

*East African Medical Journal Vol. 90 No. 10 October 2013*

**CHOLERA EPIDEMIOLOGY IN ZAMBIA FROM 2000 TO 2010: IMPLICATIONS FOR IMPROVING CHOLERA PREVENTION AND CONTROL STRATEGIES IN THE COUNTRY.**

O. Olu, MBBS, MPH, MSc, Disaster Preparedness and Response (DPR) Focal Point, World Health Organisation (WHO) Inter Country Support Team (IST) for East and Southern Africa, Harare, Zimbabwe, O. Babaniyi, MBBS, MPH, MSc, Representative, WHO, Lusaka, Zambia, P. Songolo, BSc, MBChB, MPH, Disease Prevention and Control (DPC) Officer, WHO, B. Matapo, BA, National Surveillance Officer (NSO), WHO, E. Chizema, BSc, MBChB, MPH, Director Public Health and Research, M. Kapin'a-Kanyanga, BSc, MBChB, MSc, National Epidemiologist, E. Musenga, BSc, Data Manager, Ministry of Health, Lusaka, Zambia, O. Walker, MBBS, MD, FMCP, FWACP, Co-ordinator, World Health Organisation Inter Country Support Team (IST) for East and Southern Africa, Harare, Zimbabwe

Request for reprints to: O. Olu, Disaster Preparedness and Response (DPR) Focal Point, World Health Organisation (WHO) Inter Country Support Team (IST) for East and Southern Africa, PO Box BE 773 Belvedere, Harare Zimbabwe Harare, Zimbabwe

**CHOLERA EPIDEMIOLOGY IN ZAMBIA FROM 2000 TO 2010: IMPLICATIONS FOR IMPROVING CHOLERA PREVENTION AND CONTROL STRATEGIES IN THE COUNTRY**

O. OLU, O. BABANIYI, P. SONGOLO, B. MATAPO, E. CHIZEMA, M. KAPIN'A-KANYANGA, E. MUSENGA and O. WALKER

**ABSTRACT**

**Objective:** To review the cholera epidemiology in Zambia from 2000 to 2010 in order to highlight the key lessons learned. Based on our findings, we make recommendations for improving cholera prevention and control in country.

**Design:** Ten years descriptive cholera data was extracted from the national IDSR database and analysed.

**Setting:** The study was conducted in Zambia using national epidemiology data which were disaggregated by Province.

**Subjects:** None

**Results :** Starting from 2003, there has been a progressive increase in yearly incidence of cholera in the country. In 2010, 6794 cases (500% increase compared to 2003) and 115 deaths (CFR 1.6%) of the disease were reported with Lusaka Province accounting for 85% of the total cases. Outbreaks start between epidemiological weeks 40 to 45 of the year and ends between weeks 20 to 25 of the following year (which corresponds to the Zambian rainy season). Outbreaks are largely confined to the peri-urban areas of Lusaka, Luapula, Southern and Copperbelt Provinces.

**Conclusion:** In the last 10-20 years, the epidemiology of cholera in Zambia has changed; Laboratory confirmation of *Vibrio cholerae* in the country on a yearly basis in the last ten years suggests that the country is now endemic for cholera hence the need to review current cholera prevention and control strategies.

**INTRODUCTION**

Since the discovery of the bacteria *Vibrio cholerae* in the 19<sup>th</sup> century, it has spread rapidly across the globe affecting mainly the developing countries (1). In the last 20 years, there has been a gradual shift in the epidemiology of the disease from high incidence in Asia and the Americas to Africa (2). Since 2005 there has been a progressive increase in the yearly incidence rate of the disease globally (3). Increasing poverty, retarded economic growth and development

and limited access to basic social services such as health, clean water and improved sanitation remain the underlying drivers of cholera transmission in Africa (4). Despite the availability of well documented evidence, abundant knowledge about the epidemiology of the disease and the measures that need to be put in place to ensure preparedness for and timely response to cholera epidemics, most developing countries are hardly ever prepared.

According to WHO estimates, 115,106 cases and 3397 deaths of cholera were reported from Africa in

2010 representing 36.3% of the global incidence of the disease for that year (3). Although this represents a 47% decrease in incidence from 2009 to 2010, the region has been responsible for the bulk of global cases and deaths since 1996, except for 2010 when the outbreak in Haiti (179,379 cases reported) reversed this trend (3). These figures are a tip of the iceberg as many countries under report cholera cases due to poor case definition and inappropriate classification of cholera cases as Acute Watery Diarrhoea (AWD).

