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Statistical Neural Network Modelling of Cholera in Nigeria and South Africa with Implications for Psychosocial Support

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ABSTRACT Cholera has been studied from different perspectives since its first outbreak in the 16th century. However, little is known about the psychosocial support needed, which becomes critical because its eradication has continued to defy attempts by many governments. This paper is based largely on data obtained from World Health Organization annual observatory website for Nigeria and South Africa. Cases of missing observations were estimated using spline interpolation. Statistical neural network was used to estimate the fatality rate, and forecasts were made for 2030. Results showed that fatality rates were decreasing in both countries, with a faster rate in Nigeria (-0.04) compared to South Africa (-0.06). However, the disease would still not have been eradicated by 2030. This calls for stronger concerted efforts by the government and international community in combating the disease in Africa. One major intervention would be the application of targeted psychosocial support that victims, friends, families and communities of victims lack at the moment.

INTRODUCTION

Cholera disease has been in existence for a long time. The first noticeable outbreak of the disease was in Calcutta, India, in the early 1800s due to poor water and living conditions of the occupants[1]. However, the scientific understanding of the disease was not known until 1854, during its outbreak near Broad Street (now known as Carnaby Street) in London in the Soho District. The outbreak was known as the *Broad Street Cholera Outbreak*[2]. It is caused by a bacterium, known as *Vibrio cholera* (named suggested by the Italian Scientist, *Filippo Pacini*[3] in the year 1854) which contaminates solid or liquid food. It is an acute infection that usually results in an epidemic. It is characterized by acute watery diarrhea, vomiting, severe dehydration, and muscle cramps (Kaper et al. 1995; Sack et al. 2004). It is one of the diseases that have been found to be a global threat to public health and a key indicator of lack of social development. It was a common disease the world over with not less than seven major pandemics since the early 19th century (Faruque et al. 1998), but now the infection is now largely confined to developing countries in the tropics and subtropics (Adagbada et al. 2012). It was suspected to be of Indian origin where cholera-like diseases have been described as early as the 16th century through the 19th century (WHO 2000). Africa, parts of Asia, the Middle East, and South and Central America has been largely hit in recent years. These are always due to war or civil unrest which normally disrupts public sanitation services. A study was conducted in Haiti by the Centers for Disease Control and Prevention (CDC) using Spatiotemporal modeling to determine the origin and spread of the cholera epidemic in 2010 (CDC 2011). This was necessary as Haiti had never experienced the epidemic in more than a century. The result of the model traced the spread to the contamination of the lower course of the Artibonite River.

Qadri (2005) also noted that natural disasters, such as earthquake, tsunami, volcanic eruptions, landslides and floods also contribute to cholera outbreak by disrupting the normal balance of nature. This disruption results in the contamination of food and water supplies by parasites and bacteria due to the destruction of the essential systems like those for water and sewage. Acquisition of the infection comes as a result of consuming contaminated water, seafood, or other foods. When infected, the victims excrete the bacteria in stool, and thus cholera can spread rapidly, especially in areas where human waste is untreated. In their report, Lamond and Kinyanjui (2012) observed that only about twenty percent of those infected develop

acute watery diarrhea (AWD), furthermore, ten-twenty percent of this proportion develop severe watery diarrhea (SWD) with vomiting. Delay in prompt and adequate treatment leads to loss of large amount of fluid and salts from the body system. This can further lead to severe dehydration and death within hours. The case fatality rate (CFR) if untreated may reach thirty-fifty percent (Lamond and Kinyanjui 2012). UNICEF stated their role in cholera prevention, preparedness, and response in their toolkit as: advocacy; coordination; assessments, planning, and prioritization; surveillance, early warning systems, and mechanisms; service delivery; and communication.

In general, three major reasons cause the risk of infection and spread of cholera. These are significant breaches in the water, sanitation, and hygiene infrastructure used by groups of people. The disease is transmitted through fecal-oral route via contaminated food, carriers of the infection and inadequate sanitary conditions of the environment. The principal mode of transmission however remains ingestion of contaminated water or food. There is no age group that is not affected by the infection of the disease. However, it has been found that the risk is reduced among infants who are being breastfed. This may not be unconnected with the exposure of maternal antibodies to the bacteria called *V. cholera*.

Rosewell et al. (2012) reported the habit of open land and river defecation in Papua New Guinea as being responsible for the outbreak of the disease. On the other hand, drinking and domestic use of contaminated water was described as the risk factor of the disease in India between 2004 and 2010 (Datta et al. 2012; Mukherjee et al. 2011). In Haiti, the case, as reported by Dunkle et al. (2011), was related to challenges with water supply and sanitation in refugee camps, famine, war and/or natural disasters.

Africa has been worst hit by the disease. In a WHO (2012a) report on Africa, Cholera cases occurred in Angola, Democratic Republic of Congo, Mozambique, Nigeria, Somalia, Tanzania, and South Africa between 1990 and 2013. In Ghana, Opare et al. (2012) noted that contamination of river water supply by human waste was responsible for the 2010 outbreak of cholera.

UNICEF (2016), reported continued cases of cholera in Malawi. During the week which ended on 28th February 2016, seventy-one cases were recorded; this figure is higher than the number of cases registered in the previous five weeks. The new incidence resulted in a cumulative of 907 cases since the outbreak of the disease in mid-December 2015. Out of the 71 new cases, a total of 4 deaths were recorded, totaling 14 deaths since the outbreak.

