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

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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.

___________________                                         ___________________
M D Said                                                                     Date
SUMMARY

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

By

Maryam Darwesh Said

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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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On a personal level, I am mindful of that fact that I am indebted to so many special people who gave me the gift of their time, be it while offering their expertise, or social support. In particular, I would like to express my sincere gratitude to the following people:

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# TABLE OF CONTENTS

Declaration ii  
Summary iii  
Acknowledgements vi  
Table of Contents vii  
List of Tables xi  
List of Figures xii  
List of Maps xiv  
List of Abbreviations xvi

**CHAPTER 1: Introduction** ................................................................. 1

**CHAPTER 2: Literature Review** ......................................................... 4  
2.1 Introduction: Cholera pandemics .................................................... 4  
    2.2.1 Cholera in Africa 6  
2.2 The history of cholera in South Africa ............................................. 7  
2.3 Cholera – the affliction ................................................................. 10  
    2.3.1 The pathogen 11  
    2.3.2 Infections and symptoms 13  
    2.3.3 Global surveillance 13  
    2.3.4 Transmission and spread of the disease 14  
    2.3.5 Treatment 17  
2.4 *Vibrio cholerae* and the environment .......................................... 18  
    2.4.1 Cholera epidemics and climate 21  
2.5 Socio-economic factors associated with cholera .............................. 23  
    2.5.1 Access to basic services 24  
2.6 Epidemic control and prevention .................................................. 25  

**CHAPTER 3: Research Approach and Methodology** ............................ 27  
3.1 Introduction ................................................................. 27  
3.2 Rationale ................................................................. 27
3.3 Design and development of the research framework ................................. 30
  3.3.1 Design and operations framework (A) 30
    3.3.1.1 Designate scope (A1) 30
    3.3.1.2 Determine information requirement (A2) 30
  3.3.2 Study Approach (B) 32
    3.3.2.1 Hypothesis (B1) 32
    3.3.2.2 Objectives (B2) 32
  3.3.3 Data Collection © 34
    3.3.3.1 The KZN Cholera Database (C1) 34
    3.3.3.2 Choice of data and selection of parameters (C2) 37
    3.3.3.3 Data verification (C3) 39
  3.3.4 Creation of the Attribute database (D) 42
    3.3.4.1 Selection and categorisation of parameters (D1) 42
    3.3.4.2 Compilation of the Attribute database 55
  3.3.5 Data assessment (E) 56
    3.3.5.1 Data processing (E1) 56
    3.3.5.2 Ranking of areas with a high risk for cholera (E2) 63

3.4 Spatial Modelling .................................................................................. 64
  3.4.1 Lowlands Model 65
  3.4.2 Highlands Model 65

CHAPTER 4: The Research Area ...................................................................... 67
  4.1 Introduction ............................................................................................. 67
    4.1.1 The Province of KwaZulu-Natal 67
  4.2 The demography of KZN ....................................................................... 68
  4.3 The socio-economic profile of KwaZulu-Natal ........................................ 70
  4.4 History of cholera in KwaZulu-Natal ..................................................... 74
  4.5 The cholera epidemic of 2000-2004 in KwaZulu-Natal .......................... 76

CHAPTER 5: Data Interpretation ...................................................................... 85
  5.1 Introduction ............................................................................................. 85
  5.2 The General Epidemic Picture ................................................................ 85
    5.2.1 Cholera within the demarcation of KwaZulu-Natal 85
    5.2.2 The annual trends of cholera in KwaZulu-Natal:2000-2003 86
CHAPTER 6: Statistical and Spatial Analyses ............................................. 107
6.1 Variables statistically associated with cholera ........................................ 107
6.2 The spatial approach ............................................................................. 121
   6.2.1 Spatial GIS mapping ....................................................................... 122
   6.2.2 Demographic variables and cholera .............................................. 122
       6.2.2.1 Population ............................................................................. 122
       6.2.2.2 Housing .............................................................................. 123
   6.2.3 Socio-economic variables and cholera ........................................... 123
       6.2.3.1 Water ................................................................................ 129
       6.2.3.2 Sanitation .......................................................................... 132
       6.2.3.3 Refuse .............................................................................. 137
   6.2.4 Climatic variables and cholera ....................................................... 137
       6.2.4.1 Rainfall .............................................................................. 140
       6.2.4.2 Relative humidity ................................................................. 144
       6.2.4.3 Maximum temperature .......................................................... 148
6.3 Spatial modelling for high ranking high-risk cholera areas ...................... 152
   6.3.1 The Spatial Model .......................................................................... 159