Starting from 2008, there was a surge in cholera incidence in southern Africa where huge and unprecedented outbreaks were reported in 2008/2009 (5). In 2009, 8 countries of southern Africa including Zambia reported 109,008 cases of cholera which is about 50% of all the cases reported on the continent for that year (2). In recent years, Zambia experienced major cholera epidemics; the outbreak of 2004 recorded more than 12,000 cases and 373 deaths.

In this article, we review the cholera situation in Zambia from 2000 to 2010 in order to fully understand the epidemiology of the disease and to highlight the key lessons learned from the preparedness and response efforts at the national and district levels. We used the findings and key lessons learned from our review and other similar studies to propose key recommendations for improving prevention and control of the disease in the coming years.

## MATERIALS AND METHODS

The Zambian Ministry of Health (MOH) has been collecting cholera data through the immediately notifiable disease module of its Integrated Disease Surveillance and Response (IDSR) system since the early 1970s. These are collated and reported to WHO on a yearly basis and deposited in the global health atlas which is available on the internet. For this article, we extracted cholera data from 1977 to 2010 from the national IDSR database; these were compared to the Zambian cholera data on the global health atlas to ensure consistency [6]. Descriptive data analyses in terms of place and time were conducted using Epi Info (version 3.5). Maps were generated using EpiMap,

while cholera epidemic curve were generated using Microsoft Excel.

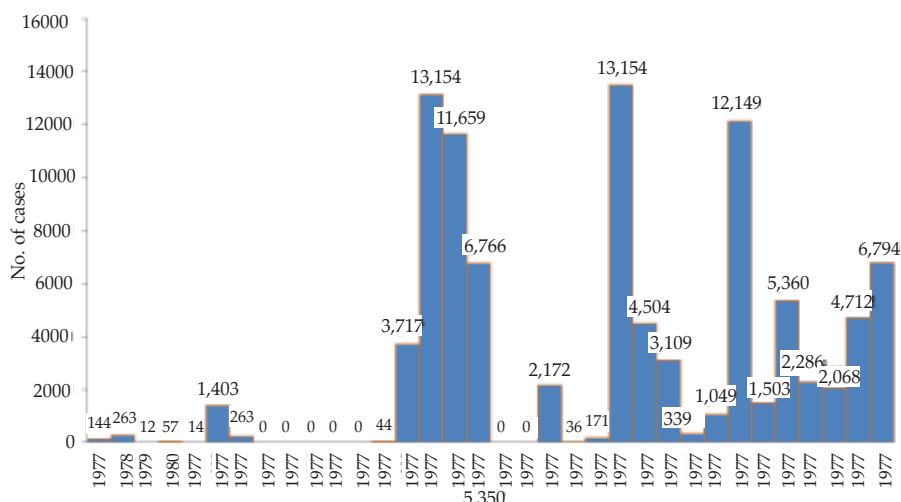
To better understand the important risk factors in cholera transmission and key challenges in cholera epidemic preparedness and response in the country, available literature on cholera in Zambia and other similar settings were reviewed. Reports of previous outbreak investigations and minutes of the National Epidemic Preparedness, Prevention, Control and Management Committee (NEPPC&MC) meetings were also reviewed. Furthermore, in-depth interviews were conducted with stakeholders drawn from the relevant sectors (such as health, water, sanitation and local administration), NGOs, the UN and the affected communities.

Laboratory data on *Vibrio cholerae* serogroup and serotype identified in the country from 2005 to 2009 was collected from the National Public Health Laboratory. These were analyzed and compared with the Case Fatality Ratio (CFR) to see if there was any correlation between serotype and mortality. To examine the relationship between rainfall and seasonality of cholera outbreaks, we collected weekly rainfall data for Lusaka Province for the last 10 years from the National Meteorological Services and plotted these against weekly cholera incidence. We reviewed existing literature on cholera in Zambia to interpret and buttress the findings of the descriptive analysis and correlation between cholera incidence and weather. Our findings are presented in the result section below.