This incidence prompted an intervention by the UNICEF nutrition team in February 2016 in some districts where they provided technical support on emergency, including nutrition response, dialogue on nutrition screening with new partnership, distributing Job Aids (screening forms, referral forms, and reporting forms) and undertaking nutrition supplies replenishment and monitoring.

Cases in Nigeria and South Africa

Nigeria recorded her first major cholera case in late 1970 (WHO 2012a, 2013a,b). The cases reported in Nigeria were 22,931, which resulted in 2,945 deaths (WHO 2012a). Since then, other few episodes have occurred (Lawoyin et al. 1999), especially in the Northern part of the country. These were in 1982 (Umoh et al. 1983), 1995-1996 (Hutin et al. 2003), and 1997 (Hutin et al. 2003; Usman et al. 2005). Abeokuta in South-Western Region of Nigeria also experienced an outbreak between November 2005 and January 2006 (Shittu et al. 2010). Another major outbreak occurred in 2010 (Ujah et al. 2015). It was recorded to have occurred in all geographic regions in the country (Shittu et al. 2010).

The 1996 cholera outbreak in Ibadan (South-West Nigeria) was due to contaminated potable water sources (Lawoyin et al. 1999). In the case of Kano (Northwest Nigeria), street-vended water and not washing of hands with soap before eating food were possible reasons for the 1995-1996 cholera outbreaks in the state (Lipp et al. 2002). Drinking water sold by water vendors was also connected with increased risk of contracting the disease. In Katsina, the outbreak of the disease was linked to faecal contamination of well water from sellers (Umoh et al. 1983).

South Africa experienced her first cholera epidemic in 1973 (Mugero and Hoque 2001). Since then, other cases occurred in 1974, 1978, 1980, 1983 (not documented), 1988, and 2000. Between 2000 and 2001, the epidemic spread rapidly through the Eastern and North-Eastern parts of South Africa (Mugero and Hoque 2001). In

August 2000, cholera cases were reported from the outskirts of Empangeni in Northern KwaZulu-Natal, with source traced to the uMhlathuze River (Jenkins 2000). This was in an area called Madlebe. However, cholera cases have even been reported in the KwaZulu-Natal province yearly since 1980, with a seemingly highest case in 1982 (12,263), and 24 deaths.

In South Africa, risk factors have been attributed to the use of contaminated water especially in rural areas, clean water collected in dirty containers and not covered, and very low latrine in affected areas. Some homes even had poor structures and holes not covered. Other risk factors included gatherings of people for occasions, like funeral, as well as poor personal and domestic hygiene.

A Review of Some Cholera Models Used

Koepke et al. (2015) investigated an outbreak of cholera in Bangladesh. They approached this by estimating the contribution of environmental variables, such as water depth and water temperature to cholera outbreaks in the context of a disease transmission model, specifically the SIRS model. The entire system was treated as a continuous-time hidden Markov model. Their model was demonstrated to have the capacity to successfully predict an increase in the number of infected individuals in the population models before the observed number of cholera cases increases, which could allow for early notification of an epidemic and timely allocation of resources.

In their report, Pezeshki et al. (2016) used artificial neural network to forecast the incidence of cholera in Iran. Data was collected from 465 villages, of which 104 reported cholera during the ten-year period of study. Logistic model was used to determine the risk factors, and artificial neural network was used for the prediction. The described Artificial Neural Network (ANN) model is capable of forecasting cholera events among villages of test group with an accuracy of up to eighty percent.

Statement of the Problem

The prevention of epidemics in most societies is a complex endeavor. More than one agency may be needed to carry out an effective prevention. When different agencies are required to collaborate towards dealing with an epidemic, the risk of misunderstanding and even duplication of efforts would be high. In most cases, achieving a single coordinating point could become vital. Therefore, this study seeks to determine to what extent such collaboration and coordination exists in the cholera epidemic. If not properly managed, cholera is known to have devastating effects on those affected by it and those who provide care for them. Inadequate management has often led to deaths, and the loss to the economy of such terminal results is not easily quantifiable. If cholera assumes the proportion of epidemic it becomes a very serious issue that would not just require medical solution but a multi-faceted strategy among which could be psychosocial support. Epidemics usually require medical interventions, and that of cholera can be nothing different (CDC 2011). Core medical personnel as well as paramedical personnel are first points of service in the outbreak of cholera. This study shed more light on the efficiency of such a crucial support in cholera outbreak.

Research Objectives

The following objectives guided this study:

1. Determination of the epidemiological incidence of cholera in Nigeria and South Africa.
2. Indication of the fatality rate of cholera in both countries.
3. Exploration of the utility of medical intervention in bringing the occurrence of cholera to an end.
4. Discussion of the possibility, if any, of the application of psychosocial support for those who directly or indirectly experience cholera in both countries.

Research Questions

Based on the background issues and the statement of the problem, this study was guided by the following research questions:

1. What is the epidemiological indication of cholera indicated in Nigeria and South Africa?
2. What is the epidemiological cholera fatality rate in Nigeria and South Africa?
3. To what extent has medical intervention resolved the occurrence of cholera in both countries?
4. What kind of support do those affected by cholera actually need?

5. If so indicated, how best can psychosocial support be built into existing support mechanisms targeting sufferers and their communities?

