposal of human excreta and by working with communities to encourage behavioral change to diminish the risks of infection [19].

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PERSPECTIVES

Recovering from an Anthrax epidemic: What are the control strategy challenges and policy options?

A Moraes

Ministry of Health, Ndeke House, Lusaka, Zambia

Correspondence: Albertina Moraes (albertina.ngomah@gmail.com)

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Anthrax is endemic in parts of Zambia, triggered annually by an interplay of environmental factors and human activity. Anthrax cases are typically reported between June and December, coinciding with the period when the human population density on the floodplain is high. Case fatality rate usually ranges from 4-20%. Anthrax impacts negatively on both public health and the livestock industry.

Zambia's Western province is currently in the middle of an anthrax epidemic; both humans and animals are affected. There have been 77 human cases (with 5 deaths reported) since the outbreak began in November 2016. The number of animal cases is unconfirmed as some livestock owners withhold information of animal deaths from officials.

Zambia presently relies on the *Technical Guidelines for Integrated Disease Surveillance and Response* as well as the *WHO Anthrax Guidelines* to guide its actions during anthrax outbreaks.

Quarantines, mass vaccinations and restricted movement of livestock, as well as public awareness campaigns have been initiated to contain the outbreak.

Key Surveillance Findings as of 31 January 2017

As of 29 January 2017, no new cases had been reported. A total of 72 cumulative cases have been recorded since the outbreak began: 25 from Shangombo, 9 from Nalolo, 37 from Kalabo and 1 from Limulunga. Of the 5 deaths reported, 3 were reported from the facility in Kalabo while 2 were reported from the communities in Shangombo and Kalabo. There are six cases currently under treatment as out-patients. The case fatality rate presently stands at 4%.

The Provincial Health Office has been transporting specimens to Lusaka for official analysis and results. Collaboration with the veterinary department is yielding results as the department has begun distributing vaccines to vaccinate animals in affected areas. Information, Education and Communication (IEC) campaigns have continued. However, one of the major challenges being faced is community members who have continued to eat the meat from infected carcasses, disregarding sensitisation messages against this practice.

The above is a depiction of the outbreak in Shangombo, one of the affected Districts. The index case, whose illness was associated with consuming meat from bovine carcasses, was reported on 11/11/2016 from Tukombwe village. There was a spike in the number of cases after 3 animals died in Sikowe village. Remains were destroyed by a combined team of Provincial Health Office, District Health Office and health facility staff. Sensitisation of the community was done. All cases were put on treatment. District and health centre staff are conducting active case investigation and community sensitisation

Research gaps and control challenges

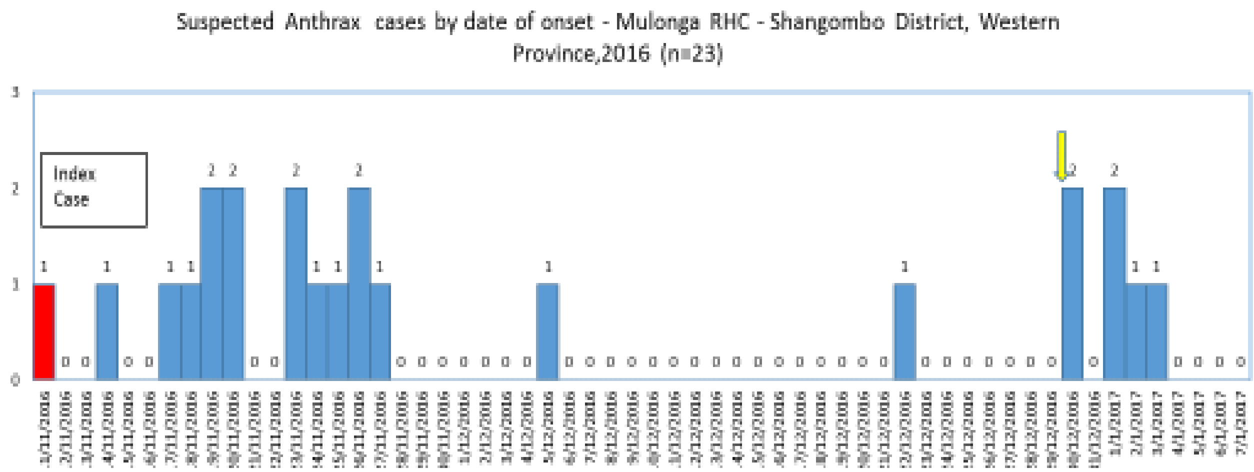
Further research into the molecular epidemiology of the disease as well as strain identification and differentiation will enhance epidemiological investigations and understanding of anthrax not only at national level, but at regional level as well.