## RESULTS

Zambia reported its first cholera epidemic in 1977/78 and from then up until the early 1990s, the country experienced major outbreaks every three to five years (Figure 1). In the 1990s, the interval between major outbreaks reduced to every two years on average. Since 1999 to date, major outbreaks have been reported almost every year except in 2002 when there was drought in the country. Starting from 2003, there has been a progressive increase in yearly incidence of cholera in the country (Figure 1).

**Figure 1**  
*Reported cholera cases in Zambia, 1977-2010*



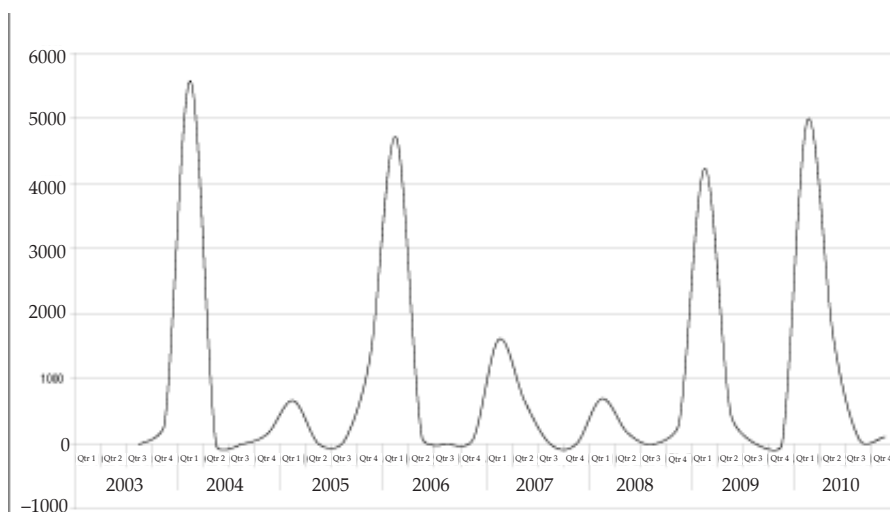
In 2010, the country reported 6794 cases and 115 deaths (CFR 1.6%) of the disease with Lusaka Province accounting for 85% (5798) of the total cases for that year. The 2010 cases represent more than 500% increase when compared to the number of cases in 2003 (1049). In 2010, the country accounted for 41.6% of all the 16,330 cases reported from 4 southern African countries namely Malawi, Mozambique, Zambia and Zimbabwe.

Outbreaks typically start between epidemiological weeks 40 to 45 of the year and ends between weeks 20 to 25 of the following year (which corresponds to the Zambian rainy season) with the peak being reached between weeks one to 13 (Figures 2 and 3). Analysis of available rainfall and epidemic data for Lusaka Province demonstrates a very strong association between onset of rainfall and epidemic outbreaks (Figure 3). From 2000 to 2010, there has been

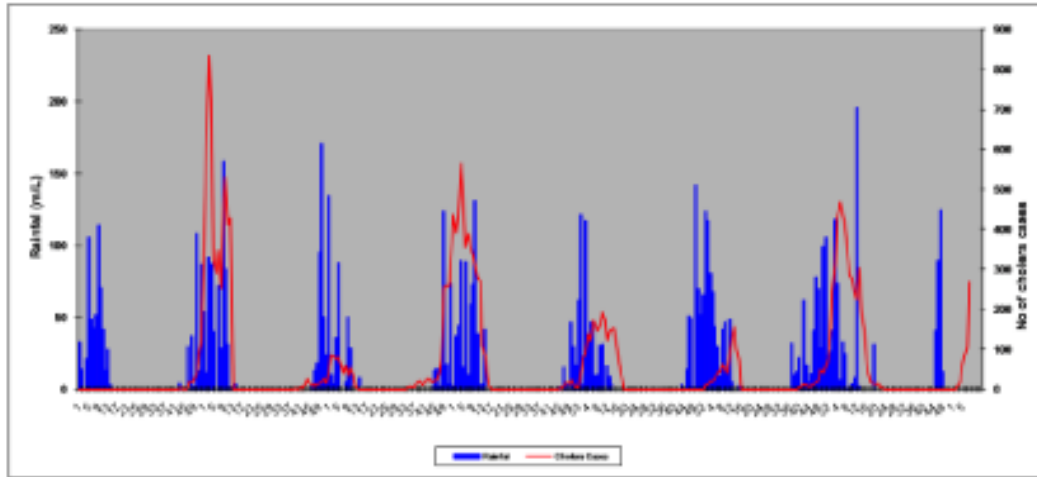
a progressive decrease in cholera Case Fatality Ratio (CFR) with a percentage decrease of 74.6% (Figure 4)