Relevance

It is anticipated that providing answers to the research questions stated above would not only expand our understating of the phenomenon of cholera in both countries studied but actually provide some solutions that had been hitherto either undermined or under-valued. The study is equally valuable for the reason that it provides comparative information on both countries. It could be that whatsoever psychosocial support that might emerge therefrom can be further subjected to the measurement of success in the different contexts represented.

METHODOLOGY

The data for the present study was obtained from the World Health Organization observatory data website. Data was collected on the incidences, deaths and fatality rate of cholera in Nigeria and South Africa. For Nigeria, the data ranged from 1970 to 2013 with missing observations in 1974 and 1990, while for South Africa, the data ranged from 1973 to 2013 with missing observations in 1975-1978, 1988-1990, 1995-1997, 2007, and 2010-2012. Also, there was no data available for 1970-1972 for South Africa. The missing cases observed within these data set were supplemented for using the cubic spline interpolation method. However, current data set for the two countries showed that South Africa had no official record of Cholera in 2014 and in the first quarter of 2015 (NICD 2015), while in Nigeria, in 2014, there were 35,996 cases, while week 12 of 2015 had a record of 1,786 cases (UNICEF 2015). The aim was to predict fatality rate of cholera using the incidences and deaths recorded in each country.

In modeling cholera, many authors (Johnson 2006; Al-Arydah et al. 2013; Grad et al. 2012; Fakai et al. 2013; Bayleyegn 2009; Sulayman et al. 2014; Ochoche 2013; SACEMA 2012; Crooks and Hailegiorgis 2014; Edward and Nyerere 2015; Isere et al. 2014; Osei 2010) have used mathematical (deterministic) models, with some mixtures of statistical (probabilistic) models. In this study, our interest is in a relatively new model in the field of statistics, known as the statistical neural network (SNN).

Statistical Neural Network

The statistical neural network (hereinafter, SNN) model was used in the analyses of the impact of the variables on the two dependent variables in this study. The choice of neural networks is because it is a very flexible and powerful model estimation which can estimate data that may fail in estimation procedure with other statistical methods. SNN has been found to be powerful in estimating imprecise and noisy data set. It has been found applicable in all fields that use data, both qualitative and quantitative. A simple sketch of the SNN is shown in Figure 1.In this study, the researchers used the Multilayer Perceptron (MLP) model of the SNN because it provides a better basis for statistical inference. The simple model used is as proposed by Anders (1996).

$$y=aX+\sum_{k=1}^{H}\beta_{h8}\left(\sum_{i=1}^{I}y_{n2}X_i\right)+e_i$$

where

y is the dependent variable.

$X=(X_0, X_1,...X_I)$ are the independent variables, with $X_0\equiv 1$.

$W=(\propto,\beta,\gamma)$ are the weights of the network attached to the input layer, hidden layer and the transfer function respectively.

e_i is the noise normally distributed with mean 0 and variance σ^2.

$g(.)$ is the transfer function.

$h=1,2,...,H$ is the number of hidden units.

$i=0,1,...,I$ is the number of input units.

The estimates of the parameters are established as follows:

$$\hat{\alpha}=\frac{\Sigma^{n}_{i=1}y^{*}_{i}h_i(a)}{\Sigma^{n}_{i=1}h^{2}_{i(a)}}$$

$$\hat{\beta}=\frac{\Sigma^{n}_{i=1}y^{*}_{i}h_i(\beta)}{\Sigma^{n}_{i=1}h^{2}_{i(\beta)}}$$

$$\hat{\gamma}\quad\frac{\Sigma^{n}_{i=1}y^{*}_{i}h_i(\gamma)}{\Sigma^{n}_{i=1}h^{2}_{i(\gamma)}}$$

This study used six hidden neurons, namely; 1, 5, 10, 50, 75, and 100. The reason for the large number of hidden neurons is due to the noisy nature of the data set, and high precision variable separation.

Model Selection

The mean square error (MSE), and criteria, such as akaike information criterion (AIC), network in-

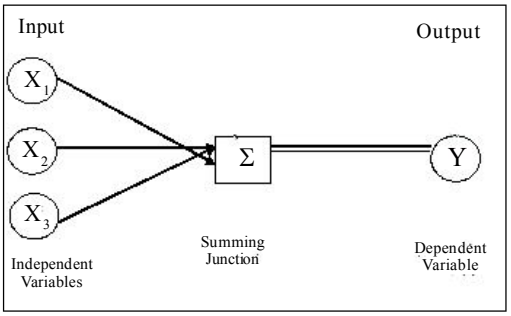


Fig. 1. A simple sketch of the artificial neural network
Source: Author

formation criterion (NIC), were used in model selection. The coefficient of determination (R^2) was also used to determine the goodness of fit of the models. The significance of the model was determined by computing the Fisher statistic, *F*, and its p-value. The model with the least MSE, AIC or NIC was considered the best. This coincides with the model with the highest R^2.

RESULTS AND DISCUSSION

This section discusses the results of the analyses.

Figure 2 is the graph of the incidence, death, and fatality rate due to cholera in Nigeria. There was a very high incidence of cholera in 1990, followed by 2010. Other high incidences were recorded in 1970 and 2000. It can be noticed that there was a high number of deaths in 1990, followed by 1970. Some significant deaths were also recorded in 2000 and 2010. Fatality rate decreased over the years. However, the rate of decrease was faster after 1990 till 2013 compared to between 1970 and 1990 inclusive.