Currently used control strategies involving mass vaccinations, quarantine, burning or burying of animal carcasses and community sensitisation fall short in the control of anthrax. Farmers tend to be uncooperative with vaccination of livestock as it coincides with the farming season and thus is viewed as a disruption to the maximum usage of animals for farming activities. Quarantine tends to be difficult to enforce due to numerous illegal routes used to transport livestock.

Communities are often reluctant to burn or bury carcasses as advised. In the flood plains where epidemics commonly occur, there is a lack of firewood to burn the carcasses. The burning of carcasses is also seen as time consuming and a distraction from farming activities. Carcasses are salvaged for meat, despite health warnings, which results in human cases. Furthermore, inhalation of spores through exposure to hides from infected carcasses that were processed for use as sleeping mats or drums has been noted to play a minor role in proliferation of epidemics.

Policy options

A one-health approach is key to achieving lasting control of anthrax. Surveillance systems must be strengthened for early detection and response.



Human Vaccination campaigns: The most effective method for mass protection against anthrax is through vaccination. Mandatory vaccinations in endemic areas (with the exception of individuals with a history of anthrax disease and pregnant women until after delivery) would reduce disease incidence by up to 92.5%, based on human and animal data.

Animal vaccination campaigns must be conducted at regular intervals. The timing of these campaigns must not coincide with the farming season so as to increase uptake by farmers.

Increasing the vaccination coverage through continued collaboration between the public and private sector, and instituting a systematic quality control programme to evaluate the performance of vaccination campaigns will increase the likelihood of success of such programmes.

Investing in infrastructure for local vaccine production: the Central Veterinary Laboratory under the Department of Veterinary and Livestock Development, currently produces a local vaccine with high potency and no side effects. This should be scaled up throughout the provinces so as to decentralise the technical and administrative support required for control of epidemics. Stockpiles of the vaccine should be available for use during epidemics; these can then be transported promptly to outbreak areas by means such as drones.

Scaling up community outreach activities in endemic areas to ensure timely treatment of cases and a reduction in anthrax mortalities, especially for communities in hard to reach areas where the long distances to facilities often affects access to care. Furthermore, *salient health information and mass media campaigns* must be designed and implemented regularly to further educate the public regarding the dangers of consuming meat from infected carcasses as well as using hides from animals dying of anthrax

Improving food security in outbreak prone areas will further reduce instance of carcass salvage by local communities.

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PERSPECTIVES

Prioritising health promotion, disease prevention and control - A transformational agenda for the Zambian health sector

K Malama

Director Health Promotion, Environment & Social Determinants. Ministry of Health Headquarters Lusaka, Zambia.

Correspondence: Kennedy Malama (malamakennedy@gmail.com)

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The World Health Organisation describes health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity [1]. Most Ministries of Health focus on treatment of infirmities and yet there are various factors including those of social and economic influence that play a part in one's complete well-being. Aspects of health as described by the WHO must be embraced for a healthy population and that the team in-charge of ensuring good health recognises the link between all factors that have an influence on the total health of any being. The Ministry of Health in Zambia has taken recognisance of the fact that all determinants of health must be taken into account when dealing with disease prevention and control. Since 1995 the government of Zambia has developed national policies in specific aspects of health provision [2, 3]. The Ministry of Health as part of its transformational agenda has undergone yet another reform in its bid to improve health at all levels. A new directorate called the Directorate of Health Promotion, Environment and Social Determinants of Health has been included in the Ministry of Health Structure to ensure a holistic approach is utilised when managing the health of the Zambian population. The Health Press – Zambia had an opportunity to meet with the Director of the new Directorate Dr Kennedy Malama who shares his views in the following excerpt:

Zambia's Health sector has undergone a number of reforms including the Strategies and Plans of 1991/1992 followed by the 1995 reforms anchored on the National Health Services Act which led to formation of Boards [4]. However, the reorganisation of the Health Sector in 2016/2017 is unique as it has been premised on a transformational agenda of prioritising Promotion of Good Health, Preventing and Controlling Disease. This shift has been necessitated by the fact that our disease burden has generally continued to rise despite the massive investment from Government and its Cooperating Partners in the Health Sector especially in the treatment platform. It is very clear that our health budget shall continue to increase if we continued at this trajectory. This scenario has called for rethinking in terms of where we want to go as a country.

Service delivery is made up of Health Promotion, Disease Prevention & Control, Treatment and Rehabilitation. As a country, our top priority should be on ensuring that people don't fall sick and those that slip through the cracks are treated and rehabilitated accordingly. We need to take those high impact community interventions to the Households.

It is evident that the majority of determinants of health lie outside the health sector and ignoring this fact is at the peril of the Zambian people's health. This mandate to navigate the determinates of Health makes the new directorate better placed to spearhead the prevention, and controlling of diseases; of course working closely with other directorates particular Public Health and Clinical Care & Diagnostic Services.

It is from the above background that Ministry of Health made a bold decision to amplify its emphasis on promoting health and preventing and controlling diseases. To ensure that this declaration does not remain rhetoric, a Directorate of Health Promotion, Environment and Social Determinants of Health has been created at the Ministry Headquarters.

The new directorate's mandate include: promoting good health, preventing and controlling disease, coordinating environmental health, occupational health and food safety, fostering intersectoral collaboration within the framework of Whole Government and Whole Society, buying into the Principles of Health in All Policies (HiAP). In addition the new directorate shall spearhead legislation and policy formulation and review, setting of standards and guidelines, resource mobilisation and health Communication. Other roles include; provision of supervision, technical support, mentorship and monitoring & evaluation at all levels.

Zambia continues to be besieged by emerging and re-emerging infectious diseases. From 2016 through to 2017 Zambia has experienced two outbreaks of cutaneous anthrax associated with eating meat from anthrax infected hippopotamus and buffalo in Chama district of Muchinga province and beef in Limulunga, Nalolo, Kalabo, Shangombo districts of Western Province. The outbreaks have reoccurred in both provinces within 5 years despite varied interventions such as health education and vaccination of domestic animals. We also note persistent diarrhoeal disease in our communities despite various interventions. There is need to revise and input appropriate and effective health promotion and disease prevention and control interventions. A holistic approach to health promotion, prevention and control of disease remains a priority. Evidence from the anthrax and diarrhoeal diseases suggests engaging all stakeholders in preventing and controlling these and other diseases is the way to go. The community needs to be engaged at all levels in order to mitigate the high burden of many preventable diseases. Borrowing from the late President J.F Kennedy of the USA, "Let's not ask what government can do for us but what we can do for human kind"

With this unprecedented prioritisation of health promotion, prevention and control of disease, the strength of this paradigm shift will greatly enhance Primary Health Care and expedite Zambia's attainment of a healthy and productive population contributing to the socio – economic development of the country. This new focus shall be catalytic in Zambia's attainment of the Universal Health Coverage. It's expected that all these interventions targeting the community particularly the households shall significantly contribute to reduced incidence and prevalence of communicable and non –communicable diseases including maternal, New-born, child and adolescent morbidity and mortality.

We need to rush to that tap and close it rather than mopping the floor expecting the floor to become dry!

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