CHAPTER 7: Conclusion .............................................................................. 172
7.1 Concluding remarks .............................................................................. 172
   7.1.1 Priorities in meeting basic needs .................................................... 176
       7.1.1.1 Managing risks ..................................................................... 176
   7.1.2 Issues at hand ............................................................................... 177
       7.1.2.1 Poverty ............................................................................... 178
       7.1.2.2 HIV/AIDS .......................................................................... 178
       7.1.2.3 Women ............................................................................... 179
   7.1.3 Predicting cholera ........................................................................... 180
7.2 Towards the future ................................................................................ 181
7.2.1 Campaigns to eradicate poverty 181
7.2.2 Public awareness campaigns 182
7.2.3 Women as partners in progress 182
7.2.4 Introduction of simple and effective technologies 183
7.3 Final Conclusion ................................................................. 184

REFERENCES ................................................................. 185

ANNEXURE I: METHODOLOGY ........................................... 206
LIST OF TABLES

Table 3.1  Extract of a “line listing form” used to capture information on cholera patients. 40

Table 3.2  The definition of temperature ranges in South Africa as classified by South African Weather Service. 53

Table 3.3  The mean % CIR of cholera of the Magisterial Districts in KwaZulu-Natal. 62

Table 4.1  Comparing the socio-economic variables of Census 1996 and Census 2001 (KZN and in South Africa). 72

Table 4.2  Cholera cases reported in the past 20 years. 75

Table 5.1  Cholera case count per KZN District Councils. 93

Table 6.1  Derived values of the cholera situation in the DCs of KZN. 108

Table 6.2  Derived values of the cholera situation in the MDs of KZN. 109

Table 6.3a-k.  Partial Spearman’s correlations of the socio-economic, demographic and climatic variables used in the study. 111-120

Table 6.4  An extract of the Partial Spearman’s correlations of the variables that were positively associated with the %CIR of cholera. 121

Table 6.5  Top 15 places that reported high cholera case numbers during the major peak. 156

Table 6.6  Top 15 places that reported high cholera case numbers during the minor peak. 156

Table 6.7  Factors used in the creation of the spatial model to create risk maps. 162