Figure 3 is the graph of the incidence, death, and fatality rate due to cholera in South Africa. A significantly high incidence was recorded in year 2000. However, relatively high deaths were recorded in 1980, 2000, and 2010 (Fig. 5). Figure 6 shows the fatality rate, which does not show any particular pattern. The rate of fatality rose and fell, with the highest rate in 2000.

The results of the analysis showed that a higher number of hidden neurons were needed to obtain precision. With the Nigerian data, 75 hidden neurons were needed, while 100 hidden neurons were needed for the data of South Africa.

Table 1 is the statistics of model determination. For Nigeria, it can be seen that the model

Table 1: Statistics of model determination

Hidden Neuron	*MSE*		R^2		*AIC*		*NIC*		*F-test*		*P>F*	
	Nigeria	*South Africa*	*Nigeria*	*South Africa*	*Nigeria*	*South Africa*	*Nigeria*	*South Africa*	*Nigeria*	*South Africa*	*Nigeria*	*South Africa*
1	35.88	1.35	0.13	0.00	38.31	1.45	37.46	0.26	3.05	0.01	0.28	1.00
5	34.36	1.35	0.17	0.01	36.69	1.44	35.32	0.00	4.09	0.14	0.22	1.00
10	31.38	1.11	0.24	0.18	33.52	1.18	31.78	1.17	6.42	4.57	0.14	0.20
50	33.47	1.29	0.19	0.05	35.74	1.37	35.42	1.41	4.74	1.08	0.19	0.60
75+	4.78	0.78	0.88	0.42	5.10	0.83	4.61	0.82	156.37	15.06	0.01	0.06
100++	8.77	0.49	0.79	0.64	9.36	0.52	8.61	0.45	75.83	36.57	0.01	0.03

Model selected for prediction - + Nigeria, ++ South Africa

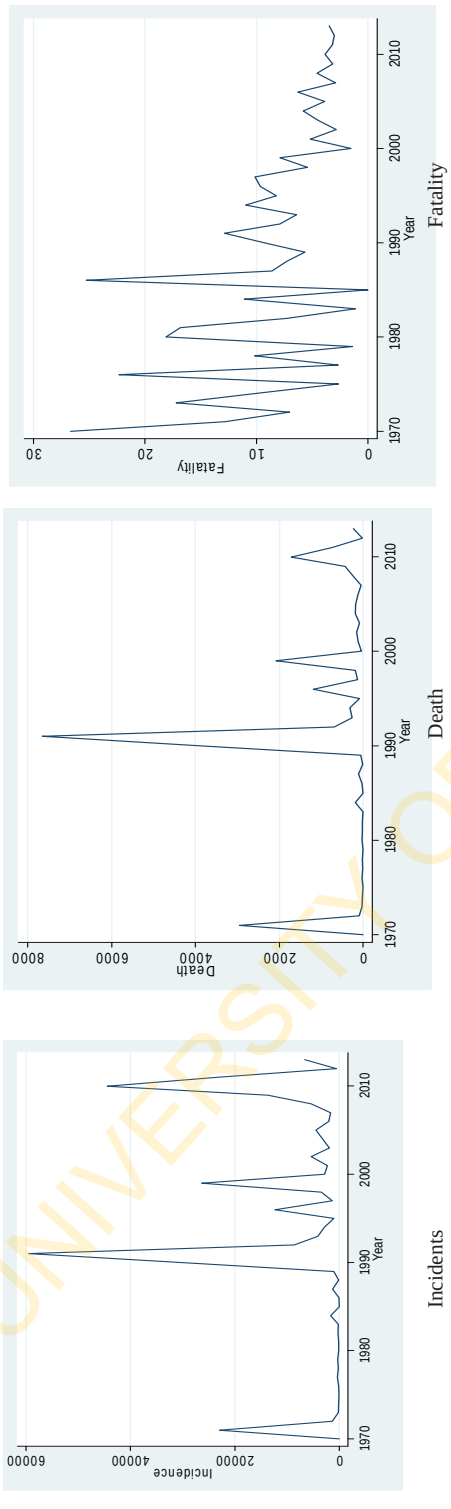


Fig. 2. Graph of incidence, death, and fatality rate due to cholera in Nigeria (1970 – 2013)
Source: Author