In terms of place, outbreaks are largely confined to the peri-urban areas of Lusaka, Luapula, Southern and Copperbelt Provinces and the fishing camps of the rural areas of Mpulungu in Northern Province (Figure 5). Seventy three percent (73%) of all the 39,285 cases of cholera reported from 2001 to 2010 are from Lusaka Province followed by 7%, 6%, 5% and 4% respectively from Luapula, Southern, Central and Copperbelt Provinces (Figure 6). In Lusaka District; which is usually the epicentre of outbreaks; majority of cases are reported from Kanyama, Chawama, Chipata, George, Kamwala and Mandevu wards all which are located in the western suburbs of the district (Figure 7). The predominant strain of cholera in Zambia is Eltor 01; since 2005 all cholera cases who tested positive (439) were identified to have this strain

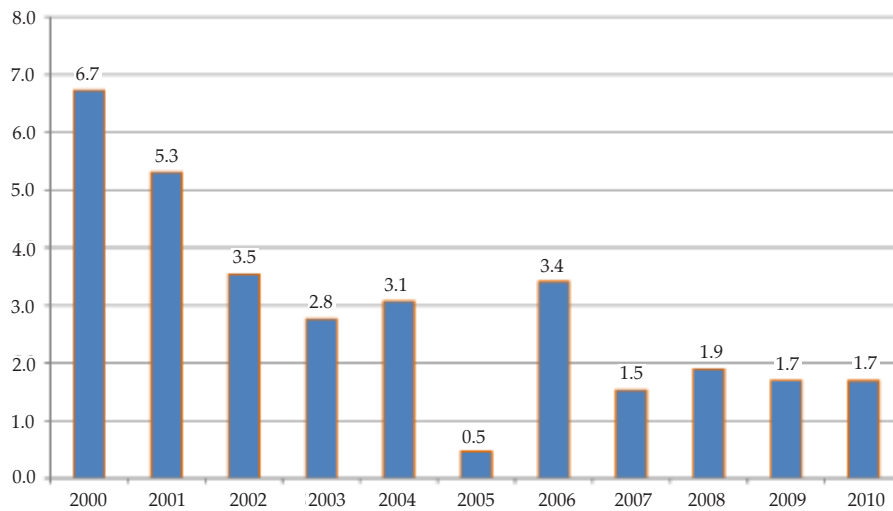
**Figure 2**  
*Reported cases of Cholera in Lusaka city, 2003-2010*



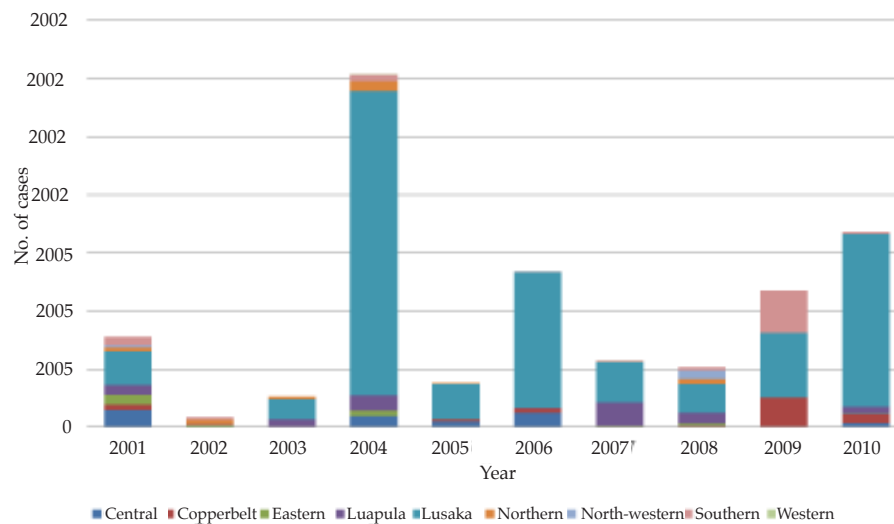
**Figure 3**  
Cholera cases and average rainfall in Lusaka, 2003-2008



