Epidemic cholera in KwaZulu-Natal: The role of the natural and social environment

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Submitted in fulfillment of part of the requirements for the degree of Philosophiae Doctor in the Faculty of Natural and Agricultural Sciences, University of Pretoria

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DECLARATION

I declare that the thesis, which I hereby submit for the degree Philosophiae Doctor at the University of Pretoria has not been previously submitted by me for a degree at another university.

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M D Said **Date**

SUMMARY

Title: **Epidemic cholera in KwaZulu-Natal: The role of the natural and social environment**

By

Maryam Darwesh Said

Promoter: **Prof. T.E. Cloete**
Co-Promoter: **Prof. S.N. Venter**
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Cholera made an unforeseen appearance on the eastern coast of South Africa in the province of KwaZulu-Natal (KZN) in August 2000. Having started from the more urban centres of the coastal region of the province, cholera proceeded unabated to the interior of the province where no community was spared from the scourge. Despite prompt medical intervention, health education and media awareness campaigns, cholera continued to spread throughout KZN. By March 2004, the official statistics of cholera cases in KZN as per the Cholera Database records, stood at 158 895 cases (Dept-KZN Health, 2000). The death toll as reported in the Cholera Database was 575 persons that translated to a percentage case fatality rate of 0.36%; the lowest when compared to the previous epidemics recorded in South African (Kustner *et al.*, 1981; Küstner and du Plessis, G. 1991). An interesting feature of the epidemic was that 99% of the cases recorded by the central and provincial Departments of Health during the height of the epidemic were all from KZN.

The question then was, what factors played a role in the cholera epidemic of KZN? This study sought to understand the outbreak and the factors that possibly contributed to the spread of the 2000-2004 cholera epidemic in KZN. The drivers of disease associated with the communities affected by cholera were also explored by analysing the complex and

dynamic interaction of their biological, socio economic, and environmental nature over time and space. The nature of the study was such that it called for a multi faceted design to involve not just understanding the societal aspect of the disease but its demographic, ecological and spatial characteristics as well. Thus GIS was used as a research tool to facilitate the comparison of the disease trends and risk factors on a spatial level in order to determine the possible role(s) played by the different environmental and socio-economic drivers.

The objective of the study was to investigate the possible role of the natural environment i.e. temperature, rainfall and humidity as the primary factors that influence cholera outbreaks in KZN; on the basis of its uniqueness in climatic conditions as compared to other areas of the Republic of South Africa (RSA). The other socio-economical and demographic factors were considered as factors that enhance the spread of the disease. As such, the exploration of the Cholera Database by use of spreadsheet, statistical correlations and spatial mapping using GIS technology mutually investigated the relationships between the different variables that came up as important factors in the spread of cholera.

Results indicated that 52% of the total cholera cases in KZN were reported from DC28 (Uthungulu), making it the focal point of the epidemic. In general, all the age groups were represented in the cholera database though the age groups 15-19 years and 0-4 years featured more prominently in the overall epidemic picture. On average the male to female case ratio was 1:1.5 respectively. The major cholera peak was experienced in 2001 and a minor peak in 2002. Both the peaks appeared during the summer months, which are also characterised by heavy rains.

The issues that were statistically proven to be associated with the spread of the disease were related to issues highlighting the inefficiencies in the provision of water and sanitation, which go hand in hand with poverty. Thus poverty was indirectly reflected in the data as an issue that compounded the cholera epidemic. There was no statistical correlation between the incidence of cholera and the climatic variables of rainfall, humidity and temperature. Notwithstanding, there was an overall seasonality revealed by the data, as seen with the cases peaking and waning between the summers and the winters

respectively. Furthermore, GIS mapping revealed a concurrence between the incidence of cholera and the climatic variables of rainfall, humidity and maximum temperature.

At the spatial level, the characteristics of the epidemic as revealed by the GIS maps and spatial modelling highlighted possible relationships between the incidence of cholera and the various socio-economic and climatic variables (Chapter 6: 6.2.3; 6.2.3). The spatial disease picture displayed a link between climatic seasons and the incidence of cholera. Spatial modelling offered more insight that the statistically supported climatic and socio-economic aspects were indeed important factors in guiding cholera outbreak predictions in the future. The cholera model illustrated this as it selected for areas considered to be at high risk for cholera (Map 34).

The results give an altogether holistic portrayal of the cholera epidemic from all perspectives and also supported to the hypothesis that cholera is a function of social and environmental factors. The results from this study further confirm the negative health effects of inadequacies in basic services delivery. The study made use of data resources to understand the relationships between the incidence of cholera and the different demographic, socio-economic and climatic variables implicated in the spread of cholera epidemics (Chapter 3: 3.3.3). It also emphasizes the importance of using reliable data as a management tool to model various scenarios in order to obtain information that could be used in the prediction and management of diseases like cholera at the community level in the future.

Keywords: Epidemic Cholera
Disease trend
Socio-economic variables
Climate
Poverty
GIS mapping
Risk models

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LIST OF ABBREVIATIONS

AIDS	Acquired Immuno Deficiency Syndrome
CFR	Case Fatality Rate
CIR	Cumulative Infection Rate
DC	District Council
DOH	Department of Health
E	East
EA	Enumerator Area
GEAR	Growth Employment and Redistribution
GIS	Geographical Information System
HIV	Human Immunodeficiency Virus
km	kilometre
KZN	KwaZulu-Natal
MD	Magisterial District
n	Number
N	North
^{O}C	Degree Celsius
ORS	Oral Rehydration Salts
ORT	Oral Rehydration Therapy
p	probability
PHC	Primary Health Care
r	Correlation coefficient
R	Rand
RSA	Republic of South Africa
S	South
sq	Square
STATSSA	Statistics South Africa
UN	United Nations
WHO	World Health Organisation
WRC	Water Research Commission

The degree PhD

Maryam Darwesh Said

Maryam Darwesh Said obtained her BSc(Hons) in Zoology and Botany from the University of Nairobi in 1985. In 1994, she completed her MSc(Med) in Molecular Biology at the University of the Witwatersrand. Thereafter she joined the National University of Lesotho as a Lecturer in the Department of Biology. She commenced with her PhD studies at the University of Pretoria in 2002 in Water Resource Management.

In her thesis, **Epidemic cholera in KwaZulu-Natal: The role of the natural and social environment**, the promovendus investigated the possible role of the natural environment i.e. climatic factors that influence cholera outbreaks in KwaZulu-Natal; on the basis of its uniqueness in climatic conditions as compared to other area in South Africa. In addition, the socio-economic and demographic factors were also considered. The issues that were proven to be associated with the disease were related to issues highlighting inefficiencies in the provision of water and sanitation, which go hand in hand with poverty. GIS technology and spatial mapping and risk modelling was used to select areas considered to be at high risk for cholera due to the inadequacies in basic service delivery. The study illustrated how health, demographic, climatic and socio-economic data can be used as a reliable disease management tool that could be used in the prediction and management of diseases like cholera. The research findings from this thesis have been presented at conferences both locally and internationally.

Supervisor: Prof: T.E. Cloete (University of Pretoria)
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