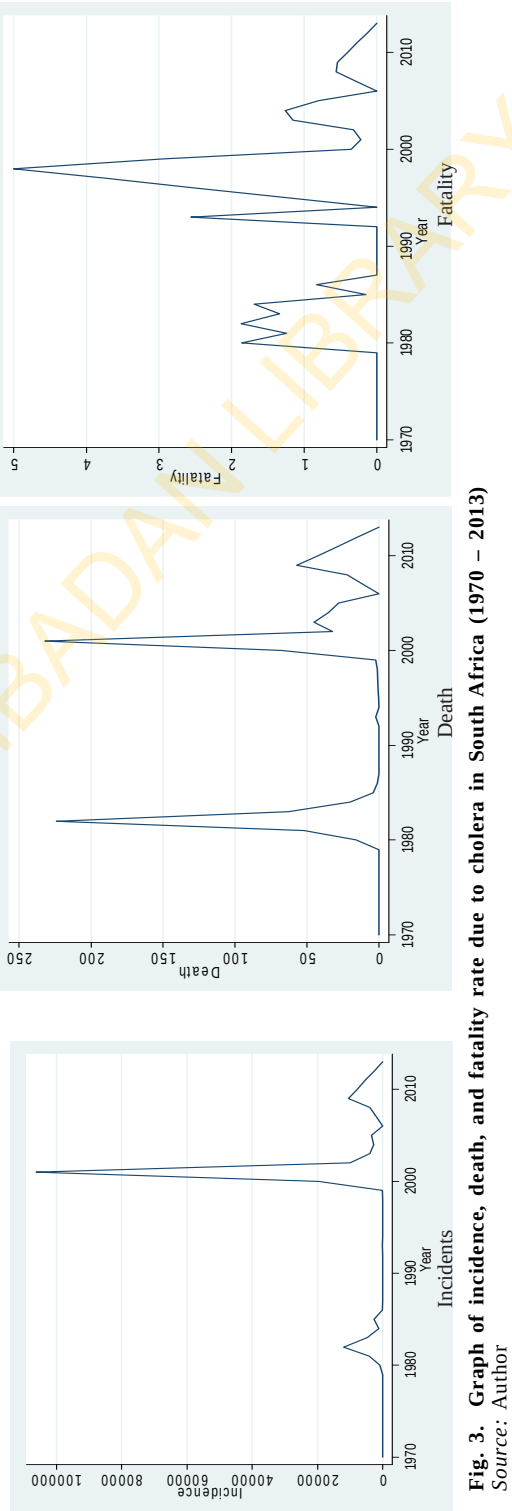


Fig. 3. Graph of incidence, death, and fatality rate due to cholera in South Africa (1970 – 2013)
Source: Author

with 75 hidden neurons was chosen as the best. The model had least *MSE* = 4.78, with a coefficient of determination (0.88) which equals eighty-eight percent information criteria being 5.10 and 4.61 for *AIC* and *NIC,* respectively. While for South Africa, the model with 100 hidden neurons was selected as the best, with least *MSE* = 0.49, with a coefficient of determination (0.64) which equals sixty-four percent, and information criteria being 0.52 and 0.45 for *AIC* and *NIC,* respectively. The model had an overall significance (*P<0.05*) in the two countries.

Predicted Fatality Rate (Nigeria - based on 75 Hidden Neurons; South Africa - based on 100 Hidden Neurons).

The fatality and predicted fatality rates are shown on Table 2. Table 2 shows that growth rates decreased in both cases in Nigeria, but decreased faster with the predicted fatality rate (mean growth rate was 0.04). And in South Africa, the growth rates decreased in both cases as well, but decreased faster with the fatality rate (mean growth rate was 0.06).

Figures 4 and 5 are graphs of fatality and growth rates. The predicted lines show a smoother rate than the original data in both countries. The smoother lines depict consistent predicted fatality and predicted fatality growth rates. However, Figure 5 (South African case) is smoother (or more consistent) than Figure 4 (Nigerian case).

Figures 6, 7, and 8 are forecast graphs for the two countries till 2030. The graphs show a sharp decline of fatality rate of cholera. The decline is faster in Nigeria in comparison to South Africa, though South Africa gets closer to zero than Nigeria. This is not unconnected to the low fatality rate of cholera recorded in South Africa over the years. It is expected in future years, the fatality rate will become zero.

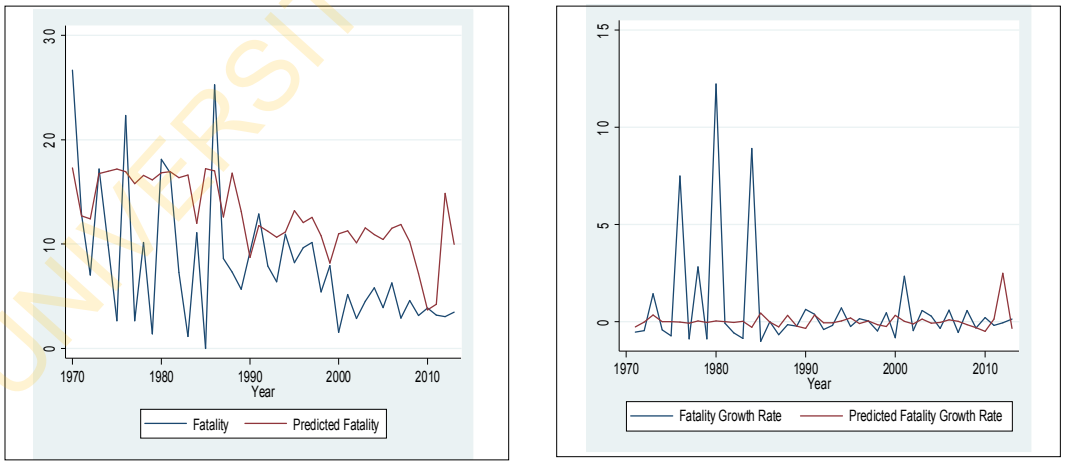
Needed Psychosocial Response

In the context of this paper, the term psychosocial support has been used to emphasize the close connection between psychological aspect of the human experience and the wider social