Table 6.8  The different selection criteria used in the risk assessment model versus the datasets of the Nov-Dec-Jan (NDJ) months of the 4 years. 163
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 2.1</td>
<td>World maps of six cholera pandemics in the nineteenth century showing the main pathways followed.</td>
<td>5</td>
</tr>
<tr>
<td>Figure 3.1</td>
<td>The possible relationships between the cholera pathogen, transmission factors and the human host.</td>
<td>28</td>
</tr>
<tr>
<td>Figure 3.2</td>
<td>An illustration outlining the research framework.</td>
<td>29</td>
</tr>
<tr>
<td>Figure 3.3</td>
<td>An illustration of the tasks assigned to the design and operations framework.</td>
<td>31</td>
</tr>
<tr>
<td>Figure 3.4</td>
<td>An illustration of the tasks assigned towards the study approach.</td>
<td>33</td>
</tr>
<tr>
<td>Figure 3.5</td>
<td>An illustration of the tasks assigned to the data collection &amp; verification exercise.</td>
<td>35</td>
</tr>
<tr>
<td>Figure 3.6:</td>
<td>An illustrative representation of how the Cholera Database was assembled.</td>
<td>36</td>
</tr>
<tr>
<td>Figure 3.7</td>
<td>An illustration of the assigned tasks that lead to the creation of the study database.</td>
<td>41</td>
</tr>
<tr>
<td>Figure 3.8</td>
<td>Schematic illustration of the tasks assigned to the overall assessment of the data.</td>
<td>54</td>
</tr>
<tr>
<td>Figure 3.9</td>
<td>The selection process for place-names to qualify for the monthly climatic variables-cholera correlations.</td>
<td>61</td>
</tr>
<tr>
<td>Figure 4.1</td>
<td>Orientation map of the study area KwaZulu, Natal, South Africa.</td>
<td>67</td>
</tr>
<tr>
<td>Figure 4.2</td>
<td>1996 Census KZN population statistics.</td>
<td>69</td>
</tr>
<tr>
<td>Figure 4.3</td>
<td>2001 Census KZN population statistics.</td>
<td>69</td>
</tr>
<tr>
<td>Figure 4.4</td>
<td>Initial cases as reported in KZN during the month of August 2000.</td>
<td>86</td>
</tr>
<tr>
<td>Table 5.2a-d</td>
<td>Annual epidemic trends of cholera in KZN from August 2000 to February 2004.</td>
<td>87</td>
</tr>
<tr>
<td>Figure 5.3</td>
<td>The annual cholera case trends in KZN.</td>
<td>89</td>
</tr>
<tr>
<td>Figure 5.4</td>
<td>Variations in monthly rainfall (mm) patterns and the number of monthly cholera cases during the epidemic.</td>
<td>91</td>
</tr>
<tr>
<td>Figure 5.5</td>
<td>Variations in monthly humidity (%) and the number of monthly cholera cases during the epidemic.</td>
<td>91</td>
</tr>
<tr>
<td>Figure 5.6</td>
<td>Variations in monthly maximum temperatures (°C) and the number of monthly cholera cases during the epidemic.</td>
<td>91</td>
</tr>
<tr>
<td>Figure 5.7</td>
<td>The distribution of cholera cases recorded among the different age groups within the DCs of KZN.</td>
<td>94</td>
</tr>
<tr>
<td>Figure 5.8</td>
<td>Cholera in the 0-4 year age group: August 2000- March 2004.</td>
<td>94</td>
</tr>
</tbody>
</table>
Figure 5.9  Cholera in the 5-9 year age group: August 2000- March 2004.  95
Figure 5.10 Cholera in the 10-14 year age group: August 2000- March 2004.  96
Figure 5.11 Cholera in the 15-19 year age group: August 2000- March 2004.  96
Figure 5.12 Cholera in the 20-29 year age group: August 2000- March 2004.  97
Figure 5.13 Cholera in the 30-39 year age group: August 2000- March 2004.  99
Figure 5.14 Cholera in the 40-59 year age group: August 2000- March 2004.  99
Figure 5.15 Cholera in the 60-74 year age group: August 2000- March 2004.  100
Figure 5.16 Cholera in the 75 and >100 year age group: August 2000- March 2004.  101
Figure 5.17 Cholera case distributions among the DCs in KZN: August’00 - December’04.  103
Figure 5.18 The % CIR of cholera among the DCs of KZN during the 2000-2004 epidemic.  104
Figure 5.19 Magisterial Districts that reporting the highest cholera cases during the epidemic period Aug00-Feb04.  105
Figure 6.1 A comparison of water supply and services for the top 15 places of the major peak and the minor peak respectively.  154
Figure 6.2 A comparison of sanitation options for the top 15 places of the major peak and the minor peak respectively.  155
Figure 6.3a-b A comparison of the average rainfall of the 30 most affected places in relation to that of the entire KZN province.  157
Figure 6.4a-b A comparison of the average humidity of the 30 most affected places in relation to that of the entire KZN province.  157
Figure 6.5a-b A comparison of the average minimum temperatures of the 30 most affected places in relation to that of the entire KZN province.  158
Figure 6.6a-b A comparison of the average maximum temperatures of the 30 most affected places in relation to that of the entire KZN province.  158
Figure 6.7 Flow diagram showing the climatic, demographic and socio-economic variables related to the Lowlands Model.  160
Figure 6.8 Flow diagram showing the climatic, demographic and socio-economic variables related to the Highlands Model.  161
Figure 7.1 The role of the natural and socio-economic environments in the cholera epidemic of KZN.  173
LIST OF MAPS