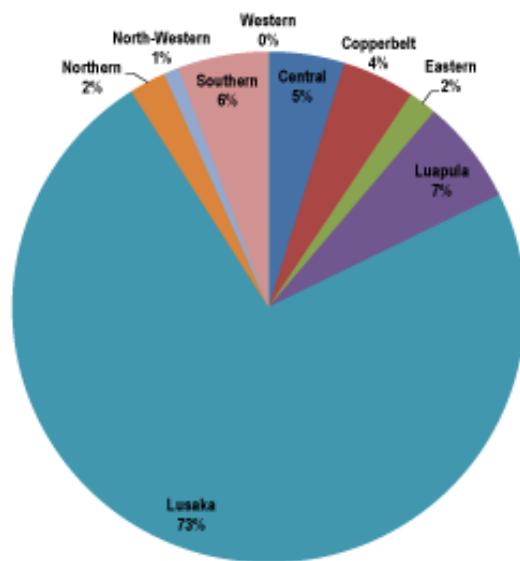
**Figure 4**  
Cholera Case Fatality Ratio (CFR) in Zambia, 2000-2010



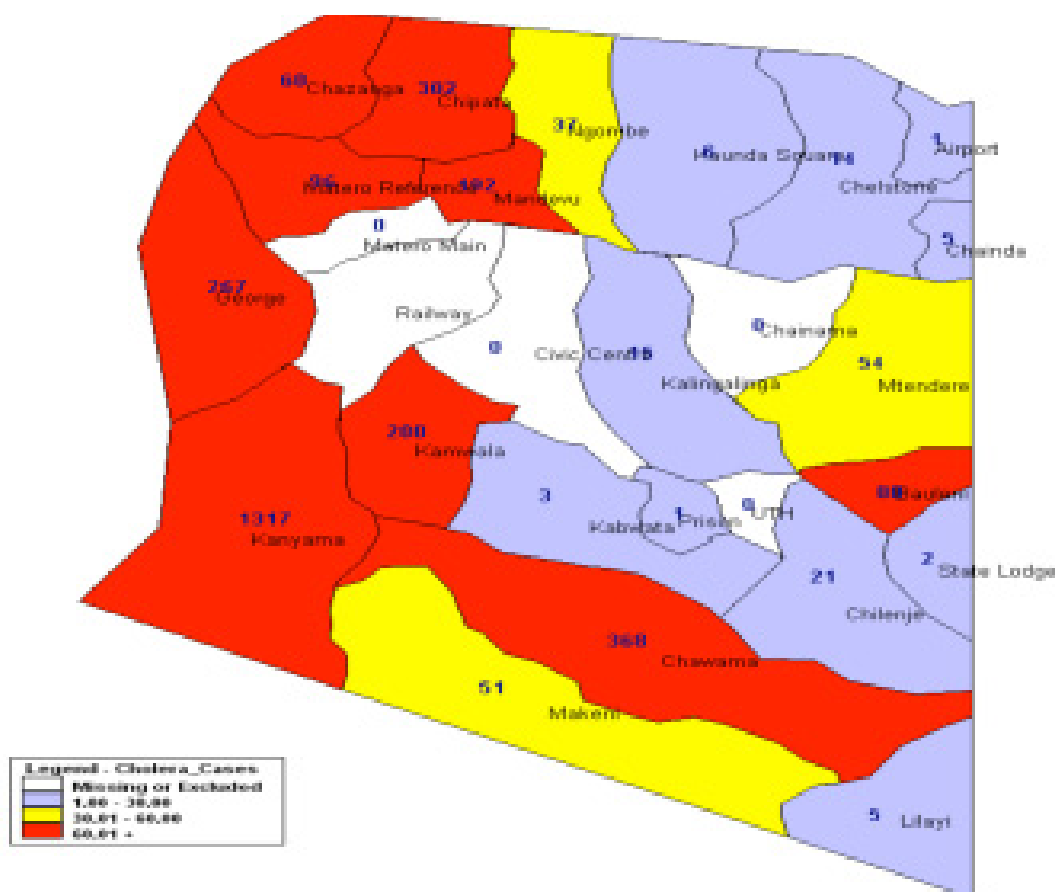
**Figure 5**  
Reported cholera cases by province, 2001-2010