Table 2: Fatality and predicted fatality rate of cholera

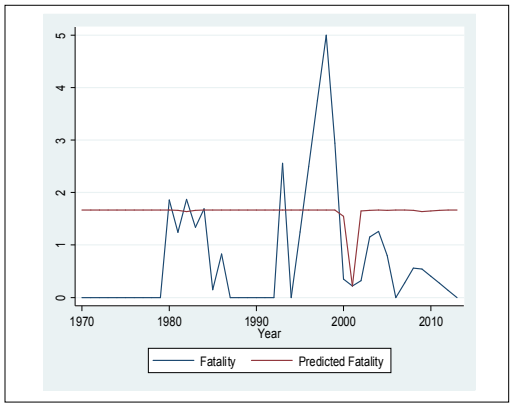
	Original data		*Predicted data*		*Fatality growth rate*		*Predicted fatality growth rate*	
	Nigeria	*South Africa*	*Nigeria*	*South Africa*	*Nigeria*	*South Africa*	*Nigeria*	*South Africa*
Mean	(8.11)	(0.76)	(12.80)	(1.63)	(0.67)	(0.06)	(0.04)	(0.13)
Standard deviation	(6.27)	(1.14)	(3.49)	(0.22)	(2.63)	(0.93)	(0.43)	(0.99)

Predicted Fatality Rate (Nigeria-based on 75 Hidden Newrons, South Africa-based on 100 Hidden Newrons)

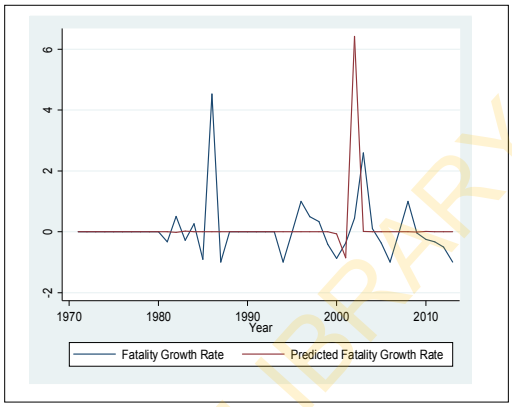


Fatality and Predicted Fatality — Fatality Growth Rate and Predicted Fatality Growth Rate

Fig. 4. Graph of fatality, predicted fatality, fatality growth, and predicted fatality growth rates due to cholera in Nigeria (1970 – 2013)
Source: Author



Fatality and Predicted Fatality



Fatality Growth Rate and Predicted Fatality Growth Rate

Fig. 5. Graph of fatality, predicted fatality, fatality growth, and predicted fatality growth rates due to cholera in South Africa (1970 – 2013)
Source: Author

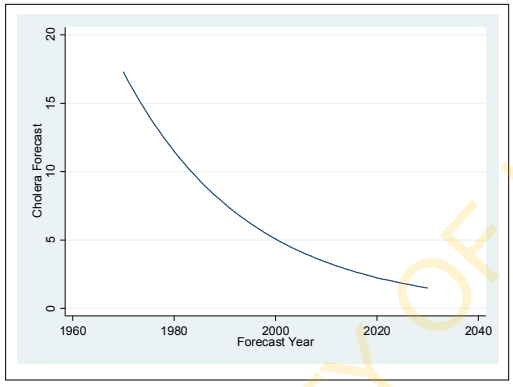


Fig. 6. Graph of forecast of cholera in Nigeria (1970-2030)
Source: Author

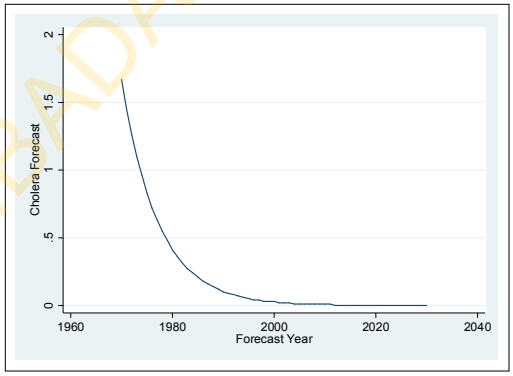


Fig. 7. Graph of Forecast of Cholera in South Africa (1970-2030)
Source: Author

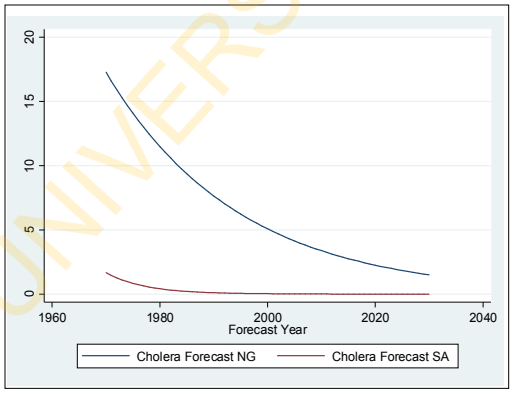


Fig. 8. Comparative graph of forecast of cholera in Nigeria and South Africa (1970-2030)
Source: Author

experience. Specifically, the cognitive (perception and memory as a basis for thoughts and learning status), affection (emotion) and behavioral and social aspects of relationships, family and community networks, cultural traction and economic status, including life table, such as school or work (ARC Resource Pack 2009a,b). Psychosocial support normally involves the culturally sensitive provision of psychological, social and spiritual care (Legg 2011). Psychosocial support involves the integration of psychological and social needs of the individual in a caring process since it relates to how the individual functioning in the community.