Map 1  Occurrence of cholera in KZN in 2000. 77
Map 2  Occurrence of cholera in KZN in 2001. 79
Map 3  Occurrence of cholera in KZN in 2002. 81
Map 4  Occurrence of cholera in KZN in 2003. 82
Map 5  District Councils, Magisterial Districts and Conservation Areas in KZN. 85a
Map 6  The proportion of people per MD (as percentage) in relation to total KZN population. 124
Map 7  Population density (people per square kilometre) per MD in KZN. 125
Map 8  Distribution of traditional dwellings (as percentage of MD) in KZN. 126
Map 9  Distribution of homeless persons (as percentage of MD) in KZN. 127
Map 10 Percentage of people with no income (as percentage of MD) in KZN. 128
Map 11 Percentage households in KZN with piped water in their dwellings. 130
Map 12 Percentage households in KZN using dam, river, stream or spring water. 131
Map 13 Percentage households in KZN using water from boreholes, rainwater tanks or well. 133
Map 14 Percentage households in KZN with pit latrines. 135
Map 15 Percentage households in KZN with bucket sanitation system. 136
Map 16 Percentage households in KZN with unspecified sanitation. 138
Map 17 Percentage households in KZN with no refuse removal services. 139
Map 18 Distribution of cholera cases and monthly rainfall during December 2000 in KZN. 141
Map 19 Distribution of cholera cases and monthly rainfall during January 2001 in KZN. 142
Map 20 Distribution of cholera cases and monthly rainfall during February 2001 in KZN. 143
Map 21 Distribution of cholera cases and humidity during December 2000 in KZN. 145
Map 22 Distribution of cholera cases and humidity during January 2001 in KZN. 146
Map 23  Distribution of cholera cases and humidity during February 2001 in KZN. 147
Map 24  Distribution of cholera cases and maximum temperature during December 2000 in KZN. 149
Map 25  Distribution of cholera cases and maximum temperature during January 2001 in KZN. 150
Map 26  Distribution of cholera cases and maximum temperature during February 2001 in KZN. 151
Map 27  Location of perennial rivers in relation to the places most affected by cholera in KZN. 153
Map 28  Distribution of Health Facilities in KZN. 102
Map 29  Showing Cholera Risk Areas by applying the Lowlands Model during Peak 1 (NDJ 2000/01). 165
Map 30  Showing Cholera Risk Areas by applying the Highlands Model during NDJ 2003/04. 166
Map 31  Showing Cholera Risk Areas by applying the Highlands Model during NDJ 2001/02. 167
Map 32  Showing Cholera Risk Areas by applying the 4xNDJ Averages and Peak 1’s socio-economic factors. 168
Map 33  Showing Cholera Risk Areas by applying the 4xNDJ Averages and Peak 2’s socio-economic factors. 169
Map 34  Showing Cholera Risk Areas by applying the models on all NDJ’s over the 4 year period 2000-2004. 170
## LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>AIDS</td>
<td>Acquired Immuno Deficiency Syndrome</td>
</tr>
<tr>
<td>CFR</td>
<td>Case Fatality Rate</td>
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<tr>
<td>CIR</td>
<td>Cumulative Infection Rate</td>
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<td>DC</td>
<td>District Council</td>
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<tr>
<td>DOH</td>
<td>Department of Health</td>
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<tr>
<td>E</td>
<td>East</td>
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<tr>
<td>EA</td>
<td>Enumerator Area</td>
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<tr>
<td>GEAR</td>
<td>Growth Employment and Redistribution</td>
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<tr>
<td>GIS</td>
<td>Geographical Information System</td>
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<tr>
<td>HIV</td>
<td>Human Immunodeficiency Virus</td>
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<tr>
<td>km</td>
<td>kilometre</td>
</tr>
<tr>
<td>KZN</td>
<td>KwaZulu-Natal</td>
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<tr>
<td>MD</td>
<td>Magisterial District</td>
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<tr>
<td>n</td>
<td>Number</td>
</tr>
<tr>
<td>N</td>
<td>North</td>
</tr>
<tr>
<td>°C</td>
<td>Degree Celsius</td>
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<tr>
<td>ORS</td>
<td>Oral Rehydration Salts</td>
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<td>ORT</td>
<td>Oral Rehydration Therapy</td>
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<tr>
<td>p</td>
<td>probability</td>
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<tr>
<td>PHC</td>
<td>Primary Health Care</td>
</tr>
<tr>
<td>r</td>
<td>Correlation coefficient</td>
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<tr>
<td>R</td>
<td>Rand</td>
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<tr>
<td>RSA</td>
<td>Republic of South Africa</td>
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<td>South</td>
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<td>sq</td>
<td>Square</td>
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<td>STATSSA</td>
<td>Statistics South Africa</td>
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<tr>
<td>UN</td>
<td>United Nations</td>
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<tr>
<td>WHO</td>
<td>World Health Organisation</td>
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<tr>
<td>WRC</td>
<td>Water Research Commission</td>
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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)
**Co-supervisor:** Prof: S.N.Venter (University of Pretoria)