**Figure 6**  
Percentage of total cholera cases by region , 2001-2010



**Figure 7**  
Lusaka district cholera cases by facility catchment area, 2008



**DISCUSSION**

The results of this study show an unambiguous cholera epidemiology in Zambia. Cases are typically confined to peri-urban areas and around water bodies

where cholera risk factors are predominant. There is a striking association between onset and end of rains and outbreaks in Lusaka, an association which has been well documented (7,8). Inadequate access to safe water and poor sanitation are perhaps the most

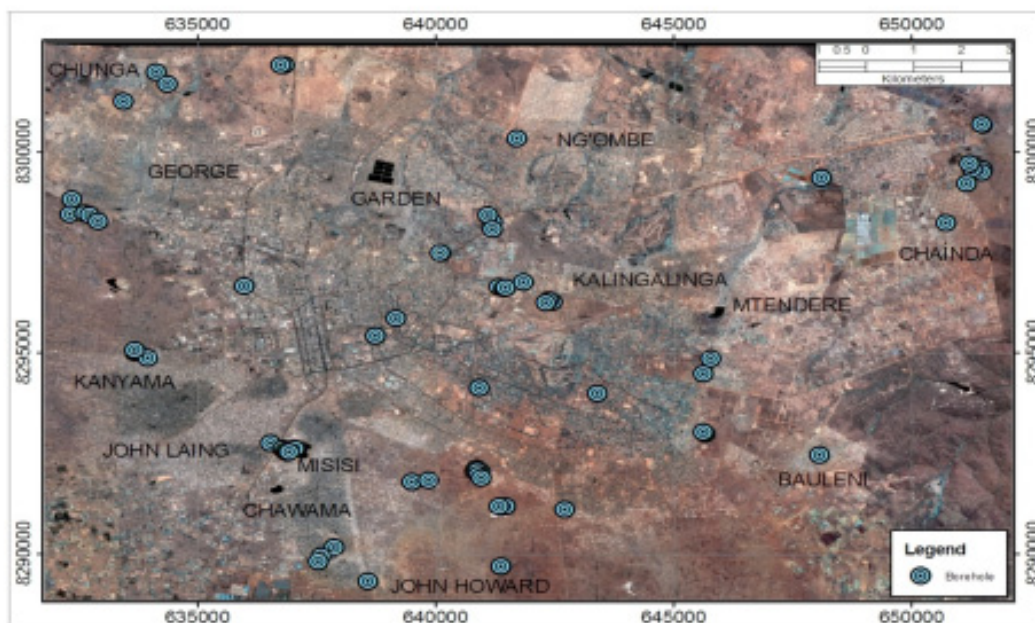
important risk factors for cholera transmission in the country. Rural-urban migration as a result of increased poverty and inadequate social services in the rural areas has created poorly planned peri-urban slums where living conditions are dire and access to safe water and sanitation is limited. Lusaka District, which is the epicentre of cholera in the country, possesses peculiar topographical attributes which fuel cholera transmission. The high water table in most part of the Province makes construction of pit latrines a technical challenge while also increasing the risk of contamination of shallow wells. Low water absorption capacity of the soil and poor storm water drainage further increases the risk of flooding which often results in erosion of pit latrines and contamination of shallow wells which are the main sources of drinking water in the peri-urban areas of the Province.

In the western parts of Lusaka District, from where majority of cholera cases and deaths are usually

reported, there are many unplanned settlements with poor access to safe water and good sanitation. In these areas, there are few water boreholes (resulting in limited access to portable water in these areas) (Figure 8). The alternative sources of water supply which are shallow wells are located close to pit latrines that are flooded during the rainy season exposing them to faecal contamination. In general, the population size of Lusaka far outweighs the quantity of water being produced and distributed by the Lusaka Water and Sewerage Company (LWSC), resulting in a shortfall of approximately 50-70 million litres of water per day. The inadequate water supply situation for Lusaka has resulted from non-expansion of water treatment facilities in Kafue, which was constructed over 50 years ago. Kafue is located about 50 km southwest of Lusaka city and water has to be pumped over that distance.