Psychosocial support is highly recommended for dealing with epidemiologies and chronic illnesses for a variety of reasons. In the case of

cholera, the study by Grimaud and Legagneur (2011) showed that the need for psychosocial support in communities that have experienced the epidemic of cholera not only draw attention to cholera and its spread but also focuses on the underlying causes and the best needed help. This type of support targets the infected, their families and the communities affected. The provision of psychosocial support to the community reinstates resiliency which is an integral part of the recovering process for the individual.

Psychosocial support is appropriate for the recovery of affected families and prevention of further spread of cholera because it is appropriate for all ages, gender and is culturally sensitive.

The local beliefs and perceptions of the community about cholera may create fear and suspicion which may lead to the spread of cholera. The studies by Grimaud and Legagneur (2011) and Surbone et al. (2010) reported the community beliefs and fears in epidemics and chronic diseases. These studies drew attention to the fact that such beliefs and fears get in the way of intervention. For example, Grimaud and Legagner (2011) reported the incredible popular Haitian belief to the effect that *"microbes do not kill Haitians"* On the other hand, Surbone et al. (2010) were of the view that what communities struggling with epidemics and chronic diseases need is research, evidence-based proposition to the effect that holistic care should be more preferred, and this is where psychosocial support becomes very valuable as with the context of this discussion. For cancer patients, it was suggested that when therapeutic strategy is combined with psychological, emotional and social factors, the results can be positive (Surbone et al. 2010; Goldzweig et al. 2009; Holland and Weiss 2008).

Psychosocial support utilizes the cultural norms of the community in an appropriate way while exposing the community members to cultural practices which may encourage the spread of cholera, and in this case, we recommend the need to explore in each country: to study the norms that fuel resistance to intervention and organize group discussions about how such norms can be broken with the people's understanding and necessary actions. Under such acceptable environment, the people are empowered to make meaningful change in the care and support for infected patients while carrying out medical preventive measures. A non-judgmental understanding of the cause and identification of symptoms would enable family members to seek appropriate help since cholera infection spreads fast. This implies a better relationship between the community members and their environment.

The psychosocial support which should involve good rapport with active listening must be incorporated into the intervention strategies that are provided to the community members. This is necessary in an area of cholera epidemics with high fatality rate. This is because the families are affected both psychologically and socially. The attention to the psychologically domain will enable the community members to regain control and will be empowered to collectively implement the necessary intervention strategies.

It will be necessary to state that in periods of cholera outbreak, there are responses from different agencies. For example, there are the medical and paramedical team, non-governmental agencies and community members. Psychosocial support will assist the integration of all those involved in the helping process in a way that the families and community members accept and cooperate with the other service providers.

Psychosocial support emphasizes the important role of the families and the community affected in a way that they are actively involved instead of remaining victims. This resilience enables the families and community to overcome the cholera epidemics and to understand and implement preventive methods. Psychosocial support builds on the strength of the families and communities to promote cooperation and a united front in the fight against the spread of cholera.

The World Disasters Report (2014) clearly indicated that cholera, as an epidemic, is mainly resolved through prevention campaigns and medical treatment, but that psychosocial support interventions play a significant role. The report specified that the psychosocial intervention includes techniques like,

(i) Non-judgmental active listening
(ii) Group facilitation
(iii) Psychological first aid
(iv) Mediation

These techniques have been foregrounded in the pyramidal intervention strategy being proposed in this paper. The pyramidal intervention strategy being proposed in this paper, therefore,

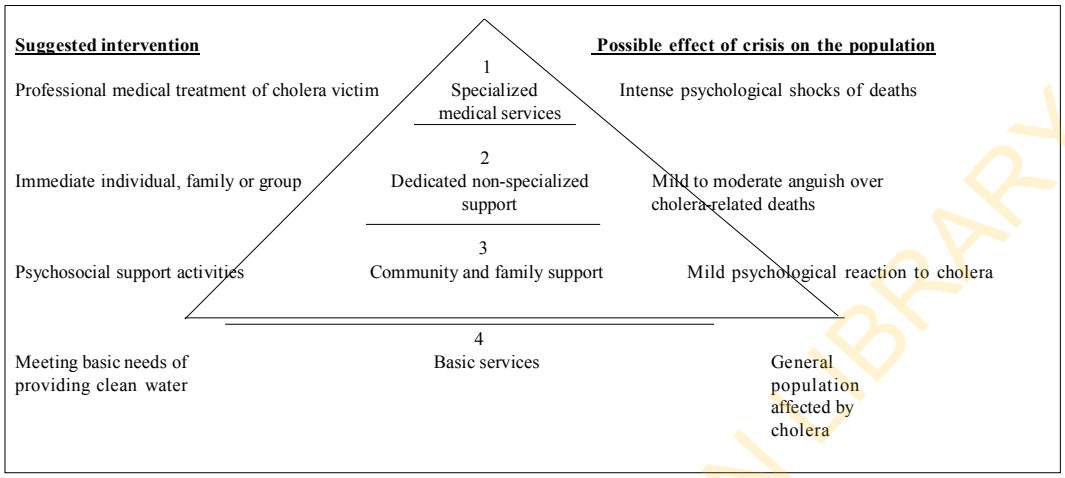


Fig. 9. Pyramidal Intervention Strategy for Cholera Event
Source: Adapted from the Inter-Agency Standing Committee (IASC) of the World Health Organization Intervention Pyramid for mental health and psychosocial support in emergencies in the IASC Guidelines (2007)

reliably and compulsorily draws ideas and strength from the World Disasters Report 2014, and the collective articulation by the World Health Organization's Inter-Agency Standing Committee (IASC) (2007) intervention strategy and scholars in the relevant literature (World Disasters Report 2014; WHO IASC 2007; Surbone et al. 2010; Goldzweiz et al. 2009; Legg 2011; Grimand and Legagneur 2011).