**Figure 8**

*Map showing Lusaka water sewerage boreholes and some high density settlements*



To address the water problem in the peri-urban area of Lusaka city, LWSC constructed additional boreholes to increase the volume of portable water produced daily, while to improve the water distribution in the densely populated wards, water kiosks where water is sold at a fee (\$0.02 per 20 litres of water) were constructed and manned; however these kiosks are mired in logistic challenges. Limited time of operation of the kiosks and inability of many of the poor inhabitants of the slums to afford the water fees results in consumption of water from shallow wells most of which have been demonstrated to be contaminated.

Other risks and protective factors for cholera

transmission in Zambia have been well documented. Sasaki *et al* demonstrated the association between low latrine coverage and poor drainage systems with high incidence of cholera while also proving the protective effect of water chlorination and hand washing with soap (9). Dubois *et al* (10), in their own case control study identified consumption of raw vegetables, leftover nshima (a local staple food) and sharing of latrines as the strongest risk factors for cholera transmission while hand washing and consumption of Kapenta, a local fish has the strongest protection for cholera infection (10). Furthermore, the association between rainfall and insufficient drainage networks

with occurrences of cholera outbreaks in Lusaka has been well documented (11).

Our findings highlight a number of key lessons which are important for improving cholera prevention and control in Zambia. Firstly, over the years the epidemiology of cholera in Zambia has changed. Laboratory confirmation of *Vibrio cholerae* in the country on a yearly basis in the last ten years suggests that the country is now endemic for cholera (12). Secondly, the timing and geographic distribution of outbreaks are very predictable. Thirdly, enough evidence exists on cholera transmission risk and protective factors; in addition to contaminated water, contaminated raw vegetable and food are important route of transmission of cholera in Zambia. Fourthly, there is a strong association between cholera outbreaks, rains and meteorological indicators such as temperature in Zambia; this association can be used to improve early detection and prevention of cholera in the country. Fifthly, the appropriate use of the available information and knowledge of cholera transmission pattern in Zambia can facilitate major reductions in cholera morbidity and mortality in the country.

Based on our findings, we propose a few recommendations to improve cholera prevention and control in the country. Given the association between consumption of contaminated food and cholera transmission, cholera control measures and messages should not be limited to ensuring a safe water chain but also addressing the issue of food handling and safety (13). The logistic challenges and costs associated with providing clean pipe-borne water at community level in the high-risk areas of the country makes this option near impossible in the short term, therefore emphasis should be placed on maintaining safe water chain at the household level through decontamination of the shallow wells and chlorination of household drinking water. In the long term, sustainable models for providing adequate quantities of clean water to the peri-urban populations of Lusaka city especially during the cholera epidemic season needs to be explored. Perhaps a community-based water insurance scheme in which corporate bodies as part of their corporate social responsibility and the richer segment of the society can pay for water consumption of the poor may be an option for Lusaka city.

Concerning sanitation, in the short term, promotion and scale up of construction of ECOSAN pit latrines which have been demonstrated to be water tight and flood proof and successfully used in some parts of Lusaka city is an option. However, more scientific studies are needed to further improve these latrines and adapt them to the local context. Hand washing has been proven to be a simple, effective and cheap strategy for prevention and control of not only

diarrhoea diseases including cholera but also other infectious diseases such as the Pandemic Flu thus it should be strongly promoted using appropriate local technology for control of future cholera outbreaks.

In view of concentration of outbreaks largely to peri-urban slums of the country, cholera vaccines may be an additional tool for cholera prevention and control in Zambia (12, 14, 15). However, the decision on the introduction of cholera vaccines should be guided by clear technical and logistic criteria which should be agreed upon by all stakeholders in the health sector of the country. Comprehensive cholera risk assessments and analysis of the pros and cons of the vaccines is critical; the issue of vaccine availability, cost and logistics for administration needs to be considered. Importantly the use of cholera vaccines should not over-shadow the traditional strategies for cholera control. In addition, the political implications and dimensions of introducing the vaccines will also need to be analysed and addressed. The good knowledge of timing of cholera outbreaks should drive well-timed emergency preparedness and response efforts. Development and implementation of emergency Standard Operating Procedures (SOPs) for cholera will facilitate timely and effective response actions throughout the year. Furthermore, the health sector should work with the National Meteorological Services to develop a real-time early warning system for cholera using a combination of rainfall, temperature and epidemiological indicators to predict outbreaks.