Depending on the socio-cultural contexts of the affected populations in both countries, the authors suggest that the assessment, planning, preparation, implementation, and evaluation of the psychosocial intervention targets children, youth, adult men and women, older persons, and people with special needs. This means the intervention should address the particular needs and resources in an identified group or population segment.

It is important to take into cognizance the fact that because the different people affected may not experience the crisis in a similar way, the authors suggest a pyramid layered system of complementary supports as follows:

In Figure 9, Level 1 intervention requires the immediate response that includes the provision of specialized medical services, targeting the smaller percentage of the affected population. Such services include diagnosis, treatment, referral and care. The community or public health education campaign should indicate medical centres, or shelters or posts to which cholera victims should be taken. In both countries, rituals and funerals are indicated in the grieving process. Death by cholera can instill fears in the relatives and communities, and the psychologist must help to instill courage in the family.

Level 2 intervention should target a small percentage of the population that might be more severely affected than others by cholera. These are people who might experience mild to moderate shock over the sudden death of beloved ones. This category of people may need individual, family, or group interventions normally implemented by trained first aid workers, some of whom would be volunteers. If this kind of intervention is not provided, it is possible that recovery from feelings of distress occasioned by grief takes much longer. In some instances, there is a possible risk of developing psychological disorder related to shock. The psychologist needs to develop healing strategies, with rational arguments that do not belittle the people's felt belief using group therapy.

Level 3 intervention targets a larger population of affected persons who would need help. The psychosocial support here would aim at restoring in them a sense of normality in their lives. Once this normality is restored they are assisted to return to their daily tasks and responsibilities. The psychosocial support may, for example, assist the affected community and families to mourn the death of their loved ones. By so

doing, they are supported to adapt much more easily to their changed life circumstances. In this case, hope is restored and resilience develops in the affected family and community groups.

Level 4 intervention targets the psychosocial well-being of the entire community affected by the cholera event. This includes those who lost their loved ones and those who did not. Their basic needs would have to be addressed, and this should, in this context, include the provision of a broader health and care services. Essentially, the provision of clean water and sanitation and water engineering services would have to be done on a much larger scale. Equally well, the community education component should be designed in such a way that everybody is reached through town hall meetings and the media. The addressing of rumour and suspicion should be taken into consideration.

The psychosocial interventions recommended above should be much more effective and sustainable by building an effective coordination component that brings together services in the areas of water, health, and education into the system. To avoid duplication of efforts and/or unnecessary competition and waste of resources, the local or provincial or state (as in Nigeria) government must designate a particular government official as the coordinator of the intervention.

Responding effectively to cholera outbreak is an emotionally and physically challenging experience for all professional and non-professional helpers. These helpers may themselves have experienced the loss of loved ones or may have been inadvertently affected directly. It is common to find that these helpers may have experienced over-work, sleep deprivation, and anxiety over whether or not the help they are giving is actually yielding sufficient results. Some of them may be frustrated or disappointed. This is why medical and psychosocial helpers must be cared for and given the same opportunities for referrals to specialized services as those affected by cholera. They would actually need psychological debriefing to reduce the net effect on them concerning the intervention or resources itself.

CONCLUSION

Cholera, as an epidemic, seems to have been addressed effectively and on a much wider scale in South Africa than in Nigeria. Even so, South Africa still experience occasional small-scale outbreaks of cholera as indicated in this paper. On the other hand, Nigeria still experiences the outbreak of cholera regularly. This may be due to the inadequate provision of clean water by designated water services in Nigeria. The problem is exacerbated by the fact that individual families still rely on the supply of portable water from rivers, streams, and boreholes in several Nigerian communities.

Given the scenario presented in this paper, it is clear that both countries cannot safely claim to have effectively protected their people from the possibility of cholera events. That is why this study suggests that the non-judgmental active listening, group facilitation, psychological first aid, and mediation techniques recommended in the World Disasters Report 2014, and scholars in the literature should be foregrounded in the pyramidal psychosocial intervention formulated in this paper to assist Nigeria and South Africa in effectively dealing with the cholera event. The authors argued that the comprehensive response needed should not just be medical in nature but incorporate medical, water, education, and psychological services. These services need to be well coordinated to avoid duplication of efforts that could lead to avoidable waste of scarce resources, suspicion and unhealthy rivalry.

RECOMMENDATIONS

It is therefore recommended that the psychosocial strategy should not just target cholera victims, families, and the communities alone; rather, attention should equally be paid to the helpers in the various services and these include the psychosocial workers themselves in order to generate a much more sustainable response to the cholera events in Nigeria and South Africa.

NOTES

1 http://www.comfsm.fm/socscie/histchol.htm
2 https://en.wikipedia.org/wiki/1854_Broad_Street_cholera_ outbreak
3 http://www.ph.ucla.edu/epi/snow/firstdiscoveredcholera. html

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