The importance of effective multi sectoral coordination of cholera preparedness and response effort and ensuring effective cholera case management cannot be overemphasized. The existing national cholera coordination mechanisms in the country should be strengthened by ensuring a more hands on approach of the national cholera task force to coordination, supervision and monitoring of cholera response activities. Furthermore development of common tools for identification of gaps in cholera preparedness and response is needed to ensure that outbreak responses are comprehensive. Although our finding shows a declining CFR trend in the country since 2000/01 which indicates improving case management, there is still room for improvement in this area. Cholera Treatment Centres (CTCs) should be decentralized and strategically located using available epidemiological data to ensure easy access to patients and an effective 24-hour referral system for cholera cases should be operationalised during outbreaks.

Finally, cholera outbreaks in any country are signs of underdevelopment emanating from long-term systemic failure, thus efforts must be made to address key health and water system problems in Zambia particularly in Lusaka city in the long

term. Greater attention needs to be paid to urban development vis-à-vis well planned urban dwellings, water, and sanitation and drainage systems. Lastly, cholera risk reduction systems will also need to be established in the country; this can be achieved through strengthening of the health system of the country.

#### COMPETING INTERESTS

The authors declare that they have no competing interests

#### ACKNOWLEDGEMENTS

To the Public Health and Research Department of MOH, Zambia for providing the data and giving the approval for the study.

#### REFERENCES

- Gaffga N, Tauxe RV, Mintz ED. Cholera: A new homeland in Africa. *Am. J. Trop. Med. Hyg.* 2007; **77**: 705-713
- World Health Organization. Cholera, 2009. *Wkly Epidemiol Rec.* 2010; **85**: 293-308
- World Health Organization. Cholera, 2010. *Wkly Epidemiol Rec.* 2011; **86**: 325 - 340
- Mintz, ED, Guerrant RL. A lion in our village-the unconscionable tragedy of cholera in Africa. *N Engl J Med.* 2009; **360**:1060 - 1063
- Mason PR. Zimbabwe experiences the worse epidemic of cholera in Africa. *J Infect developing Countries.* 2009; **3**: 148 - 151
- WHO. WHO global health atlas. WHO Geneva 2011. [http://apps.who.int/globalatlas/dataQuery/report.Data.asp?rptType=1](http://apps.who.int/globalatlas/dataQuery/report>Data.asp?rptType=1) (accessed on 26<sup>th</sup> October 2011)
- Fernández MA, Bauernfeind A, Jiménez JD *et al.* Influence of temperature and rainfall on the evolution of cholera epidemics in Lusaka, Zambia, 2003.2006: analysis of a time series. *Trans R Soc Trop Med Hyg.* 2009; **103**: 137—143
- Emch M, Feldacker C, Islam MS, Ali M. Seasonality of cholera from 1974 to 2005: a review of global patterns. *Int J Health Geogr.* 2008; **20**:31
- Sasaki S, Suzuki H, Igarashi K, Tambatamba B, Mulenga P. Spatial analysis of risk factor of cholera outbreak for 2003-2004 in a peri-urban area of Lusaka, Zambia. *Am J Trop Med Hyg.* 2008; **79**: 414 - 421.
- Dubois AE, Sinkala M, Makasa-Chikoya M, Quick RE. Epidemic cholera in Urban Zambia: hand soap and dried fish as protective factors. *Epidemiol. Infect.* 2006; **134**: 1226-1230
- Sasaki S, Suzuki H, Fujino Y, Kimura Y, Cheelo M. Impact of drainage networks on Cholera outbreaks in Lusaka, Zambia. *Am J Public Health.* 2009; **99**: 1982 - 1987
- World Health Organization. Cholera vaccines: WHO position paper. *Wkly Epidemiol Rec.* 2010, **85**: 117-128
- Naidoo A, Patric K. Cholera: a continuous epidemic in Africa. *J R Soc Promot Health.* 2002; **122**: 89-94
- Legros D, Paquet C, Perea W. *et al.* Mass vaccination with a two-dose oral cholera vaccine in a refugee camp. *Bull World Health Organ.* 1999; **77**: 837 - 842
- Lucas ME, Deen JL, von Seidlein L. *et al.* Effectiveness of mass oral cholera vaccination in Beira, Mozambique. *N Engl J Med.* 2005; **8**: 757 - 67.